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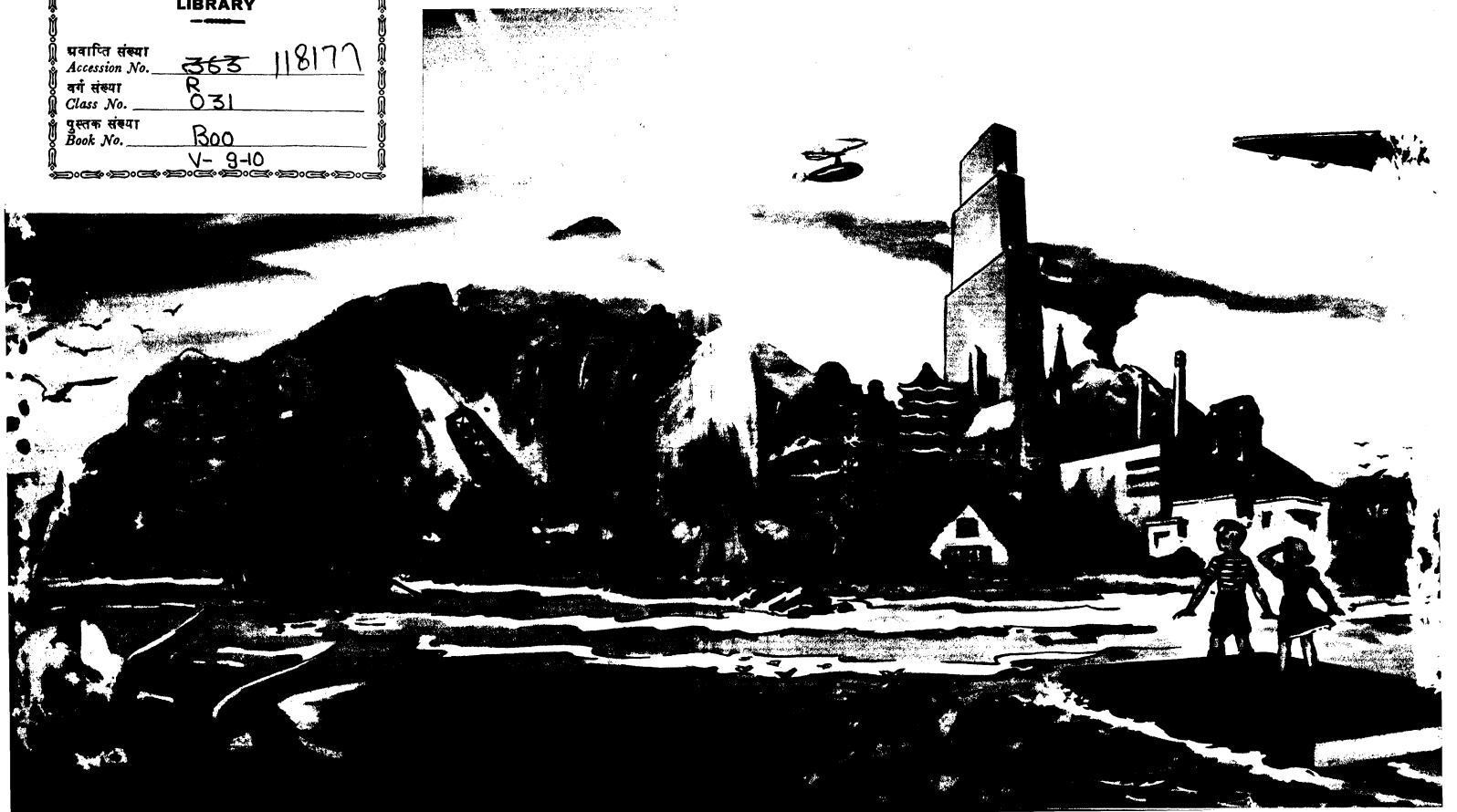

VOLUME IX

The Book of Knowledge

The Children's Encyclopedia

THAT LEADS TO LOVE OF LEARNING

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BOOK OF KNOWLEDGE

The Children's Encyclopedia

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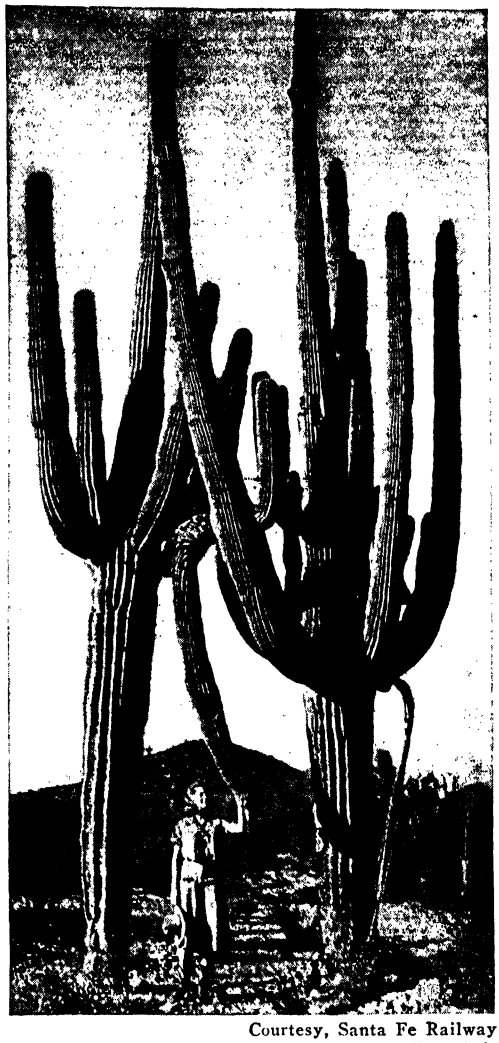
DESERTS OF ARIZONA

THE southwestern portion of the United States is a land of little rain and parts of it are so dry that they are called deserts. The state of Arizona lies wholly in this arid region, but the state is not all dry because the high mountains and high plateaus catch the rainfall from the Pacific Ocean and so are covered with evergreen trees. Arizona can thus be divided into two main parts. In southern Arizona broad plains, cut by ranges of desert mountains, extend over the border into Mexico. This region is called the Sonoran Desert from the Mexican state of Sonora. On the mile-high plateau to the north is another region of little rain and, because of its brilliantly colored rocks, it is called the Painted Desert.

The atmosphere of the desert is usually so clear that distant ranges of mountains seem quite close and the cloud effects at sunset are finer than anywhere else in the world. Sometimes the deserts grow restless, and a dust storm sweeps across the land so that for a few hours the visibility is poor; but the deserts of Arizona are friendly deserts and visitors come from far and near to enjoy a climate so different from the rest of the country. The Sonoran Desert, because of its low altitude, enjoys a mild winter and a hot summer. The Painted Desert, because it is higher, has a cold winter climate and a summer that attracts people from all over the world. These two deserts are so different in every way that they have to be treated separately.

The Sonoran Desert is a green desert and, although surface water is very scarce, vegetation is remarkably abundant. Cacti, twenty feet high, prickly mesquite, *palo verde* (green sticks), and the almost ever-present creosote bush cover hundreds of thousands of acres. The plants are all adapted to the conservation of water. The cacti store it in their cells after rain. The mesquite put down their long roots forty or more feet to find moist earth. The creosote bush has varnished leaves to prevent evaporation. All

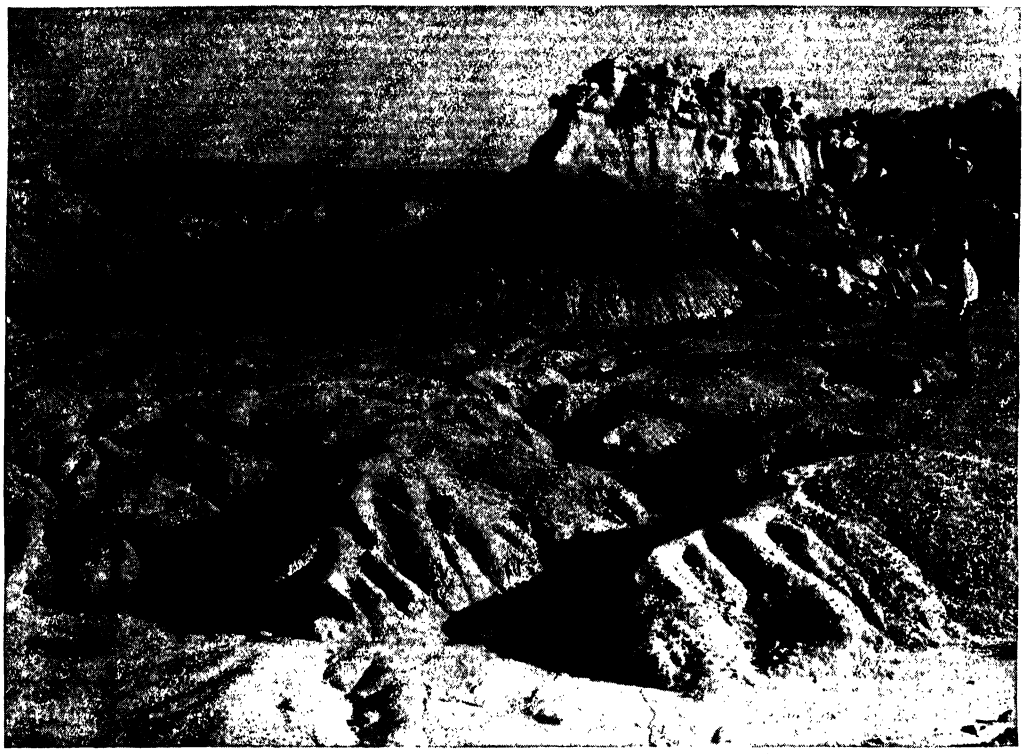


Courtesy, Santa Fe Railway

The giant sahuaro cactus of the Sonoran Desert is said to grow for fifty years before its arms sprout.

are able to make the best use of the scanty water supplies. In the desert mountains, water holes and springs can be found in the canyons so cattle ranches fringe the mountain ranges.

Although the desert appears to be a wilderness, a region of wide open spaces encircled with rugged purple mountains, it is not so uninhabited as it looks. Hard surfaced highways cross it in many places, graded graveled roads branch out from them and everywhere are crooked desert trails joining the scattered ranches, mining claims and country stores. Except in the mountains, a motor car can go almost everywhere and here everybody travels by car as the distances between points are too great to walk or ride horseback.



Courtesy, U. S. Department of the Interior

This scene in the Petrified Forest National Monument shows the brilliantly colored sandstone formations of the Painted Desert. The strange shapes of these rocks were carved by wind and water during millions of years.

The summer days on the desert are very hot. Without drinking-water, a man on foot cannot long survive as evaporation sucks the water out of his body; so if one's car breaks down the best thing to do is to sit quietly inside in the shade and wait till night to set off for help, for the nights are relatively cool.

Very little life is visible in the desert in the daytime. The sun is so hot that the animals stay in the shade and come out about dusk or after nightfall. On the Sonoran Desert live the Gila monster—the only poisonous lizard in the world, large land turtles, and a few snakes, some of which are rattlesnakes. All the animals are so scarce that you can travel all day and never see one.

Across the Arizona plateau, almost a mile high, the Little Colorado River flows northwest to join the big Colorado in the Grand Canyon. The broad valley of this river is called the Painted Desert because the rocks are red, green, yellow and gray and pastel shades that change with every passing cloud. On account of its altitude it is not like the Sonoran Desert, a country of cacti and spiny shrubs, but in general is a grassy plain. The lower parts of the valley, where the vegetation has not been over-grazed by Navajo sheep, are covered with a shrub called salt bush, or oatmeal bush, because the seed pods look like oatmeal. The mesas (flat-topped hills) bordering the Painted Desert to the north support a carpet of sagebrush dotted with juniper trees.

East of the Little Colorado the country is quite sandy because the westerly winds pick sand out of the wide, dry bed of the Little Colorado and spread it over the land, where it is piled up into dunes. However, most of these dunes are inactive and support a growth of coarse grass which in turn supports the Navajo Indian sheep.

In the Painted Desert lies the famous Petrified Forest with the trunks of ancient trees changed to opal and agate of brilliant colors. Where the Painted Desert now lies, some millions of years ago lay the delta of a large river like the Mississippi. Floods from the uplands carried down logs that became stranded on the sand bars and were later covered with mud and sand. During the long burial the trunks of the trees turned to stone and when the land was upraised

the rain waters washed away the sand and mud, leaving the trunks of the trees exposed once more on the ground. Part of the Petrified Forest is now preserved as a National Monument.

These two deserts of Arizona are not uninhabited. Large dams in the mountains store up water in the winter months from melting snow on the higher elevations. In the hot summers, this water is turned upon parts of the Sonoran Desert, making such garden spots as you will see around the city of Phoenix. From under many of the desert plains water can be brought to the surface with pumps worked by gas engines or electricity and such oases on the desert as the city of Tucson get their water from this great underground water supply.

Large cattle ranches cover much of the Sonoran Desert and cowboys can sometimes be seen riding among the cacti. The Pima and Maricopa Indians irrigate their fields from the Gila and Salt Rivers and the Papago Indians plant their crops where canyons in the mountains open out on the deserts and water their fields with flood waters. All of these Indians live in villages of scattered one-roomed houses, made of poles plastered with mud, called *jacals*, pronounced ha-cals.

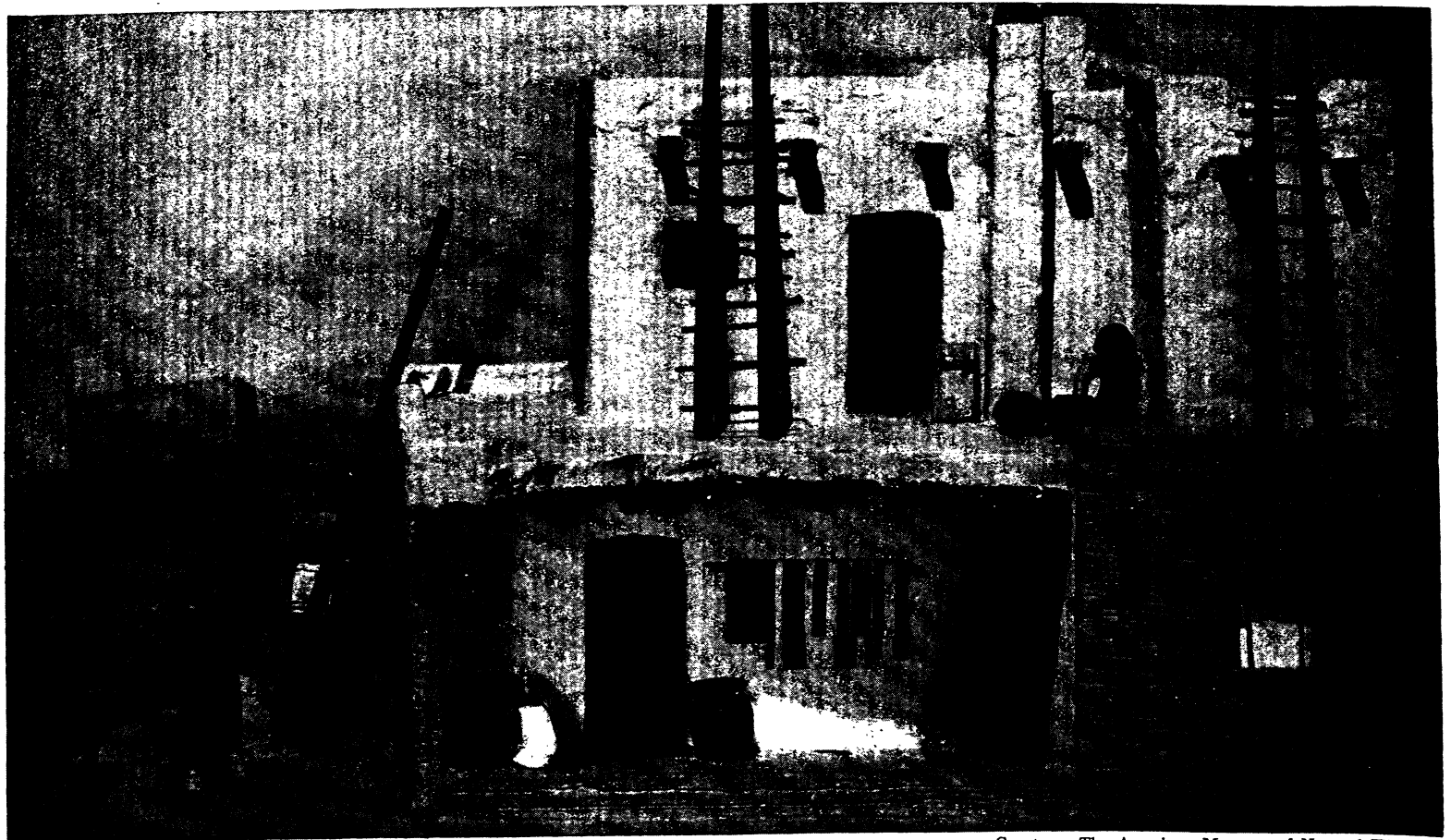
On the plateau, the Navajo Indians, the largest Indian tribe in the United States, inhabit much of the Painted Desert region. They are nomads, driving their herds of sheep and goats wherever water and grass are most abundant. Each Navajo owns several one-room circular or octagonal houses, called hogans, built of logs and plastered with mud. A Navajo's various hogans are ten to thirty miles apart. The houses have no windows, and the only openings are a hole in the roof to let out the smoke from an open fire in the middle of the clay floor and a doorway facing to the east. The Indians move with their flocks, from one hogan to another with the seasons. Navajo men are fine silversmiths, and the women are very good weavers. The jewelry and the bright blankets they make are sold to traders to help support the family.

On the mesas facing the Painted Desert, live the Hopi Indians in villages built of stone sometimes three stories high. You will be astonished to learn that the Hopi houses

Courtesy, Southern Pacific Railway

From the windows of a train crossing the desert-lands of Arizona, one can see miles of country covered with the strange and often beautiful desert plants. In this picture we see the lovely flowers of the Spanish Bayonet.

MODEL OF A HOPI INDIAN PUEBLO BUILT OF SUN-DRIED BRICKS



Courtesy, The American Museum of Natural History

Hopi Indians live in pueblos, houses made of adobe, or sun-dried bricks of earth and straw. The picture shows a model of a two-story pueblo. There are no inside stairways, only ladders against the outer walls. In spite of their rather frail appearance, adobe walls sometimes last for centuries.

are owned by the women. Indeed, the position of a Pueblo Indian woman is very high. She owns the house and receives her husband into her home. The children take their family name from their mother and not from their father; the corn, melons, squash and other vegetables belong to her when once deposited in her house by her husband. She is, indeed, queen in her own home, and is on quite equal terms with her husband. Of squash, pumpkins and other crops her store is likely to be ample, for the Hopis are good farmers. Their fields of corn, beans and pumpkins may be seen among the sand hills near their villages. They are, besides, expert makers of blankets, baskets and pottery designed with remarkable artistry.

The brown youngsters of the Hopi are a very important factor in the community. When the corn, beans and squash at the foot of the mesa are ripe, the younger boys and girls scare away the birds or other marauders from the precious harvest that has been wrung with so much labor from the sandy, sun-scorched soil. When the harvest is ready to be gathered, the little children, as well as the women, aid the men in gathering the crops, in steaming the corn in a great oven dug in the ground, and in packing the ears in sacks and blankets on the backs of the little donkeys called burros, to be carried up the steep side of the mesa to the corn rooms on the top.

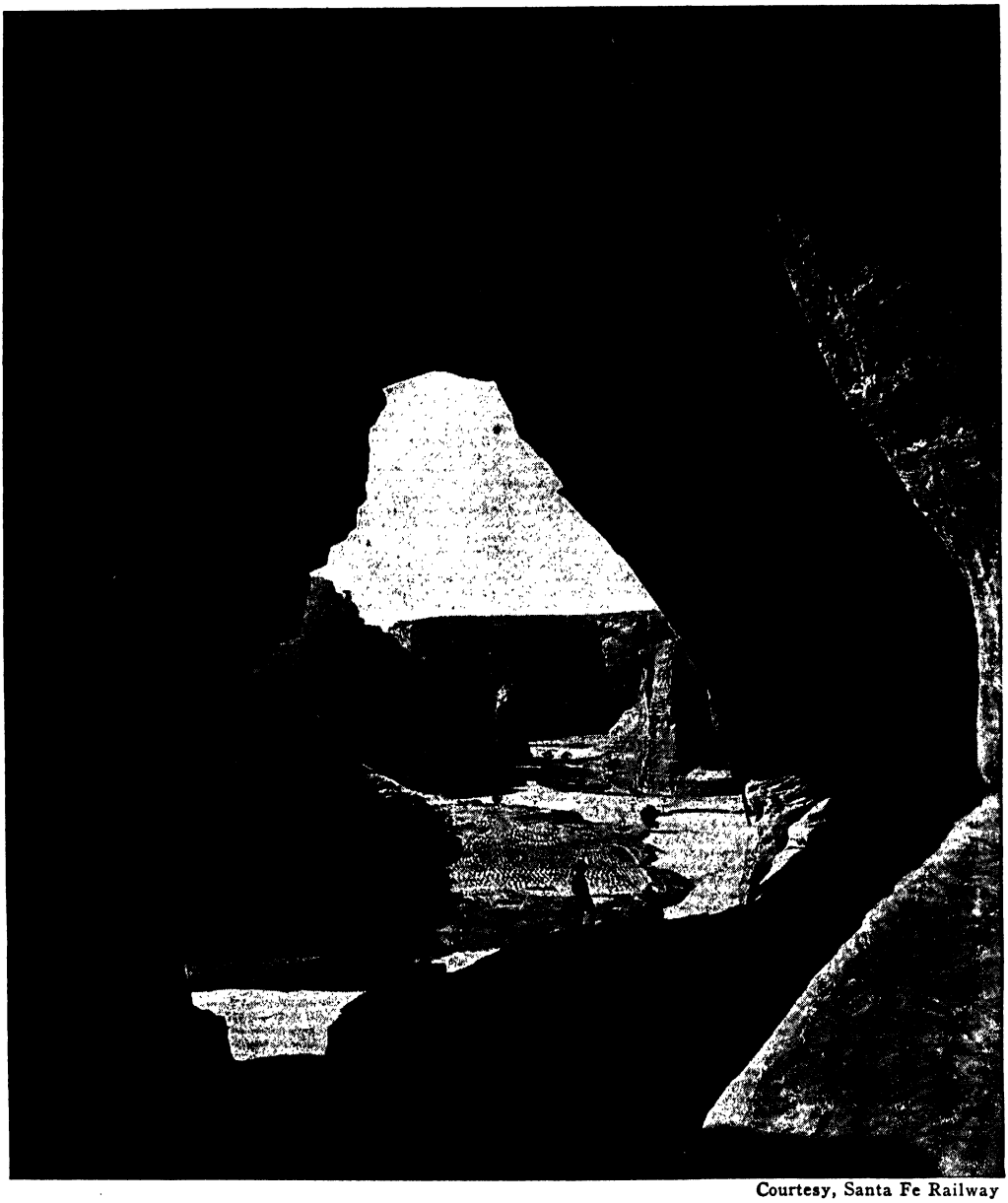
The Hopis are wonderfully hospitable, and presently we are invited into the house.

Courtesy, Santa Fe Railway

Navajo rugs are made from the wool of sheep and goats like those in the background. Here we see women carding, spinning and weaving the wool. The top picture shows a Hopi Indian mother and her child.

As we squat upon low stools, the Hopi housewife places before us a basket of bread called "piki" that looks like blue tissue paper, and signifies that we are to help ourselves. We do, and find that the rolls are really quite pleasant to taste.

"It is fascinating in the extreme to see a woman make piki," says George Wharton James. "Dry corn-meal is mixed with coloring matter and water, and thus converted into a soft batter. A large flat stone is so placed on stones that a fire can be kept continually burning underneath it. As soon as the slab is as hot as an iron must be to iron starched clothes, it is greased with mutton tallow. Then with fingers dipped in the batter the woman dexterously and rapidly sweeps them over the surface of the hot



Courtesy, Santa Fe Railway

A curiously formed rock window, in Canyon de Chelly, in the heart of the Navajo Indian reservation in northern Arizona. Many of the Navajos live here. The Navajos form America's largest Indian tribe.

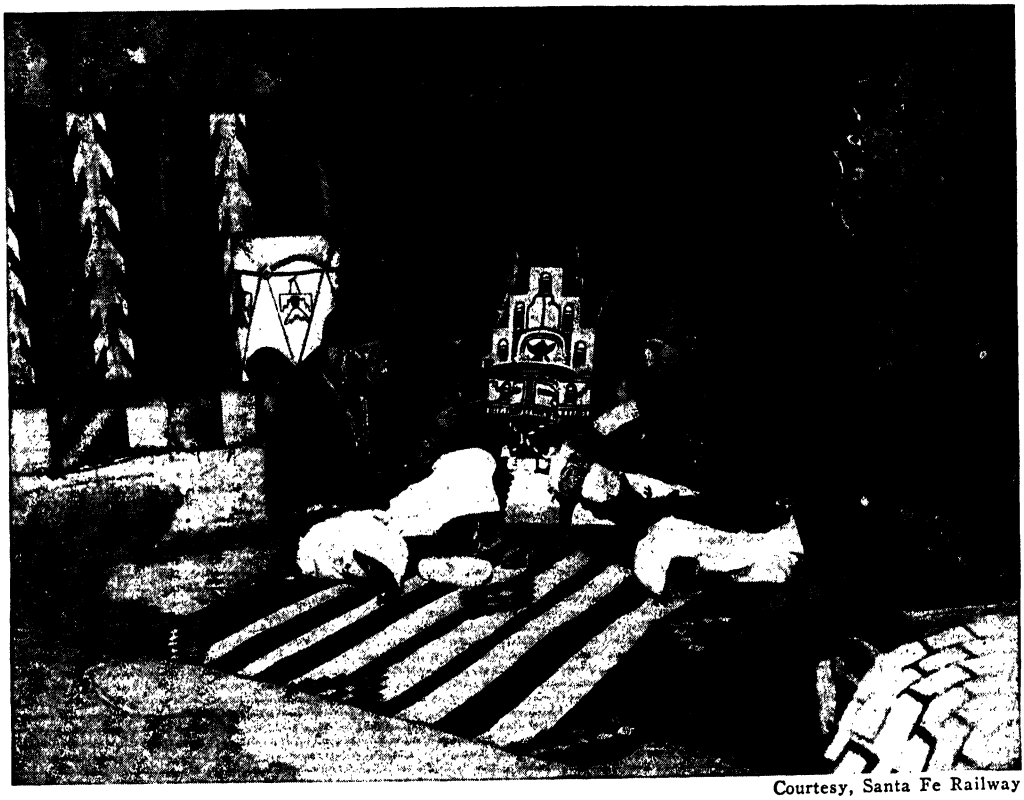
stone. Almost as quickly as the batter touches, it is cooked; so to cover the whole stone and yet make even and smooth piki requires skill. It looks so easy that I have known many white women (and men) tempted into trying to make it. Once, while attending the Snake Dance ceremonials at Mishongnovi, a young lady member of my party was sure she could perform the operation successfully. My Hopi friend, Kuchyeampsi, gladly gave place to the white lady, and laughingly looked at me as the latter dipped her fingers into the batter, swept them over the stone, gave a suppressed exclamation of pain, tried again, and then hastily rose with three fingers well blistered."

In both the Sonoran Desert and the Painted Desert the evidences of prehistoric inhabitants abound. In the Sonoran Desert large mounds, the remains of adobe buildings, dot the river valleys. One of these is preserved in the Casa Grande National Monument and another, Pueblo Grande, by the City of Phoenix. In the north in and about the Painted Desert lie the ruins of large stone apartment houses called "pueblos," the Spanish name for towns. As some of these were built in caves in canyon walls, the inhabitants used to be called "cliff-dwellers."

More is known about the prehistoric inhabitants of Arizona than about the ancient inhabitants of any other part of the United States, and their descendants still live in the same region. The descendants of the old people of the Sonoran desert are probably the Pima Indians who still dwell in Southern Arizona. The Hopi, living in their stone pueblos overlooking the Painted Desert, are descendants of the Pueblo Indians who built the cliff pueblos like Betatakin and Kiet Siel, and other large "apartment houses" like Wupatki, which now are protected by the government as National Monuments. We know their history from before 500 A.D. to the present time.

By Harold S. Colton, Director, Museum of Northern Arizona, Flagstaff.

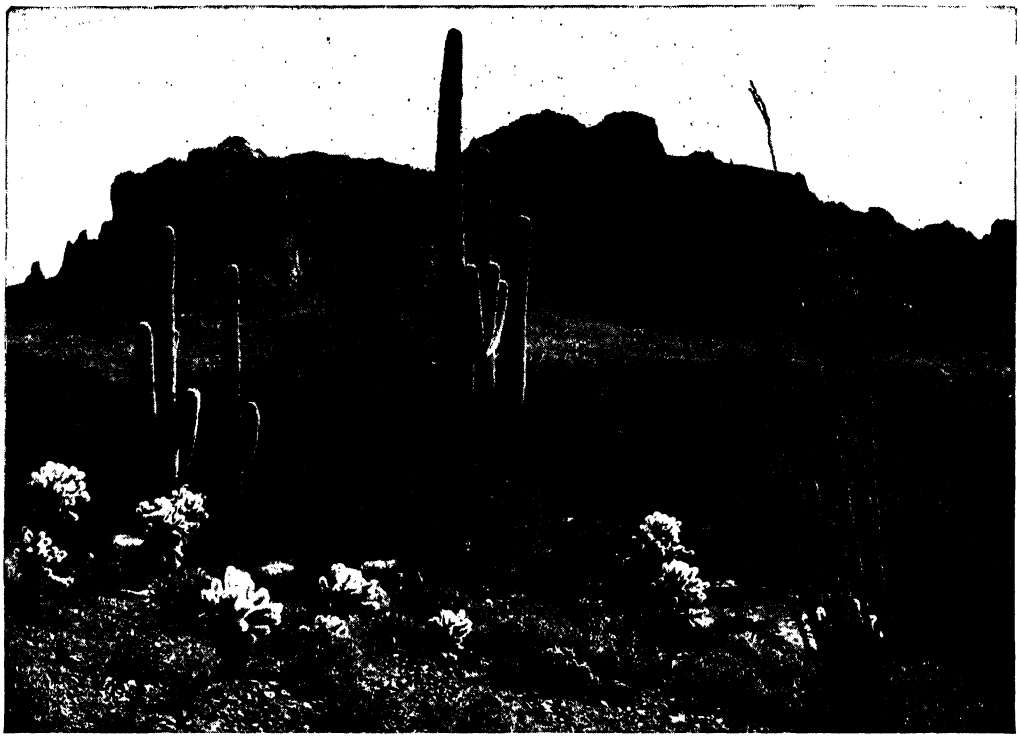
THE NEXT STORY OF THE UNITED STATES IS ON PAGE 3103.



Courtesy, Santa Fe Railway

These Hopi Indians are making "Katcina," or ceremonial dolls, at Hopi House on the southern rim of the Grand Canyon, in Northern Arizona. Note the beautiful silver ornaments worn by the two men. The traveler in the Southwest will find many of these and other Indian-made articles on sale. Modern crafts and ancient crafts that have been revived form the basis of a brisk tourist trade in the pueblo region.

CURIOUS SIGHTS IN THE DESERT



Superstition Mountain, Arizona. Indians believed that on these cliffs were human figures turned to stone.

Pictures, courtesy, Atchison, Topeka and Santa Fe Railway Co.

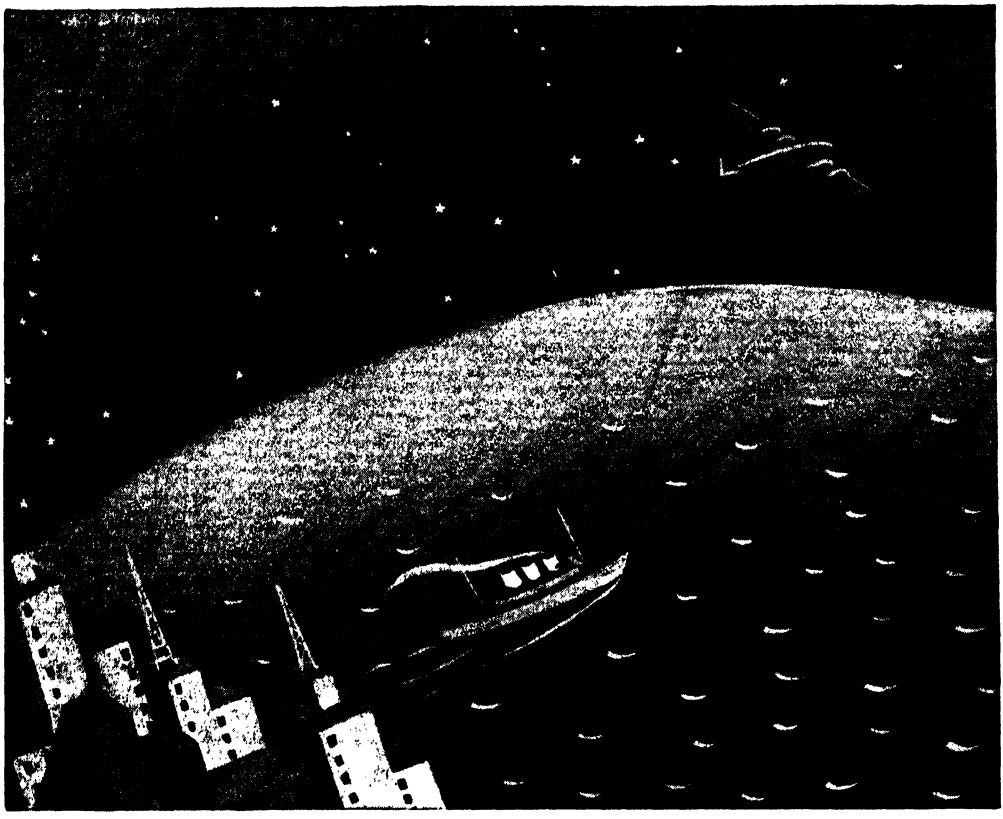
Also in Arizona is the Petrified Forest, where great trees of a bygone age have turned to stone.

Can you find the Big Dipper and the Little Dipper in this picture?

THE IMMENSITY *of the* UNIVERSE

THE word "universe" is the biggest word in the English language; but no one knows as yet just *how* big it is. Earth, the little planet on which we live, was once believed by astronomers to be a large and important part of the universe; indeed, they thought of the earth as the center of that universe and they thought that everything else revolved around the earth. Today we know that the earth is but one of the smaller planets traveling around the sun, of vast importance to us but astronomically of little consequence.

Man came gradually to understand that the stars were not mere ornaments in the sky, put there to make the heavens more



Airplanes and fast ocean-going vessels take us quickly to every corner of the earth; but the frontiers of the universe are still unexplored. The imagination of future adventurers will turn to the vast space surrounding us.

beautiful to the eyes of men, but giant suns, many of them larger and brighter and hotter than our own sun. Because of their vast distance from the earth they appear as tiny bits of light in the sky, and even when viewed through the greatest telescopes they still appear as points of light, showing no appreciable diameter.

During the last half-century, astronomers have made the exciting discovery that out beyond the stars which we can see with the naked eye and with the telescope, there are millions of isolated star systems which we now call "island universes" because they are so large. Exploration of the future will be largely concerned with these remote frontiers of the universe, particularly so since there remain few unexplored regions on the earth; the explorer will be forced to turn his attention to more distant boundaries.

The best way to get some idea of the size of the universe, so far as we can estimate it at the present time, is to start right here at home, on the earth. Since airplanes and fast ships have become commonplace, the size of the earth from a practical point of view has greatly shrunken. Where it used to take many weeks to cross the Atlantic Ocean, today we can breakfast in New York, board a plane, and have tea in London. Because we can travel so rapidly, and because the transmission of news is almost instantaneous by means of radio, the earth no longer seems as large as it did to our forefathers. The most remote country in the world, measured by miles, is less than a second away by radio, and only a few hours by plane.

From an astronomical point of view, also, the earth seems much smaller now than it did. We are now able to compare its size with that of the other heavenly bodies, and in doing so we discover that the earth is tiny in comparison with the sun and the stars, and very small in comparison even with some of the other planets in our own solar system. The diameter of the earth is about 8,000 miles, while the diameter of Jupiter, the largest planet, is eleven times that

amount, or about 88,000 miles. Four of the nine planets are enormously larger than the earth, while only two of them are very small in comparison.

THE ASTRONOMER HAS NOT YET DISCOVERED LIFE ON OTHER PLANETS

In spite of the earth's modest size, however, it is important because it is at the present time the only heavenly body of which we can say with certainty: "Life exists there!" There may be life on other planets—there may even be planets moving, unknown to us, around other suns than ours —but we know nothing definite about that as yet.

The earth is one of the nine planets which move in elliptical orbits around the sun, our day star. The nearest planet to the sun is little Mercury, a mere 37,000,000 miles from the sun. At the other limit of the solar system is the newly discovered planet Pluto, with a solar distance of between 3,000,000,000 and 4,000,000,000 miles. The closest to the earth of all heavenly bodies is our satellite, the moon, with an average distance from us of about 240,000 miles.

THE EARTH IS BUT A TINY SPECK IN THE VASTNESS OF THE UNIVERSE

Let us imagine that we are preparing for a journey to the moon—the shortest journey we can take in the sky if we intend to land anywhere. We shall imagine ourselves traveling in an airplane with the speed of 500 miles per hour. Speeding along at this rate, without even a second's slackening on the way, our journey to the moon would require something more than 20 days. A trip at similar speed to the sun would demand 20 years of life. But you would not have opportunity in one lifetime to make even a one-way trip to Pluto, since at a speed of 500 miles an hour your airplane would have to wing its way through space for some 900 years in order to reach that far outpost of the planet family. But our entire solar system, with the sun near its center, 9 planets moving around the sun, 28 moons moving around the planets, perhaps 40,000 small planets or asteroids, countless billions of meteors, uncounted comets—all this vast system is but a tiny speck in the vastness of the universe!

Since the universe stretches out beyond our little solar system in what seem to be endless vistas of star beyond star, island universe beyond island universe, astronomers long ago adopted a much larger unit of measurement than the mile, for the mile proved to be too small and inadequate a unit for the expression of astronomical distances. This becomes clear when we consider that the next nearest star beyond the sun is about 270,000 times farther away from us. In terms of miles the distances to even the nearer parts of the universe would be impossibly cumbersome figures. So the astronomer has adopted as the standard unit of measurement the "light-year," which is the distance light travels in one year.

Many people imagine, wrongly, that light takes no time to travel from one place to another, that its speed is instantaneous. Actually, to travel 186,270 miles a ray of light requires one second of time, and so far as we know today there is no speed which can exceed the speed of light. (The speed of light is usually given its approximate value—186,000 miles per second.)

IT TAKES OVER FOUR YEARS FOR LIGHT FROM THE NEAREST STAR TO REACH OUR SUN

The nearest star to the sun, Proxima Centauri, is between twenty-five and twenty-six trillion miles away from us; but the astronomer usually refers to its distance as 4⅓ light-years. The distance between Proxima Centauri and the earth is so great that light, traveling at 186,000 miles every second of the time would take 4⅓ years to cross the space between the two bodies.

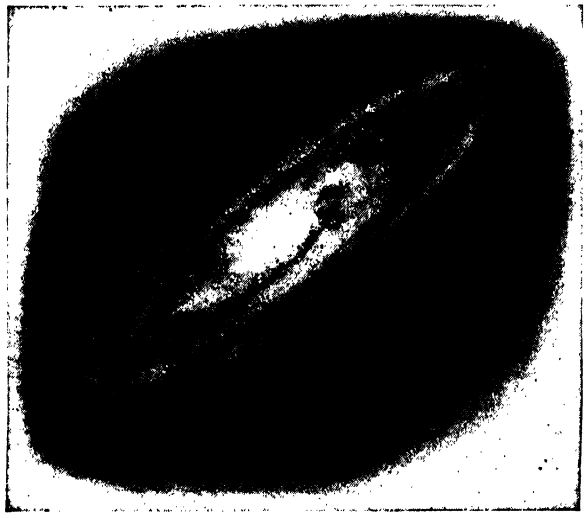
It is interesting to note that we know nothing at all of the great universe around us (with the exception of our knowledge of meteors) except for what light tells us. The astronomer measures and analyzes light, breaks it up into its colors, and in this way alone he knows of the existence and physical nature of the heavenly bodies. Light is the messenger which brings us knowledge of the universe.

IF THE SUN DISAPPEARED, YOU WOULD NOT KNOW IT FOR EIGHT MINUTES

When we look at any heavenly body we may be seeing something which no longer exists. Let us take the sun as an example. The sun is 93,000,000 miles from the earth, a distance so great that light takes more than eight minutes to make a bridge between the two bodies. We have no reason to suppose that the sun will not continue to exist for many hundreds or thousands of millions of years. But if, suddenly, some bright afternoon the sun should be destroyed by a collision with another star or in some other cataclysmic manner, we should go on seeing the sun for about eight minutes and twenty seconds after it had ceased to exist. And

this brings up another fascinating idea. Because the distances between us and the other heavenly bodies are so immense, we are looking into the past every time we look out into the sky. We are unable to see any of the heavenly bodies as they are at this moment; we see them as they were minutes, days, years or centuries ago. This is true purely because light takes time to travel the enormous distances from one part of the universe to another, to bring us the images of the heavenly bodies.

This can be stated the other way around, also. Let us imagine that suddenly some great cosmic event has occurred in a remote part of the universe. Perhaps a star, fifty trillion miles from the earth, has suddenly increased in brilliance a hundred thousand per cent. Its light will take more than eight years to cross the distance between the new bright star and the earth, and we shall only know of this cosmic explosion eight years after it has occurred.



Our Galaxy, the Milky Way, is shaped much like this, but because we are inside the Galaxy it appears different to us.

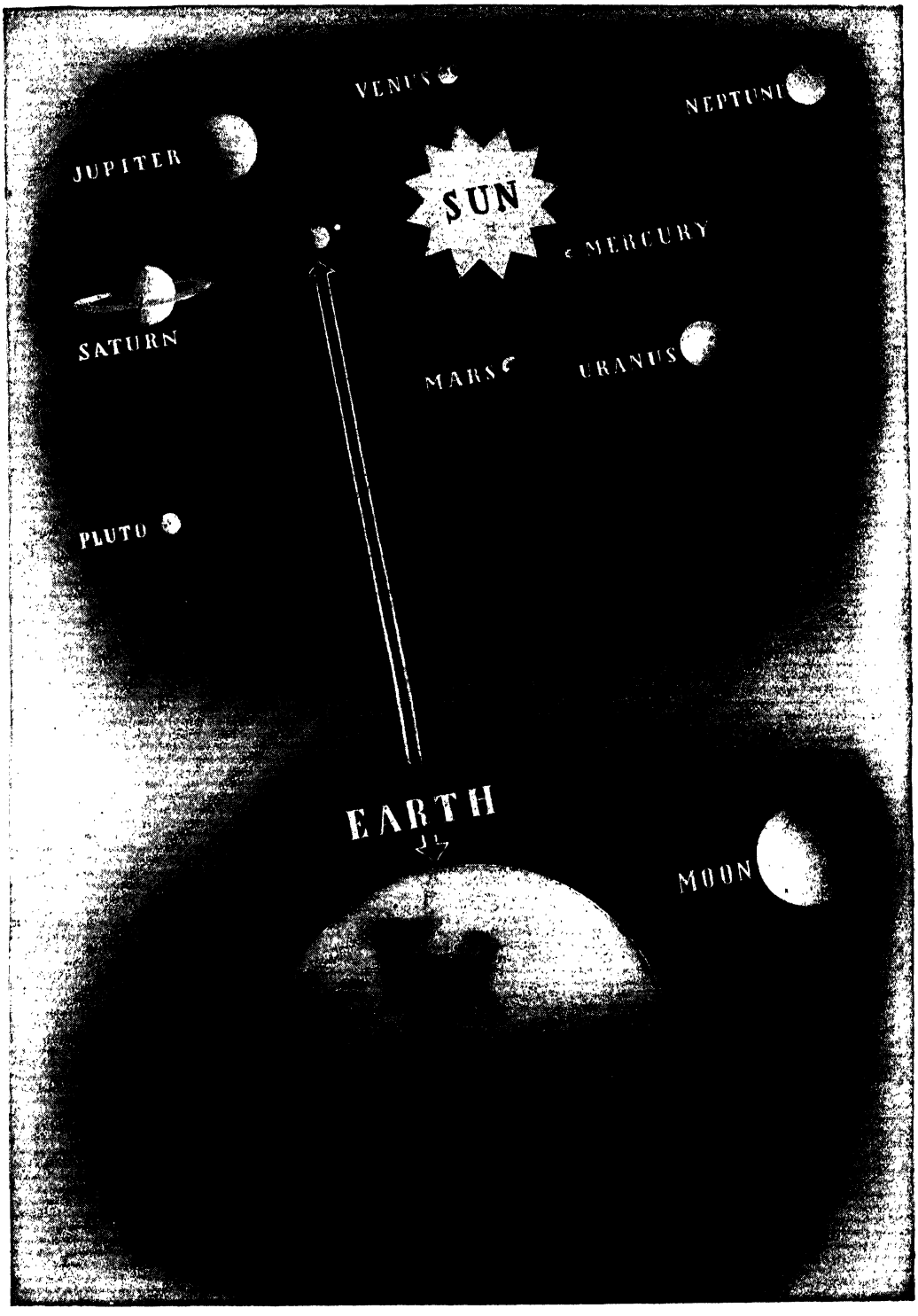
The sun, and all the individual stars that we can see in the night sky, both with the naked eye and with the telescope, belong to a great system or family of stars which is called the Milky Way Galaxy. In this Galaxy the whole solar system is no more important in size than a tiny speck of dust would be in New York's Grand Central Station; the Galaxy is composed of perhaps two hundred billion suns, many of them much bigger and brighter than our own sun. Now, these 200,000,000,000 suns, more or less, are not crowded closely together, but each two of them are separated by tremendous distances. (We have already spoken of the twenty-five or twenty-six trillion miles that lie between the sun and the nearest star.) With so many stars composing it and such vast distances between them, it is easy to see that the size of our Galaxy is actually beyond the power of our imagination.

This enormous family of stars, our Galaxy, is shaped like a great flat round cookie; but one has to imagine that instead of crumbs making up the cookie, stars are the material of which it is composed, with a great deal of space between the "star-crumbs." This cookie-shaped system of stars spins around on its axis, rotating like a giant celestial pinwheel. Astronomers estimate the approximate size of the Galaxy as probably 100,000 light-years in diameter, with a thickness about one-tenth as great.

It is believed now that the sun with its large family is located at a position from one-half to two-thirds of the distance from the center of the Galaxy, or about 30,000 light-years from the central part. When we look out toward the rim of the Galaxy we see the Milky Way encircling the sky. This is so because when we look through the thick part of the Galaxy, out toward the rim of the cookie-shaped mass of stars, we are looking through that part of the Galaxy where there will be the most stars and consequently the most light. The Milky Way then appears as a great circle around the sky, of which at any one time we see part. When we look out through the thin part of the cookie, either way, we see the scattered individual stars which light our night sky.

These individual scattered stars participate in many motions, not only their own rotational movements, but those of the Galaxy as a whole. Let us take the sun as an example. The sun rotates on its axis; it travels through space (within the Galaxy itself) at a rate of about 12 miles a second in the general direction of the star Vega; and it participates in the rotational movement of the Galaxy which carries the sun along at a rate of about 150 miles per second. All of the stars are moving, within the galactic framework, some of them toward us, some of them away from us, and some across

WHERE WE BELONG IN THE SOLAR SYSTEM



Our solar system is a midget in the universe. The earth is a midget in the solar system.

In Greek mythology the large and brilliant constellation Orion was once a human hunter. The stars that make up Orion are the group in the center of this picture. The three bright stars are jewels in his belt.

the line of sight—many, many billions of moving stars, a colossal picture.

Sirius, the brightest star shining in our sky, in the constellation Canis Major, is at a distance from the earth so great that light takes nearly 9 years to cross the distance between. Altair is more than 15 light-years away, and Aldebaran about 55. Deneb is one of the more distant of the brighter stars, about 400 light-years from us.

While the sun is probably brighter than most of its near neighbors, there are many stars which surpass it in size. Antares, the giant red star in Scorpius, is perhaps three or four hundred times the sun's diameter. The ghost mystery star known as the companion of Epsilon Aurigae, a star which shines by infrared light, has a diameter about three thousand times that of the sun. It could contain the sun at its center, and in their proper orbits and at proper distances all the planets out through Uranus, with some space left.

Within the Galaxy are not only the individual stars, some greater and many smaller and less brilliant than the sun, but there are clusters of stars, and great masses of nebulous material so large that the whole solar system would be lost within them. The Great Nebula in Orion is one of these enormous veil-like masses of extremely thin gas.

A great many years ago astronomers with their rather inefficient and uncertain telescopes observed in the heavens little patches of light which they named nebulae, believing them to be unformed and nebulous masses of gas. Some of them are, in fact, masses of gas or dust in our Galaxy. But others of these nebulae presented a strange appearance, seeming to have spiral arms or appendages curving away from the more solid-appearing centers. The early astronomers named these, naturally enough, spiral nebulae. Today we know that that is an incorrect name, for these spiral nebulae are not nebulae at all, but are, rather, other galaxies or huge systems of stars like the Milky Way Galaxy in which we live. Early astronomical instruments were not able to show the difference between these vast systems of stars and the true gaseous nebulae like that in Orion. Later work with telescope and spectroscope (always of course with the camera helping, too) has shown these spiral nebulae to be, as Dr. Harlow Shapley of Harvard calls them, "island universes," each one made up of many millions or billions of stars.

If you are interested in seeing one of these "island universes," you can do so if you locate first the Great Square of Pegasus, one of the easiest of the star groups to identify. It can be easily found in the night sky of autumn or winter. Draw a line through the pointers of the Big Dipper (the two stars at the outer end of the Dipper's bowl) and continue that line through the North Star, through Cassiopeia, and on about as far again to the south. This will bring you to a great square. Three of the four stars which form the Square are in the constellation Pegasus, but the fourth,

Alpheratz, which marks the northeast corner of the Square, is in the constellation Andromeda. Alpheratz and two almost equally bright stars to the east of it form a beautiful brilliant line of stars. Above the middle star of the three is a tiny faint elongated patch of light.

A SPIRAL NEBULA SO FAR AWAY WE SEE IT AS IT WAS 750,000 YEARS AGO

This is another star system, another cookie-shaped mass of stars like our own Milky Way Galaxy, but this one you can see as a whole because you are outside it. We can never see the Milky Way Galaxy as a whole because we are inside it, but here is a chance to see what our Galaxy would look like from away off in space. The Great Spiral Nebula in Andromeda, or the Andromeda Galaxy as it is often called now, is so far from us that light takes about 750,000 years to cross the space between it and the earth. Think how far back into history you are seeing! You see the Andromeda Nebula tonight as it used to be 750,000 years ago. This is the most distant object which you can see with the naked eye, and although it is so far away, it is still the nearest of the spiral nebulae. If you want to find out how many miles distant it is, find the number of seconds in 750,000 years and multiply 186,000 miles by that figure.

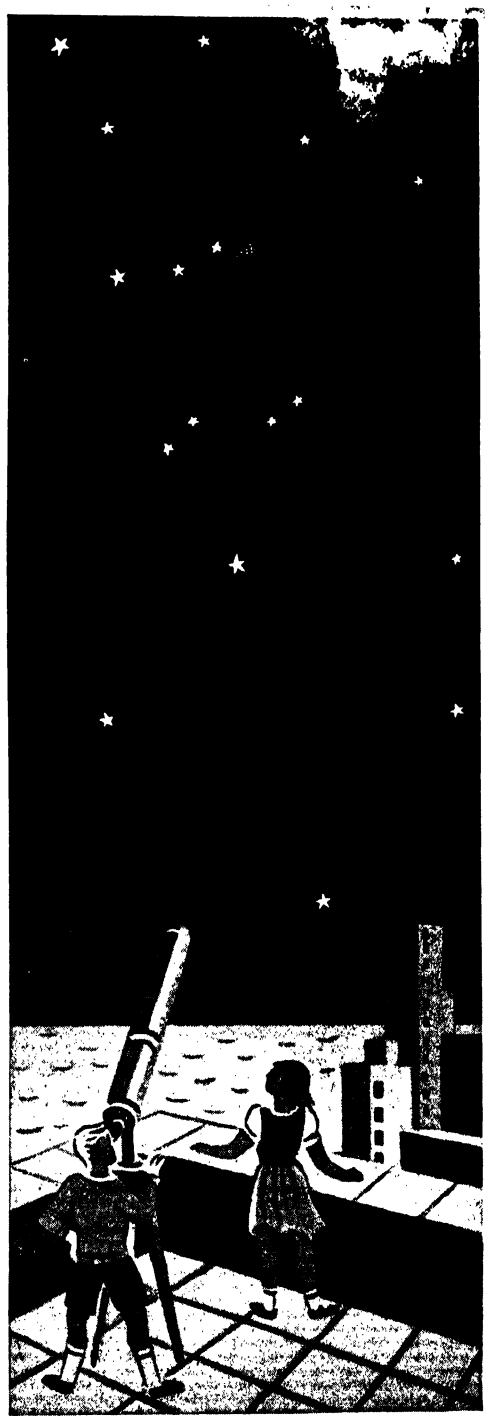
THE UNIVERSE MAY HAVE BOUNDARIES, BUT NO ASTRONOMER HAS FOUND THEM

With our greatest telescopes, in combination with the camera (for all our distant astronomical exploring is done with a combination of telescope and camera) we have photographed up to the present time hundreds of millions of these island universes, penetrating space to a distance of more than 500,000,000 light-years. And we do not know whether we have even yet approached the boundaries of the universe. At the moment we do know that the universe seems to stretch on and on, beyond the farthest reach of our most powerful instruments and almost beyond the imagination of men.

One of our great astronomers was once asked how many stars there are in the entire universe. He suggested that there might be as many stars as there are grains of sand in all the beaches in the world. Try to count the grains of sand in one small bucket of beach sand, or in a cupful, and you will have some little conception of what the astronomer meant.

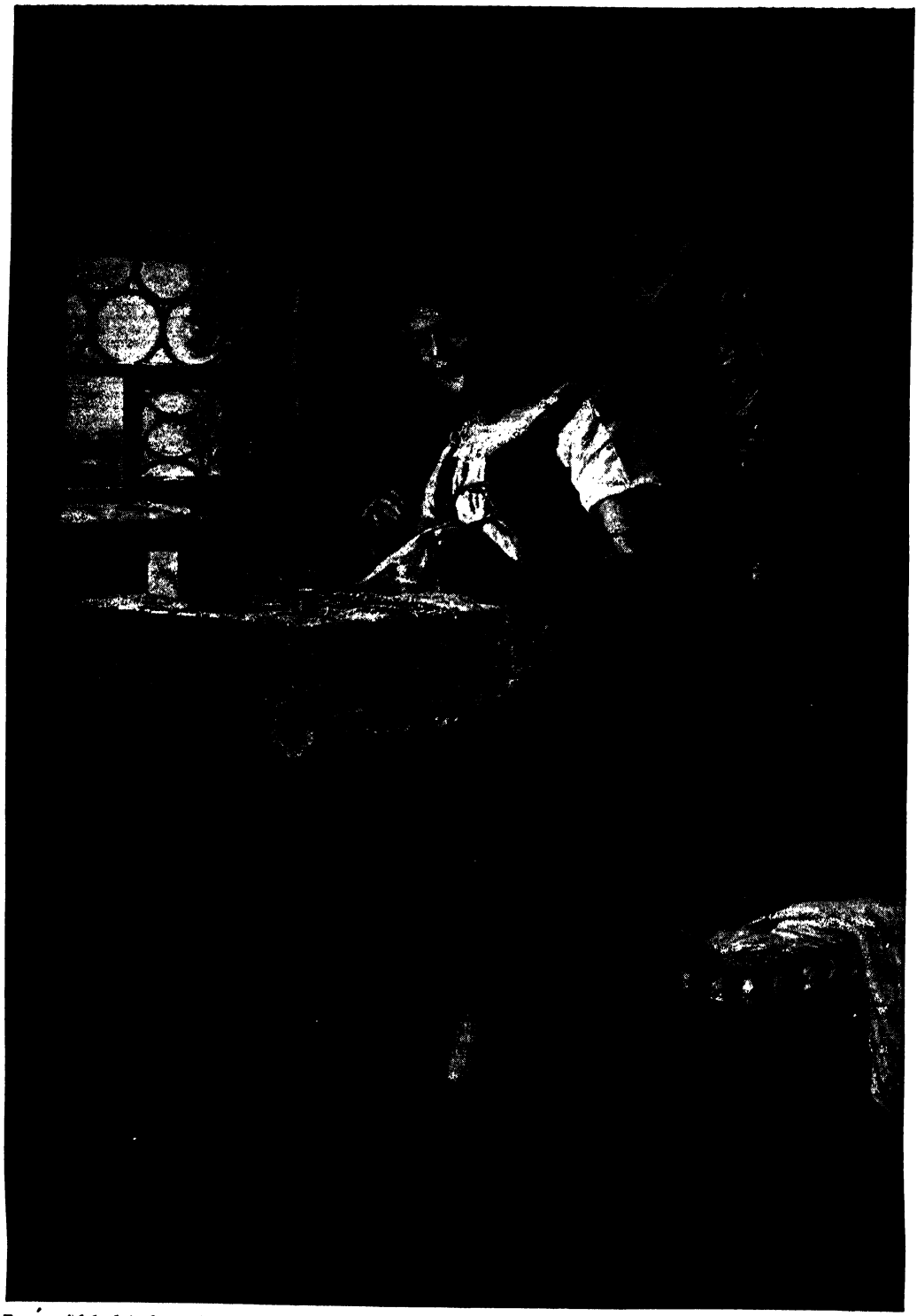
By MARIAN LOCKWOOD.

THE NEXT STORY OF THE EARTH IS ON PAGE 3169.

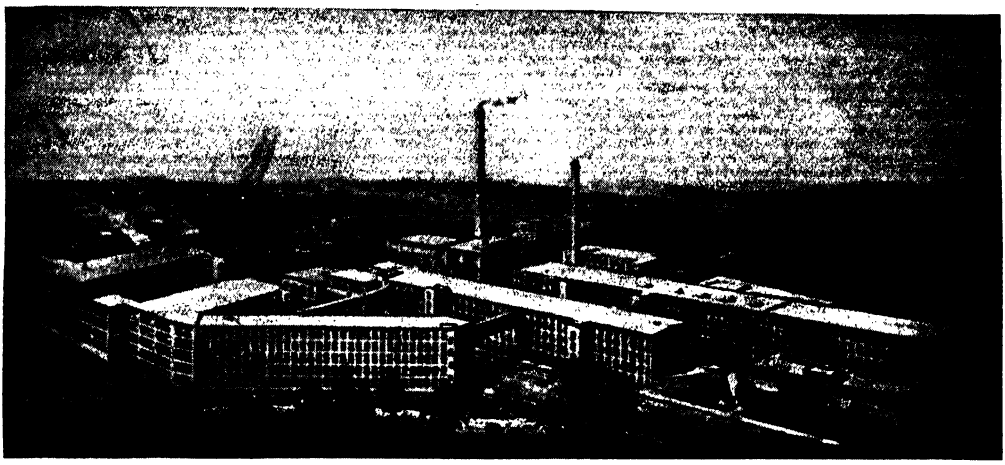


The faintly misty cluster near three bright stars, about an inch and a quarter down from the top of the picture, is the Great Nebula in Andromeda, a star-city somewhat like our own.

SEWING A FINE SEAM



Every girl had to learn how to sew not so long ago, as all clothing was made by hand at home. Women took pride in their fine needlework, and developed the art of making delicate lace, like that on the table.



Courtesy, The Oakville Co., Division Scovill Mfg. Co.

A modern plant for the manufacture of pins.

PINS AND NEEDLES

ALTHOUGH pins and needles have been used since very early times and billions of them have been made and lost, yet we can not tell you very much about their history.

Pins must have been invented before needles, because needles are used in sewing and that requires some skill. So, to discover the very first pins, we must go back to the primitive life of the cave-men. As the ice cap of the Glacial Period crept down from the north, the cave-man found it necessary to cover himself with warm clothing and the clothing at hand was the skins of animals. But the skins had to be fastened together, and what was more natural than to use a sharp thorn—the first pin. An ordinary pin still has this same shape, pointed at one end and with a head at the other. North American Indians used the spines of the honey-locust tree for the same purpose; and the gipsies once used thorns, boiled in oil to harden them, as pins.

The cave-man did not know how to harden his thorn pins, so they did not last very long; but finally some cave genius thought of using a splinter of bone. The first bone pins were very rough, but in time the cave-man learned to smooth and polish them. Stone Age artists made quite beautiful pins with well-carved heads and smooth, polished points. Such pins must have been clumsy, however, and with the invention of bronze smaller and finer pins were made of the new material. The flowing robes of the women of ancient Greece were probably fastened by large bronze pins.

In Roman mythology, Bellona, goddess of war, was supposed to have invented the needle. The first needles were made of wood or fish bones and had no eye but were used like an awl, with which shoemakers used to punch holes; other early needles had the eye at the point, like the shoemaker's awl of to-day. However, the scraps of beautiful embroidery which have come down to us from the Babylonians, Phrygians and ancient Egyptians indicate that these people had very good needles.

The Greeks, too, used needles. There is an old story about a soldier, the only one to escape after a battle, who was put to death by the women of Athens who stabbed him with their long dress pins. After that the women were compelled by law to sew their robes and forbidden to use these pins.

The Romans of the Iron Age used ivory, bronze and gold pins, and probably silver pins too. Fine pins made of silver were found in the tombs of the early Peruvians, who were in the Bronze Age when the Spaniards reached South America.

The Chinese seem to have invented steel needles, and their use gradually spread across Asia to the Moslem world in the west, and then reached Europe through the Moors. The

town of Nuremberg, in Germany, was the earliest centre of the industry in Europe, and needle-makers were incorporated there in 1370. The industry began in England in 1560, under Queen Elizabeth, but had no importance until a hundred years later.

THE FIRST WIRE PINS ARE MADE IN THE FIFTEENTH CENTURY

The ordinary pins of to-day are made of wire, but the exact year in which wire pins were first made is not known. They were undoubtedly being made in England in the fifteenth century, for a law of 1483 forbade their importation. In spite of this law, most of the pins then used in England were brought from France and Germany, where brass pins were made as early as the sixteenth century. It is said that brass-wire pins were first brought to England for Katherine Howard, the unhappy fifth wife of Henry VIII. In 1626 John Tilsby set up an establishment for making brass pins at Stroud, in Gloucestershire, and not long afterward their manufacture was begun in Bristol and Birmingham. English pins became noted for their excellence.

The American colonies imported pins from England, and no attempt was made to manufacture them on this continent until after the Revolution. In 1775 Congress offered a prize for the first twenty-five dozen pins made in America equal to those of English manufacture, but there is no record that the prize was ever claimed. During the War of 1812, however, the price of pins became so high that manufacture in the United States was started, although the industry did not become really successful until 1836.

AMERICANS INVENT MARVELOUS MACHINES FOR THE INDUSTRY

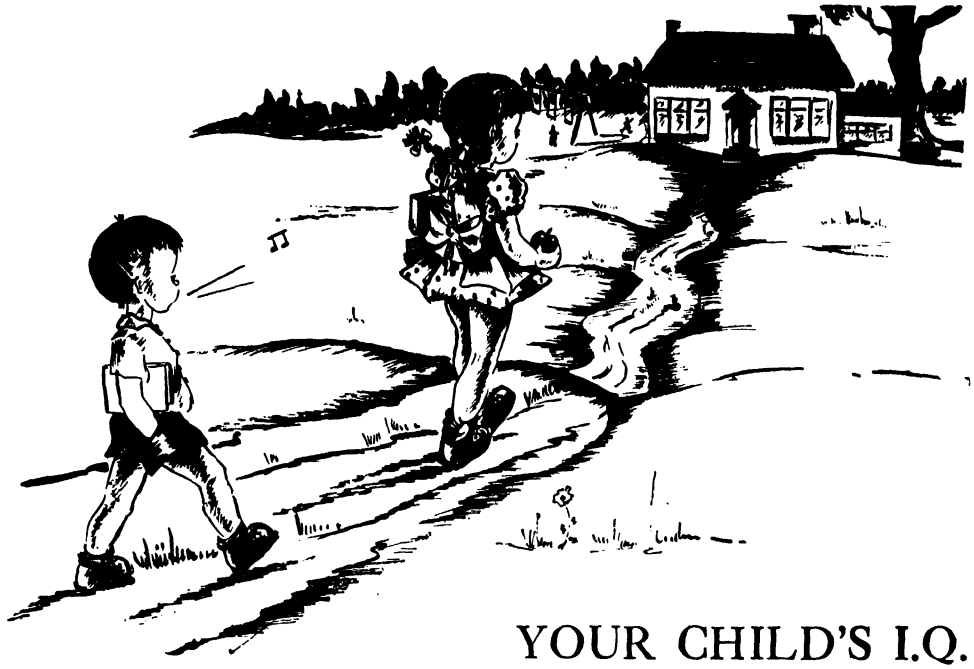
Until the end of the eighteenth century, pins and needles were made largely by hand. In 1824 an American, Lemuel W. Wright, invented a machine to make pins in which a solid head was formed in one piece with the shank. In 1826 a stamping machine was invented to drill the eyes of needles; and in 1836 Dr. John Ireland Howe, a New York physician, invented a better machine for making solid-headed pins. By the 1880's machinery had displaced all the old hand processes. Now machines do all the work. The brass wire for pins is wound on a reel, then drops into a machine which cuts it into short lengths. A little hammer springs forward and makes the heads, and then the other end is sharpened. The pins, hundreds a minute, fall out of the machine and are taken to be cleaned and coated with tin. The best grade of pins are made from brass which is rustproof; but both brass and steel pins are plated with tin because it remains bright and smooth. Next they are polished with sawdust or some other substance, and run through a machine which arranges the points all in one direction. Another clever machine sticks them in rows in the familiar paper strips for our use.

THE CONVENIENT SAFETY PIN IS AN ANCIENT DEVICE

We are apt to think of safety pins as a modern form of pin; but these, too, in crude form, were used in prehistoric times although not so much as straight pins. Safety pins were used by the Romans centuries before the Christian era; and in Italy, during the ninth and tenth centuries A.D., they took the form of brooches. For some unknown reason, their use disappeared from this time until about 1550. Shortly before the Civil War, an American in New York made the first safety pin out of wire, and developed a small business. However, the first safety pin patent was not issued until 1869, and the modern industry was established in Brooklyn, New York, in 1875. Now, safety pins are a convenience we are apt to take for granted.

Almost all sewing needles are made of steel. The steel is rolled into a rod and then drawn into wire of the required thickness. The wire is then fed into a straightening machine which also cuts the wire into certain lengths. In hand sewing needles the length cut is always that required to form two needles. To make the wire perfectly smooth and straight, it is next rubbed over a flat steel plate. The lengths are pointed, first one end and then the other, by being rolled over a revolving grindstone. The blanks with two pointed ends are then fed to a machine which stamps grooves in what will be the heads of the finished needles, then pierces the eyes through these grooves and finally cuts each blank in half to form two needles. The needles are hardened by being heated and then cooled in oil; they are tempered or toughened by blue heat. Since blue heat discolors the steel, the needles are finished by being scoured and polished. All of this work is done by machines which hold the wire firmly in place through the various processes. The polished needles roll down an incline which brings the heads all in one direction; then they are examined, graded and made up into packets.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 3121.



YOUR CHILD'S I.Q.

A CHAPTER FOR PARENTS

MANY of the mothers and fathers who read this chapter were among the first school children ever to have the magical letters and numbers *I.Q. of 92*, or *I.Q., 100* or *115 I.Q.* placed after their names in the school records.

Sometimes these records were explained to the children and their parents, but more often they were not. Sometimes even the teacher was not quite sure that she understood them. Sometimes a group test was given to the whole class, then, after a few days or weeks, I.Q.'s were reported. More commonly, in those early days and in larger school systems near some college or university, the children were brought, one at a time, to a room or office. There they listened to questions about words, sentences, numbers and stories which were to be repeated or explained.

Among other things, the child was commonly asked, if he was old enough, to imagine that he had lost a ball in a round field, and then to draw paths with a pencil showing how he would look for the ball if he were actually walking around in the field. The interview was over when the child began to show difficulty in knowing the answers. Then his replies were scored and his I.Q. reported.

The letters "I.Q." are the initials which stand for the words "Intelligence Quotient." The word "intelligence" is quite common in our daily speech, and although we mix up its meanings, we are fairly certain that a child needs intelligence in order to do the many things asked of him in the grades, high school and college. The word "quotient" is taken from arithmetic, and means a figure that is obtained when you divide one number by another. When we divide 36 by 12 and get 3, the 3 is the quotient.

To find a child's Intelligence Quotient, we first count up the number of years and months of his actual age (called Chronological Age, or Calendar Age). Then we give him a test in which the questions have been carefully arranged. At the beginning even a youngster of three years usually knows the answers; the difficulty of the questions gradually increases so that it takes a child of around ten or twelve years of age to get the right answers, and so on.

In other words, an average ten-year-old child should be able to do all the three-, five-, seven-, eight- and ten-year-old questions, but he will have difficulty with the twelve- and fourteen-year questions. Instead of counting

A child's I.Q. often depends on the way his or her education is directed. Well-chosen reading material in the home is generally very important in this connection; it broadens the interests of the child.

up the per cent he makes on the whole examination, we find how far up he can go in this scale in terms of the difficulty of the questions. This test score is then called the child's Mental Age, although it probably should be called his Test Age.

With the child's Chronological Age and Mental Age now known, we can very easily figure out what his Intelligence Quotient (I.Q.) will be. By dividing the child's actual age (Chronological Age) *into* the age score (Mental Age) he made on the test, we get his Intelligence Quotient. If a ten-year-old makes a ten-year score on the test we divide 10 by 10 (or 120 months divided by 120 months) and the quotient is 1.00. The decimal point is ignored, so we say that the child has an I.Q. of 100, which is average.

Now if our eight-year-old youngster was able to answer all the eight-year questions on the test and even go so far as to pass the ten-year questions also, he then would be given a test score (Mental Age) of 10, which when divided by his age (8) would give him an Intelligence Quotient of 125 (10÷8 equals 1.25), and he would be classed as being *above average,* or *superior.*

Instead, if for a variety of possible reasons, our eight-year-old was not able to answer the eight-year questions, and could pass only the three-, five-, six- and seven-year questions, then we would divide his Mental Age of 7 by his real age of 8 and his I.Q. would be 87½, recognized as *below average* (7÷8 equals .875).

It can be seen from the above illustrations that an I.Q. can be obtained for almost any child between the ages of three and sixteen years. With different types of tests and different ways of scoring, even younger and older individuals may be measured. Not only that, the same child can be measured at different ages. If he is average, as a four-year-old he would pass the four-year questions and show an I.Q. of 100 (4÷4 equals 1.00, or 100); and as a twelve-year-old he could pass the twelve-year questions and still show an I.Q. of 100 (12÷12 equals 1.00, or 100).

By this time the parent may say, "Why then, my child's I.Q. depends upon the test that was given to him." This is true. However, these tests are not just a collection of questions made up out of thin air, but have been worked out and tried over and over again with thousands of school children of all ages, so that when a child secures a score on these tests he is actually being compared with children from all walks of life. The wise parent will respect this comparison at least in

terms of the child's ability to do the work covered by the tests.

Does the test measure everything? Of course not. For example, it will not show how happy the child is in relation to his home and school. Nor will it tell how well he can hold a job when he grows up. These scores will not directly show whether he will be popular, well liked, shy or boisterous. Each one of us has known individuals who were not the brightest in school, yet who now occupy a real place in the neighborhood, respected by people of their own age, and loved by their families. At the other end of the scale we may have also known the bright child who turned out to be arrogant, or excessively shy and incapable of entering into the plays and games enjoyed by groups of children and adults.

Carefully directed activities in the child's early years may mean a higher I.Q. level later on.

Furthermore, there are many trades and skills which are not touched by this sort of measurement; such trades and skills, in fact, make up more than three-fourths of the world's employment. It must not be believed that a high I.Q. means a poorly adjusted person, any more than we should believe that a high I.Q. shows the individual to be the "best" in his group. We must consider many other factors along with the I.Q. score, and only then will we get the full picture of our children's interests and possibilities.

The I.Q. is concerned most closely with the ability to do work requiring the special study and preparation which are characteristic of advanced schooling. A youngster with an I. Q. distinctly below the average should not be advised or encouraged to set his goal on becoming a doctor. He might well have the social poise needed by a physician, but long before he could practice he would be required to enter college and take courses of the most complicated and technical nature, and pass these well at the head of his class before being recommended to even more complicated school work in the medical college itself. If difficulty in school work is already present, along with an I.Q. below average, how much more sensible it would be for a boy to turn early in life, with careful and skillful guidance, to other fields of work where advanced schooling is not so strongly required. One of the best sales managers we have ever known (who was receiving a salary far beyond the average physician's income) had not "made the grade" in college.

On the other hand, one of the finest families the author has ever known was made up of parents with high I.Q.'s, who had children with excellent school records and even higher I.Q.'s These parents did not depend

Both photos on this page from All the Children

A well-rounded education includes not only the study of books but training in the arts as well.

on the I.Q.'s alone, but saw to it that they and their children met with and enjoyed the various social groups and affairs of their community. Furthermore, the youngsters were given well-rounded interests. They learned to build with tools and to repair the family car.

Is this I.Q. a trait that is inherited from one generation to another? To-day the answer is probably: "Within limits—no." In the early history of mental measurements the inheritance of the I.Q. was undoubtedly exaggerated. Much evidence has been gathered during the last ten or fifteen years which shows that the encouragement of parents, teachers, friends, successes and failures in school, work habits and study habits, and whether or not there has been built up a well-directed enthusiasm for this type of ability early in the child's life . . . all exert their influence on the measured I.Q.

A CHILD'S I.Q. MAY BE AFFECTED BY ENVIRONMENT AND TRAINING

Well-chosen reading material in the home adds substance to that which we are measuring. So does encouragement given to the child in such a way that he learns to find in guided reading not only the answers to questions but also the happiness of discovery and imagination undoubtedly essential for intelligence. Some reports show that the I.Q. can be changed to quite a considerable degree when surroundings are changed. However, most of our surroundings do not alter very much in this society of ours, and as a result the scores on these tests remain fairly steady.

Studies have shown that adopted children grow to an I.Q. level which resembles that of their foster parents rather than remaining similar to that of their real parents. Evidence has also been obtained which seems to show that children who are encouraged early in life through the Pre-school and Kindergarten years acquire I.Q.'s somewhat above those who have missed this directed schooling. Even though some school systems do not have this particular type of training, interested parents and Elementary teachers can see to it that the child has material and encouragement leading to intelligent growth.

When an exceptionally low I.Q. is discovered, and those below 70 (.70) are usually classified into varying degrees of feeblemindedness, there usually appears in the reports on these cases very little evidence to show that these individuals can be encouraged into above-average I.Q.'s. Advanced, or even customary, school programs are not the type of intellectual food needed by these boys and girls. With these cases a below-average home environment is far too often found.

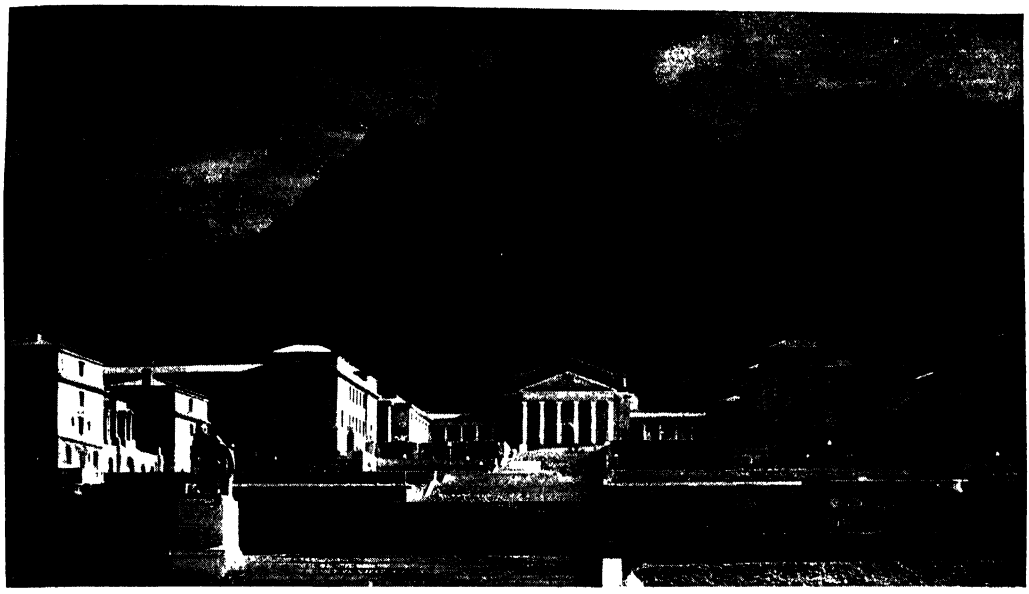
On the other hand, we must remember that there are relatively few of these feebleminded persons in our population as a whole. Most (in terms of people) differences in I.Q.'s fall between scores of 85 and 120, and we do not have real evidence to prove that these differences are due to heredity alone. Human experience is so complex that there may well have been during any child's life (any adult's as well) occasions, unnoticed and uncontrolled, which have had an effect on intellectual growth and development. It is easy to ignore all these influences of environment and to attempt to lay the full responsibility of the I.Q. score in the lap of heredity, but the easy way is not always the accurate way.

One report, confirmed by others, shows that children of college professors quite often average higher I.Q.'s than those whose parents have other forms of employment. We can well ask, is this due to inheritance alone? Or might it not also be due to the fact that a child in a teacher's home will usually find from birth on an expressed interest in and a whole array of experiences which are in line with the very traits measured by these tests?

I.Q. AND OTHER TESTS SHOULD BE GIVEN AND INTERPRETED BY TRAINED WORKERS

As a suggestion, be interested in all the many ways your children can be measured by these tests and others. Do not be influenced by rumor or by the numbers alone. To secure a reliable measurement of your child's ability, be sure that a trained worker has given and interpreted the tests. Unfortunately there are "quacks" in psychology as well as in medicine. Bumps on your child's head, or the width of his forehead are only some of these spurious signs used to confuse parents, and they are not used by the honest and sincere workers who are trying to help your child find his place in life. To-day the teachers in our schools are better prepared to interpret for you what these scores mean, and, more important, their limitations.

There is a place in society for almost every individual, and the limits which are indicated by the intelligence score still allow us to observe each child in ways which will help us to guide him toward happiness and adjustment to society. The I.Q. is important and has its place as a measure or comparison; but let us not regard it as an end in itself.



© Ewing Galloway

Cecil Rhodes Memorial University, at Capetown in the Union of South Africa.

THE BRITISH EMPIRE IN AFRICA

WHEN we come to read the history of Africa we realize again the meaning of the term "dark continent." Except for the Lower Nile regions and the places where Rome had her colonies, little is known of early Africa. The Negroes and Bushmen kept no records; they lived for the moment, and their memory was short. The absence in the interior of Africa of any real barriers, such as great mountains, allowed tribes to move about freely, so that customs and beliefs became mixed. Outside of the Europeans who have found a home in the various parts of Africa (and about whom we shall speak later), and the Asiatics introduced by them, the chief peoples of Africa are the Bushmen, the Negroes, the Hamites (Egyptians), Berbers and Arabs. Then there are various mixed races, resulting from the intermarriage of these. The Bushmen, who are short, yellowish brown hunters, lived on the borders of the Kalahari Desert, and formerly shared the whole of Cape Colony with the Hottentots, a mixed race of yellowish brown complexion. Negroes are to be found in almost every part of the vast areas that extend from the southern edge of the Sahara Desert to the Cape. The Berbers live north of the Sahara in Algeria and Morocco. The Arabs are scattered across all the north of Africa; in Egypt the people are Hamites; and in Ethiopia and Somaliland they are mixed Hamite, Arab and Negro.

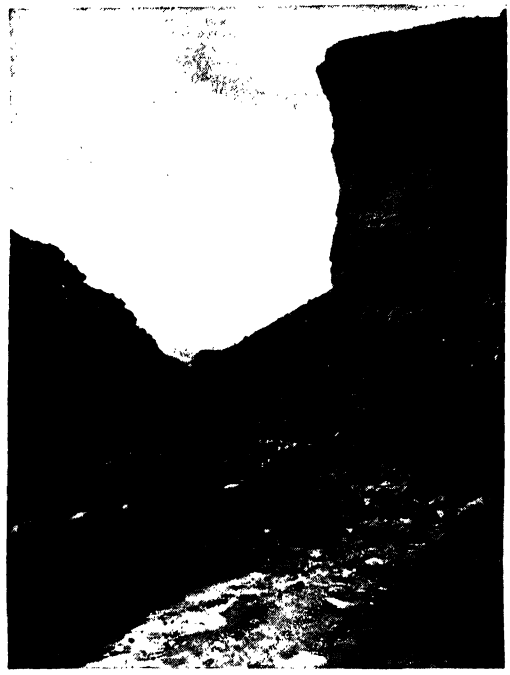
Of all these peoples the Arabs were the last to come. Spreading in a great wave of Mohammedan conquest from Arabia through Egypt and North Africa in the seventh century, they then crossed the narrow straits of Gibraltar and took Spain. The Arab was used to obeying the chief of his tribe; he was a good trader, and could build and fashion beautiful things. The Arabs brought slavery into the areas where they settled.

The age of discovery in the fifteenth and sixteenth centuries made Europeans aware of the immense continent that lay south of the Mediterranean. Otherwise, the Arabs or the Turks (another Mohammedan people, who had overrun southeastern Europe and conquered Egypt) might have gained entire control in time over the many native peoples of the "dark continent." As it turned out, however, the conquests of the Arabs and Turks extended only over a comparatively small part of Africa. By far the largest part of the continent was colonized by various nations of Europe—particularly Great Britain, France, Germany, Portugal, Belgium and Italy. Most of these countries have important holdings in Africa at the present time.

The Portuguese were the first Europeans to *discover* South Africa. Bartholomew Diaz sailed round the Cape of Good Hope in 1488, the year that Columbus sent his brother to England to ask for aid from Henry VII; and in 1497, the year that John Cabot discovered Newfoundland, Vasco da Gama sailed into Table Bay.

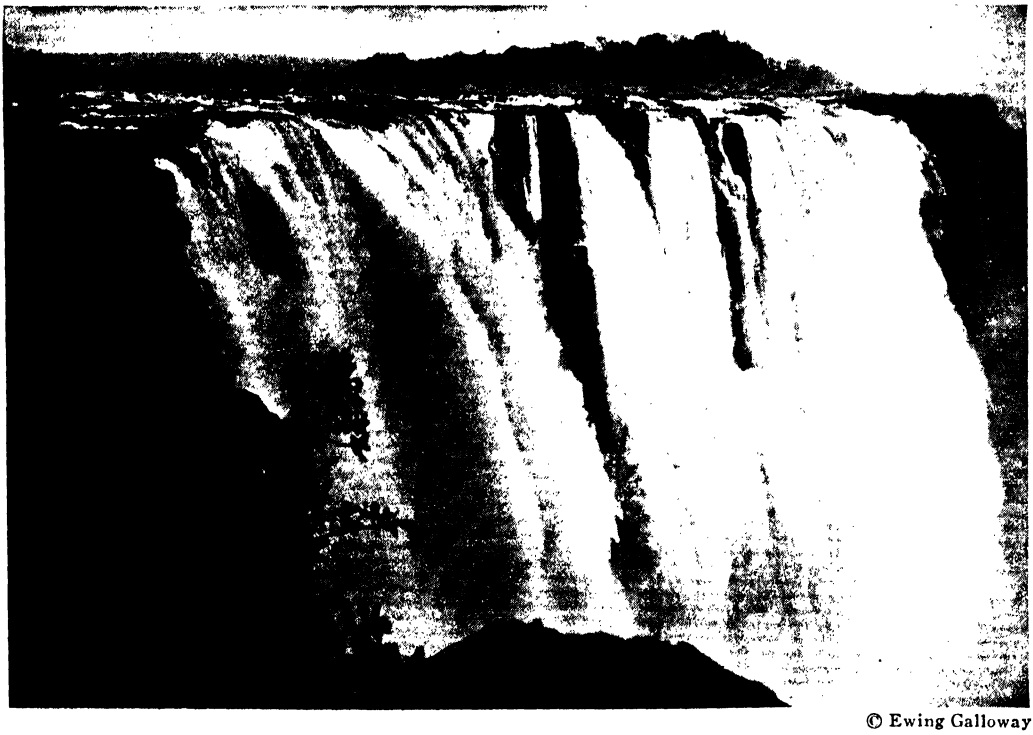
But the Dutch were the first who attempted to make a *settlement* in South Africa. Some sailors, who had been wrecked in Table Bay in 1648 and afterward rescued, brought home a glowing report of the land behind great Table Mountain. The Dutch East India Company thought it would be a good plan for its ships to stop there and so break the long voyage to and from the East Indies. The company established the first settlement there in 1652. The early colonists found that inland were fine pastures and a pleasant climate. Gradually the little settlement grew larger. Toward the end of the century the settlers were joined by a few hundred French Huguenots, who had fled from their native land.

When the Napoleonic Wars broke out, Holland, as we learn elsewhere, fell under the rule of the conqueror. As England was



Courtesy, South African Railways and Harbours

The Golden Gates, near Bethlehem, in the Orange Free State. This province of the Union has many such rocky hills, though much of it is high, rolling table-land.



© Ewing Galloway

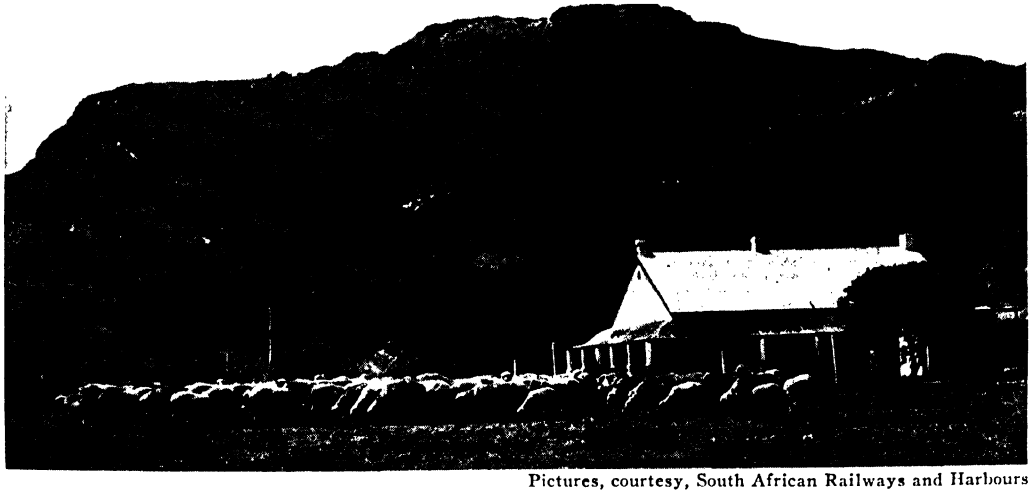
One of the world's greatest waterfalls is the Victoria Falls of the Zambezi River in Southern Rhodesia. This is a view of the main cataract, where the great river drops nearly 350 feet into the narrow canyon below.

at war with Napoleon, the British ships thereupon proceeded to attack Cape Town and to take possession of it. But they did it in the name of the Prince of Orange, as the ruler of Holland was then called. This was in 1795. When peace was made, in 1802, the colony was given back to Holland. War between Britain and France soon broke out again, and this time Holland was a dependency of France. In 1806 a British force once more took possession of the Cape Colony, this time in the name of the King of England. In the agreements made after Napoleon's fall in 1814, Holland formally signed the Cape Colony over to England; but England paid Holland a large sum of money just as the United States paid for the Philippines after the Spanish-American War. At that time the Cape of Good Hope had not half so great an area as the province has now, and there were only 27,000 white people scattered through it.

A Dutch church at Graaff Reinet.

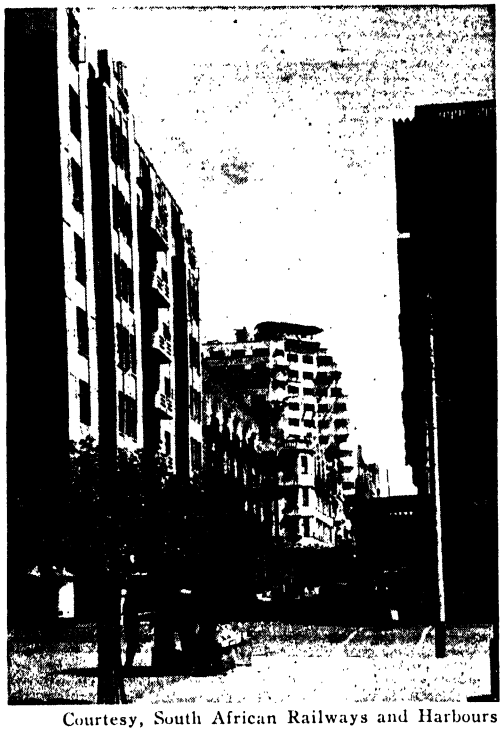
The Dutch farmers in the section were called Boers, a word which meant, originally, "farmer." The Boers did not like the change of rule and when, about twenty years later, slavery was abolished in all British possessions, they liked it still less. Most of the Boers were farmers who had large herds of cattle tended by the slaves. The sudden freeing of the slaves left the big landowners without the means of continuing their ranches. They felt that the sums of money allowed to them for freeing the slaves were not sufficient. Besides all this, raids of murderous Kafirs at this time wiped out hundreds of Boer homesteads, and the British officials in London read the situation wrongly, and blamed the Boers. Because of all these grievances some of the Boers began to trek—that is, to migrate by ox-wagon. (Trek comes from the Dutch word *trekken,* to draw or pull.) In all, about four thousand left Cape Colony with their wives and children, their flocks and herds. Some of them stopped in the fertile country beyond the Orange River; others went on until they crossed the Vaal River. The going-away of the Boers out of Cape Colony is known as the Great Trek.

The Matabele, who were brave warriors, had conquered the lands to which the Boers had come. The Matabele attacked the white men, but were defeated; their primitive weapons could not match the firearms of the Boers. The latter now founded two republics —the Orange Free State and the Transvaal.



Pictures, courtesy, South African Railways and Harbours

Here is a typical homestead nestled in a fold of the high, rolling plateau, or Karoo, in the Cape Province. In the dry season the Karoo is burnt gold under a sapphire sky, but the rains cover it with flowers.



Courtesy, South African Railways and Harbours

The fine modern buildings of Joubert Street in Johannesburg, the Union's greatest commercial city. Joburg, as it is affectionately called, was once a gold-rush town.

The second British colony, Natal, was founded partly because of the Great Trek. In those days most of that part of the country was ruled over by a Zulu king called Dingan. The Zulus, like the Matabele, were great warriors, who conquered the more peaceful tribes and forced them to do their bidding. But when the Boers had gone up into their new lands, they still wanted to be able to reach the sea, so some of them crossed the Drakensberg Mountains and sent a few of their number to ask Dingan to permit them to settle in his country.

Dingan received them in a friendly way, but just as the envoys were leaving he had them murdered, and then sent off his warriors to destroy the rest of the Boers who had crossed the Drakensberg. Most of the Boers received warning in time and made what is called a *laager* by drawing their wagons together round their camps so that they could shoot from behind them. Many of them were killed, but reinforcements reached them, and when the main body of Zulus came on, the Boers won a great victory, which is remembered as "Dingan's Day." After that the Zulus had a new king named Panda, who was more friendly. When the Boers had settled themselves, trouble began between them and some of the Kafir tribes. Then the Government at Cape Colony said that, after all, the Boers were British subjects, though they were not living in British territory, and they could not object to the British setting up their own government in Natal—which they proceeded to do. But the Boers did not want to be under British government; some of them went back over the Drakensberg, and Natal gradually became more and more British in character.

Now the Boers in the Orange River Colony and in the Transvaal were coming into contact with brave and warlike Kafir tribes who not only refused to become slaves but raided the Boer farms and frequently made war on them. The danger from such neighbors as this brought the British and Boers into alliance in self-defense, and finally an agreement was made by which the Boers in Transvaal acknowledged the sovereignty of the British crown. When the danger was over, however, and the power of the Kafir tribes broken, the Boers rose again to throw off British control. They won a victory at Majuba Hill. Then there were so many people in England who said that, after all, the Boers were right, and had done exactly as they would have done in their place, that the British gave back the Transvaal to the Boers. But Britain failed to make the Boers see that she was acting through a sense of justice, not through fear. The Boers grew to think that they had received their land again because the English had been defeated and were afraid. This led to further trouble.

THE BRITISH AND DUTCH IN SOUTH AFRICA BECOME ONE NATION

Gold mines were found in the Transvaal, and a great many British subjects went there to get gold out of the mines. But the President, Paul Kruger, said that these *Uitlanders*, as they were called, must pay heavy taxes, and the Uitlanders said that if they did, they ought to have a share in the government, which the Boers would not allow them. And as President Kruger was using the money he received to buy guns and instruments of war, people really began to think that he intended to make the Boers masters of all South Africa. The result was a great war (1899-1902), in which the Boers were defeated.

For a time the old Boer republics were governed as crown colonies. However, the British and the Boers came to realize that it would be much better if they worked together as friends. So the British colonies of Cape

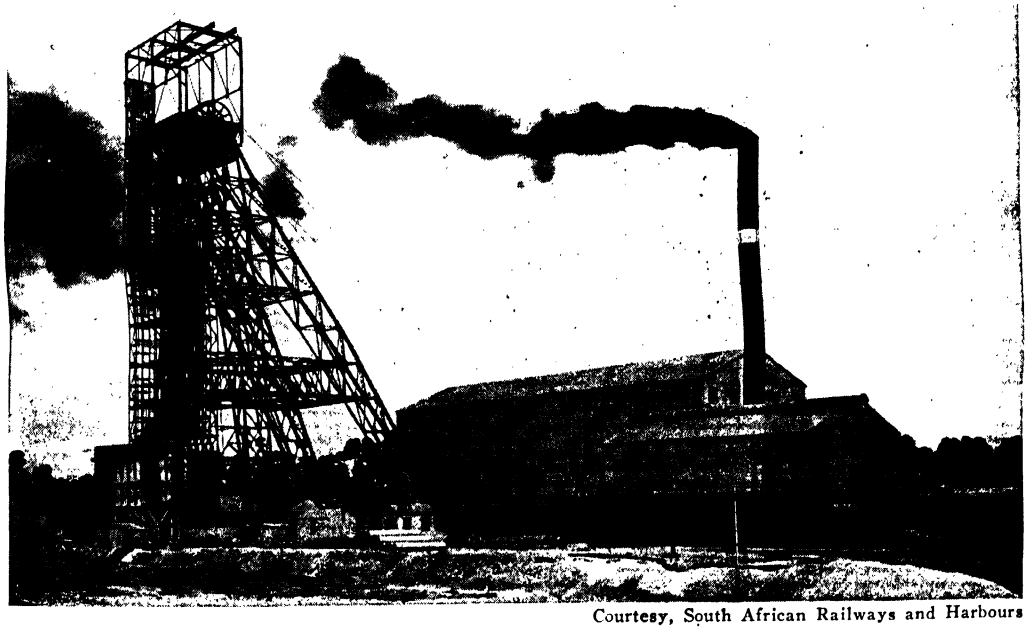
Colony and Natal joined with the Dutch provinces of the Orange Free State and the Transvaal to form a single free nation, the Union of South Africa, as one of the overseas dominions of the British Empire.

During World War I, South Africa took her share of the defense of the Empire; a Boer general completed, with South African and British troops, the conquest of German East Africa, now called Tanganyika; and German Southwest Africa was added as a protectorate to the territory of the South African Union.

The seat of government for South Africa is Pretoria in the Transvaal; but the Legislature meets in Cape Town. There is a Governor-General appointed by the Crown, assisted by an Executive Council of 12 Ministers. Parliament consists of a Senate of 40 members and a House of Assembly of 150 members. In addition four senators and three assemblymen directly represent the native races. Both the English and the Dutch languages are official, spoken in Parliament and taught in the schools.

The most striking feature of South Africa is the rise from the sea northward by steps to a lofty plateau which forms the far interior of the country. Starting from the coastal plain, one ascends to a mountain range which, being climbed, is found to be flat-topped, and to stretch away in another loftier plain. Beyond, still another mountain range leads to a second higher plain, bounded by a third range and a third plain. The last and highest mountain range which climbs to the third far-stretching plateau is about 120 miles from the southern seacoast. The lower parts approaching the sea are rich in vegetation and gorgeous with flowers. Nearly all kinds of fruits will grow, though native fruits are few. Corn, wheat, oats, barley, potatoes, sugar, cotton and tobacco grow abundantly in suitable places; but the wealth of South Africa, apart from its mining products—gold, diamonds and coal—is in its grazing lands. The grasses of its plains, though coarse and brown, rear vast numbers of cattle, sheep and horses, mules and donkeys, while its average wool clip exceeds the average value of its diamonds. A special product is ostrich feathers, of which over a hundred thousand dollars' worth are exported every year. Diamonds are mined at Kimberley by the De Beers firm, with which Cecil Rhodes was formerly associated. In the Transvaal the Witwatersrand, commonly called the Rand, is the greatest gold-producing region in the world. The average value of the gold recovered from its rocks every year is many million dollars.

Stretching along the western side of the



Courtesy, South African Railways and Harbours

These are the buildings of a gold mine in the Rand, the greatest gold producing area in the world.

Union is the former German colony of Southwest Africa, which, after World War I, was given to the Union of South Africa to govern. This country is sparsely inhabited by wandering tribes of natives called Hereros, who pasture their animals on the rare fertile stretches. Most of the country is a desert, with little or no rain. The coastal stretch has great sand ridges piled up by the southwesterly winds. Fogs are frequent and are caused by a cold current from the south. The capital is Windhoek.

We have now glanced at the region which is governed by the Parliament of the Union of South Africa. Then there are wide areas bordering on the Union that are under British protection, and are controlled by resident commissioners and assistants who are directed by the High Commissioner for South Africa. Immediately to the north of the Union are three protectorates in which Great Britain sees that the native races have fair play. They are Basutoland, Swaziland and Bechuanaland. Tribal chiefs under a supreme chief do the ruling. Native customs exist, so long as they do not conflict with justice, but magistrates' courts decide disputes between Europeans and natives. The Basutos are skillful herdsmen and rear a special breed of horses. Swaziland has excellent grazing grounds. The Bechuanaland Protectorate is a land of deserts with fertile patches used entirely for pasturing.

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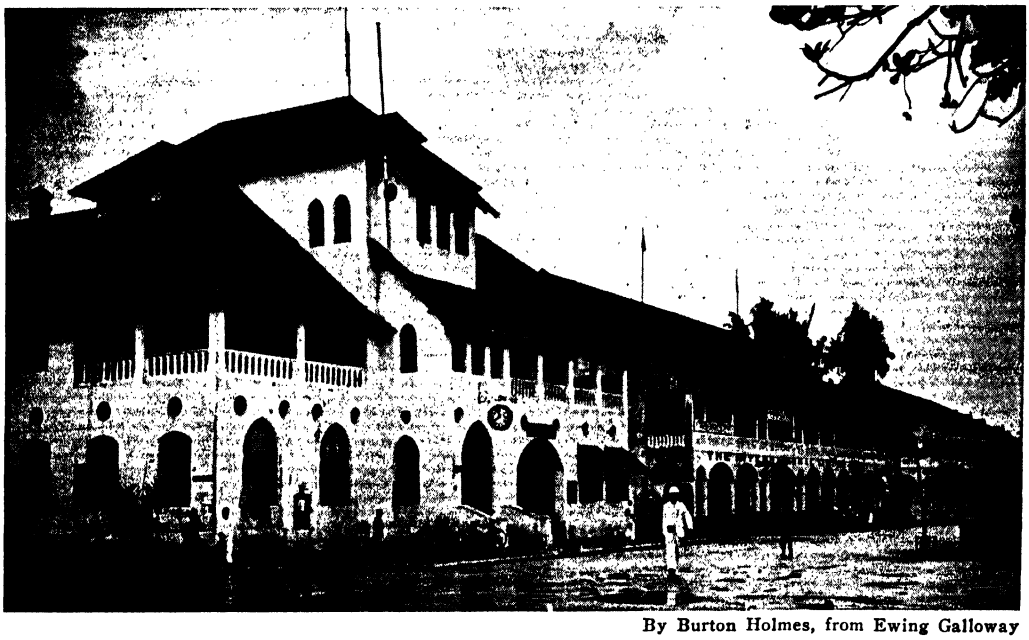
Native women planting mandioca, or manioc, the plant from which comes the tapioca we use for desserts.

The district of Rhodesia, divided into Northern and Southern, fills a large part of Central Africa between the Transvaal and Lake Tanganyika. It was claimed by Cecil Rhodes as land suitable for colonization. He was its pioneer, and he chose there to have



By Burton Holmes, from Ewing Galloway

A street in Dar-es-Salaam, the seaport of Tanganyika, a protectorate which was a German possession before the first World War. The building on the corner is the Post Office, and next to it is an automobile salesroom.

his grave. Rhodesia is high enough to be a white man's country. Bulawayo stands more than 4,000 feet above sea-level, and Salisbury is 4,850 feet high. This lofty land is now visited freely for its scenery, which includes one of the world's great waterfalls, where the mighty Zambezi River suddenly plunges with a voice like thunder into a chasm more than twice as deep as Niagara Falls. The natives call it "the smoke that sounds." The first white man to see this great spectacle was Dr. Livingstone.

Rhodesia, besides being a grazing country and producing corn, cotton, tobacco and fruits, is rich in mineral wealth. In ten years it exported two hundred and fifteen million dollars' worth of gold, and now its yearly output is nearly thirty millions. It produces also copper, lead, silver, coal and other minerals.

Developed by the British South African Company between 1889 and 1923, it was then purchased by the British Government, but the company still retained its mineral rights. The railway from Cape Town has been extended through the whole country to Belgian Congo, which bounds it on the north. An eastward branch from Salisbury reaches the coast at Beira through Portuguese territory.

If you look on your map at the eastern boundary of Rhodesia you will see a territory called Nyasaland, which stretches along one shore of Lake Nyasa. This country is a protectorate of Great Britain. Here the explorer Livingstone, of whom you read in Volume 14, worked. Zomba is the seat of government, but Blantyre the chief town. Nyasaland has railway connection with the river ports of the lower Zambezi, and there are steamers on the lake. The climate is suited for tropical farming, and cotton and tobacco are successfully grown.

Next we look at a place on our map with a long queer name, the Territory of Tanganyika. Before World War I, this was a part of German East Africa. The other part was added to Belgian Congo. Tanganyika is a mountainous land and includes the lofty Kilimanjaro, over 19,000 feet high. Parts of it are well forested. The lower lands are unhealthful and malarial. The people are of Bantu origin and very brave. At present the country produces copper, cotton, sisal hemp and cocopalms. Considerable numbers of cattle, sheep and goats are pastured. Now Tanganyika is a trusteeship of the United Nations.

We are progressing north in our travels

Courtesy, South African Railways and Harbours

Kruger National Park in South Africa is a wonderful wild animal preserve. Here we see some of the wildebeest and zebras in the park. Kruger National Park is named for the great Boer leader, "Oom" (Uncle) Paul Kruger.

© Ewing Galloway

This native soldier is watching the waterfront of Port Sudan, on the Red Sea, in the Anglo-Egyptian Sudan, great territory that stretches from Egypt southward to the borders of Kenya and the Belgian Congo.

and next must consider Kenya Colony, before World War I, British East Africa. Central Kenya is a lofty plateau, varying from 5,000 to 8,000 feet. From this plateau beautiful Mount Kenya rises to a height of 17,000 feet. Nairobi, the capital, is 5,450 feet up. It is this height that makes Kenya a white man's country. Animals which sportsmen call "big game" still roam through Kenya, and a journey on the railway through the country would be an exciting affair. In Kenya there are about 23,000 Europeans, 85,000 Asiatics, 21,000 Arabs and 4,056,000 Africans, belonging to the Masai, Swahili, Bantu and Galla races. The chief port is Mombasa, unhealthily situated. Because of its varying altitudes Kenya has greatly varied products and is a land of great promise. Dairying is profitable. Wheats and barley can be grown, also cotton, rice, coconuts, groundnuts, coffee and sugar. Lake Victoria, which lies between Kenya and Tanganyika, is the second largest freshwater lake in the world. It is now well supplied with vessels for travel and business.

Linked with the government of Kenya are the protectorates of Zanzibar to the east and Uganda to the west.

Uganda is about twice as large as Wisconsin, and, with its population of about 3,931,000, is one of the populous parts of Central Africa. It is an important link in the great Cape-to-Cairo railway scheme, and reaches also to the Indian Ocean by rail to Mombasa. The native capital is Mengo, or Kampala. British government officials make Entebbe their headquarters. On the western side of the country stretches the snowy range of Ruwenzori, 17,000 feet, which divides it from Belgian Congo.

The island of Zanzibar is separated from the mainland by a channel twenty-two-and-a-half miles across at its narrowest part. In the sixteenth century the Arabs of the east coast sought help from the Arabs of Muscat in driving out the Portuguese. In 1832 the Sultan of Muscat transferred his capital to Zanzibar. As traders and slave-raiders the Arabs had great power over eastern Africa and far into the interior. Zanzibar town has an excellent harbor which was formerly a center for trade along the whole east coast.

Dating from 1890, the British control of the Sultanate of Zanzibar includes the islands of Zanzibar, Pemba, some smaller islands and a strip of African coast. More cloves are grown in Zanzibar than anywhere else in the world.

IVORY TUSKS AND SOAP BALLS

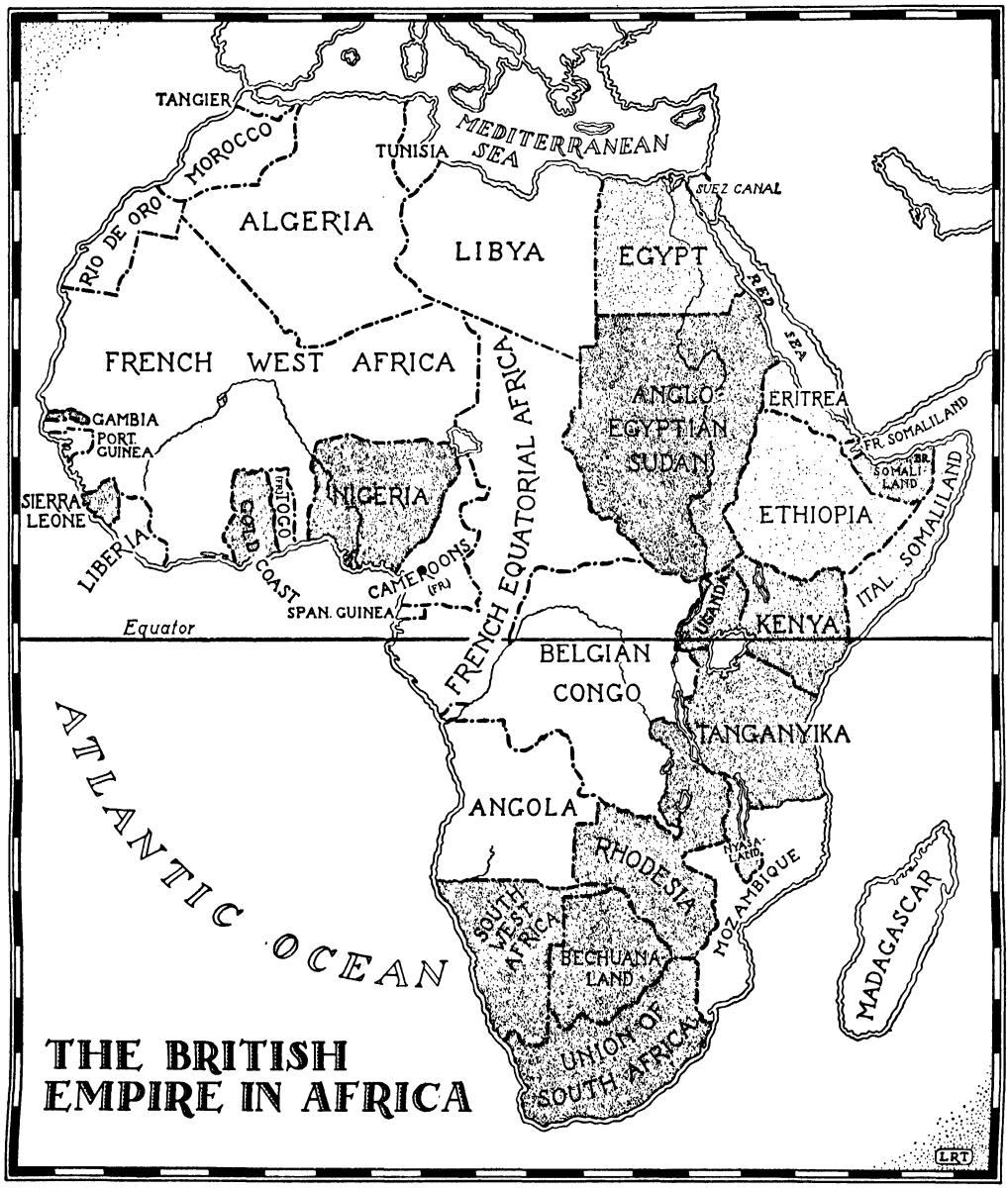
© Underwood & Underwood

A scene in the main street of Mombasa, in Kenya. Great ivory tusks, once worn by the proud African elephants, are being brought from the jungle to be shipped across the ocean to America.

© Underwood & Underwood

In the market at Fort Portal, in Uganda, we see a soap merchant advertising his wares. The soap is made into balls, and the merchant has made a lather to show the passersby what good soap it is.

Northward of the Kenya Territory is a triangular section which, before World War II, was divided into Italian East Africa, British Somaliland and French Somaliland. More than seven-eighths of the territory was owned by Italy; and included the Kingdom of Ethiopia won by conquest in 1936. During the war the area was fought over a number of times. Parts of it changed hands more than once. Ethiopia, with the help of the British, recovered her independence in 1941. Near the entrance to the Red Sea, and opposite Aden, is British Somaliland. It is inhabited by about 700,000 Mohammedans who are mostly nomadic, driving their cattle and sheep from place to place according to the season. The capital is Berbera. The chief exports are cattle, sheep, hides and gum.



The dark shaded areas belong to the British Empire. The Union of South Africa is a self-governing dominion. Egypt and Ethiopia are independent. Libya, Eritrea and Italian Somaliland are under British rule at present.

© Ewing Galloway

In many places efforts are made to educate the natives in the methods of civilized living. This sewing and drawing class of young Nigerian women is carried on at Lagos, Nigeria, in British West Africa.

A protectorate on the east coast which Britain holds jointly with Egypt is the enormous Sudan. This tract extends from Uganda down the courses of all the Nile's tributaries leaving the central lakes and mountains, and those that leave Ethiopia. It goes as far as Wadi Halfa. The central forests and swamps, the main courses of the Atbara, the Blue Nile and the White Nile, the plateau of Darfur back to French Equatorial Africa, the Nubia and Libyan deserts —in all nearly one million square miles— are included in this great province. The names of the towns in this once "wild waste" all tell a story. Khartum speaks of Gordon's death, Omdurman of Kitchener's victory, El Obeid of Hick's massacred Egyptian army.

The Sudan has reached a stage when it can show a vastly improved store of cattle. Other livestock raised are horses, asses, sheep and goats and camels. The old trades in ivory and gum are continued briskly. In fact, the section produces about 85 per cent of the world's annual supply of gum arabic, and its vast reserves of gum trees have not even been surveyed. The chief grain raised is millet. Irrigation has given encouragement to cotton growers, and both Egyptian and long-staple American cottons are raised. Senna and sesame seeds, dates, groundnuts, vegetable ivory, hides and skins, gold and mahogany are important products.

Now let us take a big leap over to the coast lands around the Gulf of Guinea. British settlements here have had difficult times. In fact, the low coast has been called "the white man's grave." Nowhere has there been deep penetration into the country, except recently in Nigeria. Modern science with its work against tropical disease may some day raise the barrier. Now the general plan is to have a small colony on the coast and a considerable protectorate behind it. Gambia, for instance, has the small area of four square miles only, but the adjoining protectorate has 4,000. The protectorate consists of a strip of land extending six miles on each side of the river Gambia to a distance of about two hundred miles in a direct line from the sea. The river is deep enough for seagoing ships. Much of the land is cleared for cultivation. The inhabitants, who are thrifty and industrious, belong to the Negro race almost entirely. The European residents are officials, traders or missionaries, and their number is around one hundred. How did trading begin on this rich coast?

Usually a fort was built where the traders lived, and some protection was offered to friendly tribes around. As time went on, this pulled things together somewhat, but the Europeans did not look upon themselves as permanent settlers. They were traders who would presently go home. The colony of Gambia has been occupied since the reign of James II. Its capital is Bathurst. It exports

© Ewing Galloway

A street in Freetown, the capital of Sierra Leone, on the west coast. Freetown has a wonderful harbor.

groundnuts (somewhat like our peanuts), beeswax, palm kernels, rice, cotton and corn.

The Gold Coast is the oldest of the British African colonies. It produces a fair amount of gold, but a more valuable product is cocoa. Other products are palm oil, kola nuts, rubber, palm kernels, copra, manganese, mahogany, and some diamonds. Behind its coast-line is the native country of Ashanti, and lands still farther inland, called the Northern Territories. Its government administered the small part of German Togoland allotted to Great Britain after World War I. Accra is the capital of the whole protectorate, which is about 92,000 square miles. Kumasi is the capital of Ashanti. The Ashanti first became known to Europeans early in the eighteenth century as a strong, warlike nation. At the beginning of the nineteenth century they came into conflict with the British. This conflict lasted, off and on, almost a hundred years, until the country was annexed by the British in 1901. The Kumasi tribe of the Ashanti possessed a gold stool on which for years the kings had been crowned. But in 1896, when their chief was taken prisoner, this stool was hidden by the tribesmen and has never been found.

Sierra Leone, Mountains of the Lion, was occupied in 1788 to be a home for released slaves. The capital, Freetown, is the largest seaport on the West African coast and has an excellent harbor. Bo, in the hinterland, has a school for the education of chiefs. Sierra Leone is a well-watered, well-wooded and generally hilly country. White men can live safely about forty or fifty miles inland. The wealth of the country comes chiefly from the oil-palm, the kola-nut tree and also gold, diamonds, iron ore, and cotton.

Nigeria is a large colony and protectorate. It covers an area of 339,000 square miles, and has a population of 20,461,000. Lagos is its port, and Kamo its great inland trading center. Nigeria has coal-fields, tin-mines, fine forests and fertile soil. It produces cotton, cocoa, groundnuts, corn, rice, coffee, tobacco, palm-oil and kernels, gum and rubber. A small part of the German Cameroon colony was given to Britain and was ruled from Nigeria. Nigeria is a splendid country for big-game hunting. The animals found there include the elephant, lion, leopard, giraffe, hyena, West African buffalo, antelope and other small game. Monkeys and snakes are numerous. In the plateau regions cattle, sheep and goats are raised.

Today, in addition to Tanganyika, both the Cameroons and Togoland are United Nations trusteeships. However, about 25 per cent of the area of Africa and about 25 per cent of its population are still a part of the Commonwealth of Nations. Before long it is possible that Southern Rhodesia will become, after South Africa, the second African dominion.

THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 3107.

THE NERVOUS SYSTEM

Harold M. Lambert from Frederic Lewis

Coming down—but the pillow will help. The roller-skate wheels have moved faster than the boy's nervous system could balance his body in a rapidly changing position.

THE living body has been called "a little world set in the midst of a larger world." Within the body, hundreds of different events are continually taking place. And at every moment, many things are occurring in the world immediately about which indirectly or directly affect the body. The well-being of every living thing depends on a delicate balance between its own inner activities and those of its surrounding.

How is this balance brought about? How does it happen that so many different events are so nicely adjusted to one another? In large part, the nervous system is responsible for these adjustments. Indeed, it is often called the adjuster mechanism of the body. Let us see how the nervous system of the human body is made up, and how it works.

The nervous system of the body may be divided into two main parts. The first of these is the somatic nervous system. It controls the general relations of the body with its surroundings. Through it, we are able to sense things that happen around us and to us, and to do something about them. The somatic system is a large one, including most of the brain and spinal cord and the nerves which connect them with various parts of the body.

The second main part is the visceral nervous system. It governs the inner activities of the body—digestion, breathing, excretion of wastes, blood circulation, secretion of glands and reproduction. This visceral portion is commonly called the autonomic nervous system.

Although these two systems do some of their work independently, they are really very closely knit. To illustrate this, one has only to remember how the sight or thought of tempting food makes the mouth water; or how an embarrassing situation causes one to blush.

Like the other organ systems, the nervous system contains billions of cells. These nerve cells, or neurons, as they are called, have a special shape and structure which are different from those of all other cells. They neither look nor behave like liver cells or bone cells or skin cells.

As you know, all cells have a nucleus which is surrounded by cytoplasm, and the neuron is no exception. But the remarkable thing about the neuron is that part of the cytoplasm is drawn out as an extremely long, thin fiber, or axon. The axon may be as much as a yard long, but only 1/2500 of an inch in width. Other, shorter fibers sometimes run out from the cytoplasm around the nucleus. These are known as dendrites. Thus, the neuron has three parts: a cell body, a long axon and one or more dendrites.

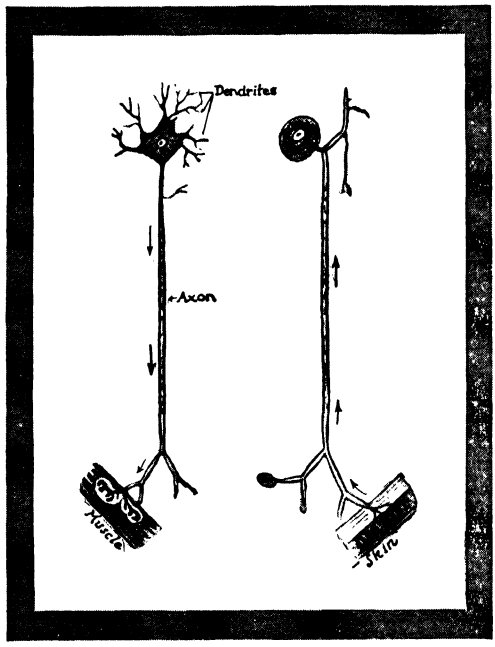
The cell bodies of the somatic nervous system are found in or near the brain or the spinal cord, while their axons are gathered together into cables which pass out to the body as nerves. The nerves which are attached to the spinal cord are the spinal nerves. Those which are connected with the brain are called cranial nerves.

According to the way in which they function, neurons of the somatic nervous system are regarded as being either sensory or motor.

The sensory cell bodies are located in

small groups, or ganglia, along the side of the spinal cord and brain. Their fibers carry messages from the body to the brain and spinal cord. When the sensory messages, or impulses, reach the brain, we are able to perceive a great many different things.

It is commonly said that man has five senses: sight, hearing, smell, taste and touch. Actually, we have many more than five. You can feel pain or cold or heat. And the feeling of pressing a finger down on a table top is quite different from that of touching it lightly. Even when your eyes are closed, you can tell whether your knee is bent or straight and whether your arms lie at your side or are raised in the air. These impressions, and many more, can truly be called senses. Each of them is made possible by the impulses sent to the brain over various sensory neurons.



In a motor neuron, left, impulses travel from the inside out. Travel is in the opposite direction in a sensory neuron.

The motor nerve cells conduct impulses in the reverse direction, that is, from the brain and spinal cord out to the body. Motor impulses go to various muscles. Now, all movements of the body are caused by the contraction of muscles. And since it is the motor-nerve impulses which start muscular contractions, they are responsible for setting off all types of movement.

What are these impulses? How does an event in the surrounding world or in the brain start one of them on its way along a nerve fiber? First, consider a sensory impulse from the skin of a finger.

As sensory axons enter the skin, they break up into many small branches. Each of the branches ends among the skin cells. The ending is a special one, often shaped like a tiny net. But the ending on a fiber which carries pain impulses is different from that on a touch fiber. Indeed, every ending is especially fitted to perceive only a particular kind of change, or stimulus. Stimuli such as light, sound, pressure, odor, taste, pain, cold or heat can each make an impression on only one type of nerve ending.

Once the ending is stimulated or excited, an impulse starts along the fiber toward the spinal cord. The impulse is not an electrical current, but, in some ways, it is similar to such a current. Essentially, what happens is this. Certain chemical changes take place within the stimulated nerve ending and these changes spread rapidly along the nerve fiber. The process is rather like the spreading of small waves after a stone is thrown into a pond.

The impulse in a motor axon is much the same, except that it starts in the cell body in the spinal cord and moves towards the muscle it brings into action.

Nerve impulses move rapidly—as much as 200 miles per hour. Not all of them go this fast, however. In certain animals, especially cold-blooded forms, some of the impulses go no faster than a man can walk. Remember that an average walking pace is about one yard per second, and that an impulse often has to travel only an inch or two in a small animal. Thus, it may still reach its destination very quickly.

Nevertheless, even the most rapid of nerve impulses are slow compared to the passage of electricity through a wire, or compared to the speed of light. Light reaches the earth a few minutes after it leaves the sun, but a nerve impulse would require over fifty years to travel the same distance.

No nerve cell leads an independent life. It is always in touch with other nerve cells. The most usual situation is for the axon of one cell to end on the dendrites of another. This region where the two neurons touch each other is known as a synapse. The duty of a synapse is to provide a means of getting an impulse arriving along an axon across to a neighboring cell body. Long chains of neurons, with many synapses, are common. But the simplest and most easily understood pattern is a chain of three neurons. Let us

examine how such a chain might work.

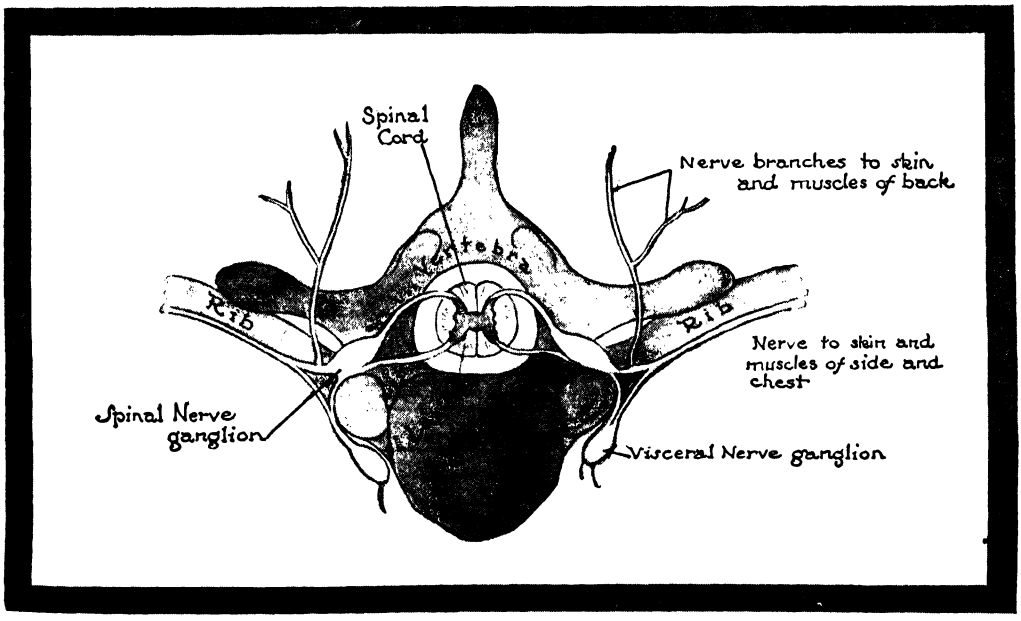
Suppose you cut or burn your finger. You quickly pull it away from the offending stimulus. This type of action, in which no thought is necessary, is called a reflex. The reflex is the simplest and most general activity of the nervous system. A simple reflex requires the passage of impulses over three neurons. The first of these is the sensory neuron which picks up the message in the skin of your finger and conducts it to the spinal cord. There, it is transferred across a synapse to a short, connecting, or adjuster, neuron. After crossing a second synapse, the impulse reaches a third, or motor, cell and backs out again to a muscle which will help to pull away your hand. All this happens in a fraction of a second—actually, before you are conscious of any pain.

Anyone knows, however, that there is more to burning a finger than pulling it away from a hot object. That is only the beginning. Almost at once, you are aware of a sharp pain; then the pain becomes dull and throbbing. These sensations leave no doubt in your mind that you have been burned and that you want to do something about it. You recall, perhaps, the last time your finger was burned and how soothing a certain salve proved to be. And so the salve is obtained and applied. During this sequence of events, a bewildering variety of things has been taking place in the nervous system. To explain even a few of them, the brain and spinal cord must now be examined in more detail.

As we have seen, neurons have their cell bodies in or near the spinal cord and brain. Their axons run out in the spinal and cranial nerves to connect with other tissues. There are thirty-three pairs of large spinal nerves and twelve pairs of cranial nerves. Of course, each of these becomes divided into many smaller nerves.

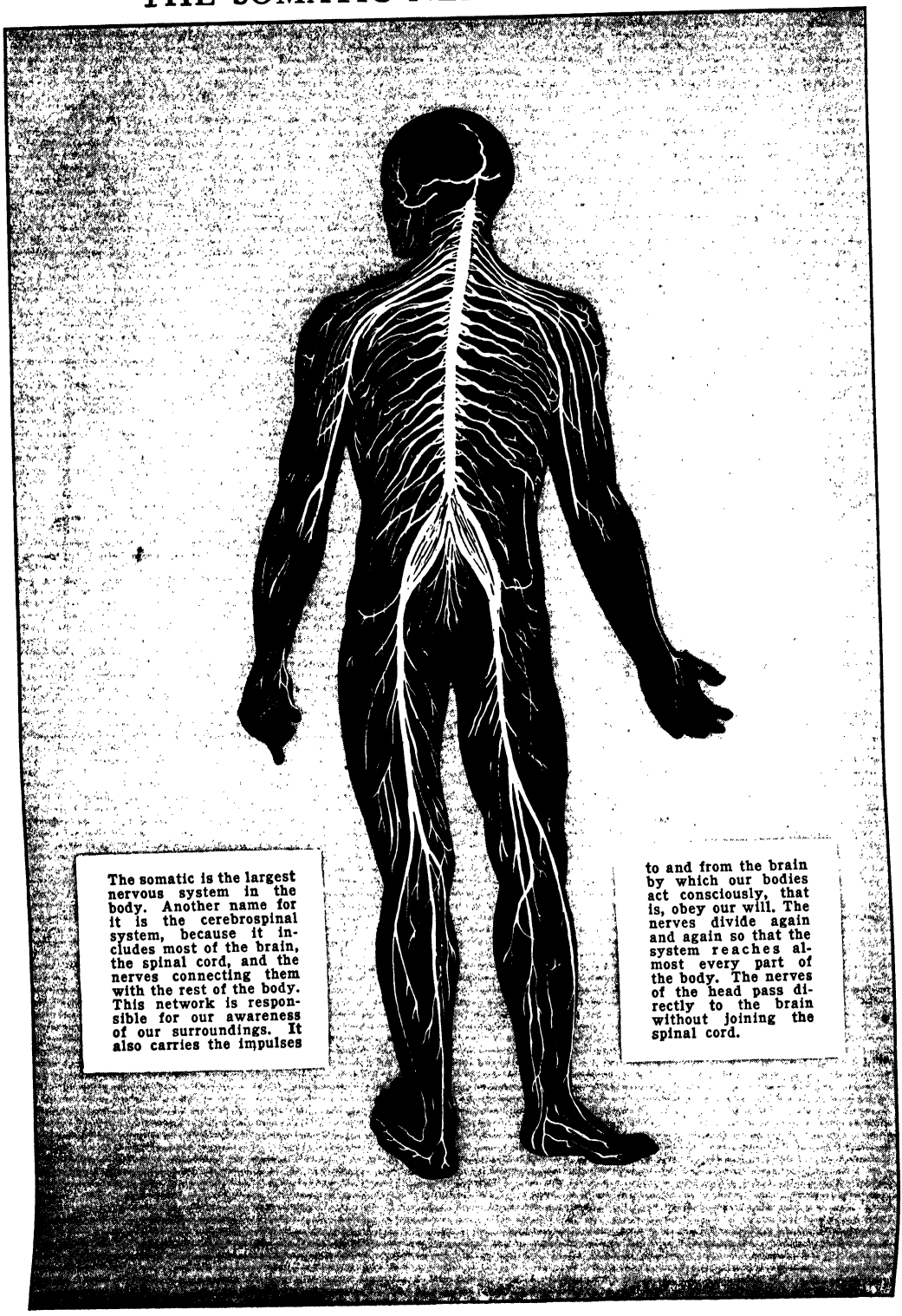
On each spinal nerve, near its connection with the spinal cord, is a swelling. This swelling, or ganglion, as we have called it, contains the sensory cell bodies. Each of the sensory cells which are clustered together in a ganglion sends off two processes. The longer one, going to some body tissue, has already been described. A second, shorter process extends into the spinal cord and synapses there with another neuron.

The motor-nerve cell bodies are found in the substance of the brain and spinal cord. They are arranged in a very special way. If one cuts through the spinal cord and examines the cut surface, two separate kinds of tissue can be recognized. In the center of the cord there is a mass of gray matter, shaped somewhat like the wings of a butterfly. It is filled with thousands of nerve cell



A cross section of a vertebra and the spinal cord. The wing-shaped gray matter in the cord contains motor-nerve cell bodies; and the white matter surrounding it is made of axons. Bundles of axons also branch from the gray matter and pass out through the vertebra. The spinal nerve ganglion contains sensory-nerve cell bodies.

THE SOMATIC NERVOUS SYSTEM



The somatic is the largest nervous system in the body. Another name for it is the cerebrospinal system, because it includes most of the brain, the spinal cord, and the nerves connecting them with the rest of the body. This network is responsible for our awareness of our surroundings. It also carries the impulses to and from the brain by which our bodies act consciously, that is, obey our will. The nerves divide again and again so that the system reaches almost every part of the body. The nerves of the head pass directly to the brain without joining the spinal cord.

bodies. Around the outside is a rind of white matter. Here, many different kinds of axons are crowded together. These include the sensory and motor fibers running to and from the rest of the body. Also present are fibers which connect one part of the cord with another, or link together the cord and brain. These fibers are usually quite short.

Now the fibers which bring about these interconnections between various areas of the spinal cord and brain are not scattered at random through the white matter. Their arrangement is quite definite. The nerve fibers in the white matter are grouped together in bundles; and the fibers in each bundle, or tract, have an entirely different job to do from those of neighboring bundles. For instance, one tract carries sensations of pain up to the brain, while another transmits orders for muscle contraction in the reverse direction. Altogether, twenty-five or more such tracts are known, each with a constant location and a particular function. Like the axons in spinal nerves, the tracts of the white matter are known as sensory or motor according to the task they perform.

From Frederic Lewis

Sneezing is a reflex action. Nerve impulses from the nose pass to the brain. Other nerve fibers then carry impulses out to head and chest muscles causing them to contract.

One might expect that axons running from the spinal cord to the brain would have their cell bodies in the cord; and that fibers which pass impulses in the reverse direction should have their cell bodies located somewhere in the brain. This is precisely what is found.

Sensory impulses which reach the spinal cord from the outside stimulate other nerve cells in the gray matter. They are then passed along to the brain over the axons of the appropriate sensory tracts.

Similarly, motor impulses from the brain cells go down one of the motor tracts and stimulate motor-nerve cells in the spinal gray matter. The messages are then carried out into the body in motor axons. Therefore, every impulse running from the brain to some body tissue, or vice versa, has to pass through at least two neurons. Usually, three or even more nerve cells are included in the chain.

In contrast to the relatively simple structure of the spinal cord, the brain is a vastly complex organ. It is made up of a huge number of cells which are all interconnected by axons. As in the cord, the cells and their axons are grouped in regions of gray and white matter. Here the gray is outside.

The brain has often been compared to a gigantic telephone switchboard in which hundreds of incoming messages are received, sorted and sent out again. For the brains of some lower animals, this is a reasonably fair comparison. But in higher animals, and particularly in man, the brain is much more than a switchboard. Incoming impulses are not merely sorted and relayed out again. Some are, of course, but large numbers of them are treated in quite a different way. If this were not true, man's behavior would be based entirely on reflexes. There could then be no such things as memory or thought.

The special treatment which impulses receive in the higher brain centers is generally spoken of as an association, or integration, of impulses. In simplest terms, this means that different kinds of messages from several regions of the body may be brought together in the brain. There, they are weighed and balanced, so to speak, one against the other. When this has been done, the various impulses are combined. The individual then becomes conscious of a single impression. Several original stimuli are recognized together, as a unit, rather than as a series of separate things.

It is as though a number of telephone operators were to take down several telephone messages on the same general subject coming from various cities. If they then talked over what they had learned, combined it all into a single report and sent it

along to its destination, they would be doing what the brain centers do with incoming impulses.

As a further illustration, consider what happens when you pick up an orange. Immediately, you recognize it as an orange. That is the fact which your brain tells you. But think of all the different messages which must have reached the brain. Impulses from the eyes give information about the size, shape and color of the orange. Impulses from the finger tell the brain that the orange skin is smooth and slightly oily. The orange doesn't feel heavy, like a stone; it is much lighter. Nor is it firm, like an apple, for it can be pushed in with a finger tip. It has a particular odor which is quite different from that of other fruits. Tap it with your finger and it doesn't sound hollow like a melon. It sounds solid.

That kettle really is hot. The little girl pulls her finger away without thinking (reflex action), but the sensation of pain travels all the way to the brain.

You are hardly aware of all these separate things in handling an orange. Yet each of them has excited a certain type of nerve and sent a special impulse to the brain. Each of the impulses is then compared with memories of other oranges, and, finally, the brain associates them all automatically. You are only aware of the final result. You recognize at once that the object you are handling—which you see, smell and touch—is an orange.

Where in the brain do these many activities take place? Is it possible to point to special areas and say here is where temperature impulses from the finger are received, and here is the region where they are associated with touch impulses? With what part is vision associated? How about the outgoing motor impulses which cause muscle contractions—do they also arise in special regions? The answer to all these questions is: yes.

The story of how men have discovered the location of these areas of the brain is one of the most interesting in the history of science. A little over a century ago, many people believed that it was possible to judge a man from the shape and position of bumps on the bones of his head. It was thought that the bony bumps indicated similar bumps on the brain surface. And so people wasted money to be told that their "wisdom bump" or their bump for manual skill was particularly large.

Such ideas are now known to be worthless. But the idea that special functions are connected with special regions within the brain has survived and grown. Many men have devoted their lives to studying the brain and, as a result, the function of dozens of different parts is known.

As we study some of these functions, it is necessary to describe a few of the parts. Essentially the brain has three main regions: the brain stem (including the medulla oblongata), the cerebrum and the cerebellum. The midbrain is part of the brain stem.

The brain stem connects the spinal cord with the other parts of the brain. It is the most primitive area of the brain. The brains of some fishes are little more than simplified brain stems. Since this is true, it is not

surprising that most of our instinctive and automatic activities are controlled by the brain stem. All types of sensory impulses stop in this primitive region before going on to higher brain centers. As a result, they are able to stimulate the many different kinds of motor neurons which are also present in the brain stem. And in this way, simple nervous reflexes are brought about, such as sneezing.

A newborn baby sucks its bottle even though it knows nothing about food. It blinks its eyes when a bright light shines in them and it is startled by a loud noise. Similarly, a man's heart beats faster when he runs; and his rhythmic breathing requires no thought. These and many other actions are automatic reflexes. They are performed unconsciously. Some of the nerve impulses which control them pass in and out over the cranial nerves. Other impulses follow the path of the spinal nerves. Still others, as we shall see, run in the visceral nervous system. But the brain stem serves as a "clearing house" for all of them.

The cerebellum has developed on top of the brain stem, and has slowly increased in size and importance. It is the organ for the regulation of balance and skilled movement. Animals which have a small, poorly developed cerebellum are sluggish and can not move smoothly or gracefully. In contrast, an animal like the deer or the horse, whose movements are skillful, has a large cerebellum.

Balanced, co-ordinated movements really involve a great many things. Sensory impulses from skin, muscles, joints, the eyes and, most important, from the ears—all reach the cerebellum. They provide information about the position of the body and its many parts. This information is used by the cerebellum to control the contraction of various groups of muscles.

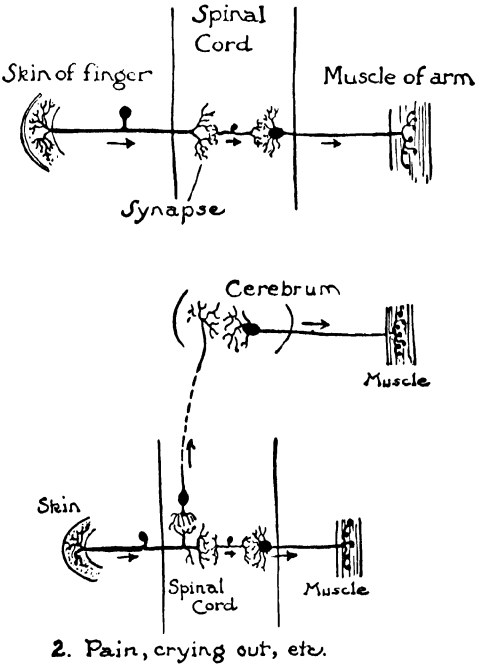
When a man trips and then saves himself from falling, it is the cerebellum which directs the contraction of the proper muscles. This co-ordination of muscular movement may be relatively coarse, or it may be exceedingly delicate. For instance, kicking a football does not require nearly such precise control as threading a needle.

The functions of the cerebellum, like those of the brain stem, are automatic. Although they regulate bodily movements, we are never conscious of it. Conscious awareness of the position of the body depends on the third main region of the brain, the cerebrum, which is much the largest of all.

In lower animals, all activities of the body are under the control of the brain stem. Passing from lower to higher backboned animals, one finds the main "central office" shifting gradually up the brain stem toward the cerebrum. In man and other mammals, the cerebrum becomes greatly enlarged and dominates all the actions of the other parts of the nervous system. Since it was the last to develop, the cerebrum is often referred to as the new brain, while the original reflex centers of the brain stem and cerebellum are called the old brain.

In man, the cerebrum is by far the largest part of the brain. It is composed of two lobes, or hemispheres, each about the size of half a large grapefruit. Both of these cerebral hemispheres have an irregularly folded surface. The folds are a little like those on the surface of a walnut, but soft, of course.

The number of folds is greater in man than in many lower mammals. They also vary from one human brain to the next. But a great abundance of these folds is not, as one often hears, a sure sign of superior intelligence. The cerebrum of a horse is much more richly folded than that of a man. The brains of many outstanding men have been examined to determine the pattern of their cerebral folds. It is true



In a simple reflex (1), impulses are transferred from sensory to motor nerves in the cord. Pain impulses (2) go all the way to the cerebrum for recognition.

that in some cases unusually abundant foldings have been found. But in many other instances, the patterns were quite ordinary.

The cerebrum contains both white and gray matter. In contrast to the spinal cord, however, the gray matter now makes up the outer layer of each hemisphere. This outer mantle of nerve cell bodies is known as the cerebral cortex. Although the cortex is a very thin layer, rarely more than a sixth of an inch in depth, it is probably the most important single part of the brain.

The cerebral white matter lies beneath the gray cortex and consists of millions of nerve axons. These axons, of course, are related to the cell bodies in the cortex. They interconnect the cell bodies, both with each other and with various areas of the old brain and spinal cord.

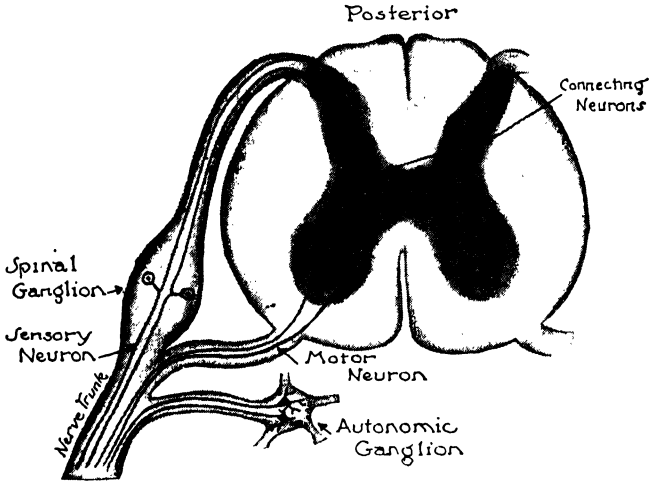
It has been estimated that the cortex contains about 920,000,000,000 nerve cells. Connections between them and other areas form a network which is so complex that it staggers the imagination. Actually, the number of possible combinations of connections far surpasses any figure ever given by astronomers in measuring the distance to even the most remote stars. For practical purposes, the number approaches infinity. Thus, it is hardly surprising that we are only beginning to understand how the cortex works.

In studying the spinal cord, we learned that its white matter is made up of a number of tracts, both sensory and motor. We have also seen that many of the sensory nerve-bundles "stop over" in the old brain. Nearly all sensory impulses, however, go on into the cerebrum. In order to do this, they must be relayed over at least two more sensory tracts.

Similarly, most motor impulses start in the cerebrum and are conducted down into the spinal cord. Some of them travel without interruption. Others are transferred to new nerve-bundles in the old brain and then are continued. By means of these sensory and motor tracts, the cerebrum co-ordinates the activities of the old brain and, hence, of the entire body.

Now the important point is this. Each sensory tract ends in the cerebrum in a specific region. And each motor tract which leaves the cerebrum arises from a specific area. In other words, pain impulses enter at one point, touch impulses at another; and motor impulses to muscles moving the eyelids have a different origin from those to the shoulder.

Thus, there is a large motor area of the cortex and, next to it, a large sensory area. If you place the palm of your hand over one ear with the fingers toward the top of the head, you cover these areas. Your fingers cover cells connected with the feet and legs. Your palm covers the region which controls movement in the head and arms. In fact, all parts of the body are represented in the sensory and motor areas.



A closer view of the spinal cord shown on page 3061.

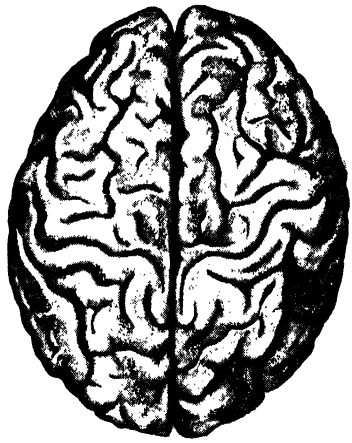
Each half of the body is controlled by the cerebral hemisphere of the opposite side. If your hand is placed over the left ear, it covers the areas which regulate the right side of your body.

Actually, this is only the beginning of what is known about the different areas of the cortex. Let us assume that pain impulses from a finger have just reached their special cortical area. Here they would cause at least two things to happen. First, they bring about a conscious recognition of pain in the finger. They do this by calling forth a great variety of nervous events about which we still know very little. Second, the pain impulses excite other nerve centers which are concerned with memory or the recollection of past experiences. Together, these two results now determine which cells in the motor area shall be stimulated and, thus, what reactions will take place in the

body in response to the stimulus of pain.

Besides the main motor and sensory areas, there are other parts of the cortex which have special connections. Some of them are very important. Light impulses from the eyes, sound impulses from the ears and impulses from the nose started by odors, each go to their own special area. Accordingly, in these respective regions, we experience sight, sounds and smells.

There are also associating connections between these three areas. Otherwise, how could seeing a picture of a tempting roast make you remember how good such a dish smells? Or why, on hearing the song of a bird, should you recall what a bird looks like?



The cerebrum as seen from above, with the front at the top of the drawing.

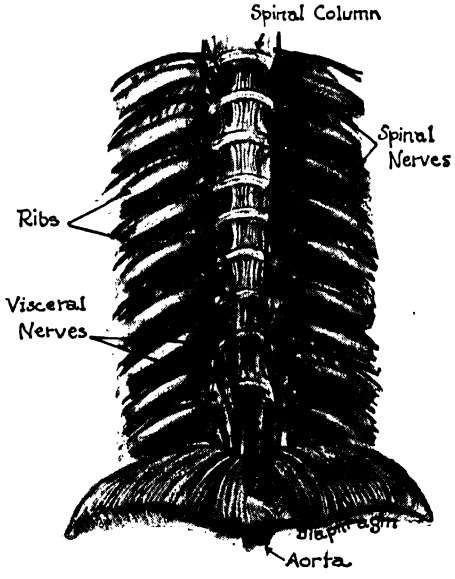
On the motor side, there are also certain areas for doing special things. One of the best known of these is the so-called speech center. Here are associated all the movements of the mouth, tongue and voice-box, which are concerned with speaking. A right-handed person uses the speech center on the left side of his brain. Normally, the center on the right lies undeveloped and unused throughout life. But if the center which is in use is destroyed, the unused area may start working. Speech will then be very slowly restored. In a case like this, the person must learn to talk again.

At the beginning of the chapter we said that the nervous system consists of two main parts. So far, we have been examining the first of these, the somatic nervous system. We have seen something of how it controls the reactions of the body to its surroundings. Let us now turn to the visceral nervous system and learn how some of the internal activities of the body are regulated.

Some internal organs can function quite apart from any nervous control. The muscle of the heart has its rhythmic beat which may continue after its nerves are cut away. Muscles of the digestive tract are able to contract automatically. Glands may be caused to secrete by chemical substances dissolved in the blood. But the visceral nervous system co-operates in the control of all these organs.

The visceral nervous system is made up of many separate groups of nerve cells. These cell clusters, or ganglia, are scattered through the tissues of the body. There is an especially important row of them along each side of the backbone. Nerve fibers connect the ganglia with one another and with the brain and spinal cord. This intricate network spreads out and reaches every part of the body, from the hair follicles in the skin down to the deepest organs.

The visceral nerves always have one of two possible kinds of action. Remember, for instance, that excitement makes the heart beat faster, while rest causes it to slow down. Also, anger may slow or stop the muscular contractions of the stomach, causing indigestion, while the pleasures of good food and a quiet, peaceful atmosphere actually help the stomach to do its work.



Important connections between the two nervous systems lie on either side of the spine.

In each of these cases, one action is brought about by one type of visceral nerve, the other by a visceral nerve with an opposite function.

In other words, all our internal organs are regulated by a balance between two different sorts of nerve impulses. Whenever the impulses are correctly balanced, our inner life goes on smoothly; so smoothly, in fact, that

we are unaware of it. But let something disturb the balance ever so slightly, and the functioning of several organs will be upset.

The visceral nervous system is closely knit with the somatic system. One rarely works independently of the other. Much of the control over visceral activity occurs in the brain stem. But, of course, the cerebral cortex reigns over all the actions of the brain stem. This explains why even thoughts of a delicious meal may cause the mouth to water. The nerves have acted on the salivary glands.

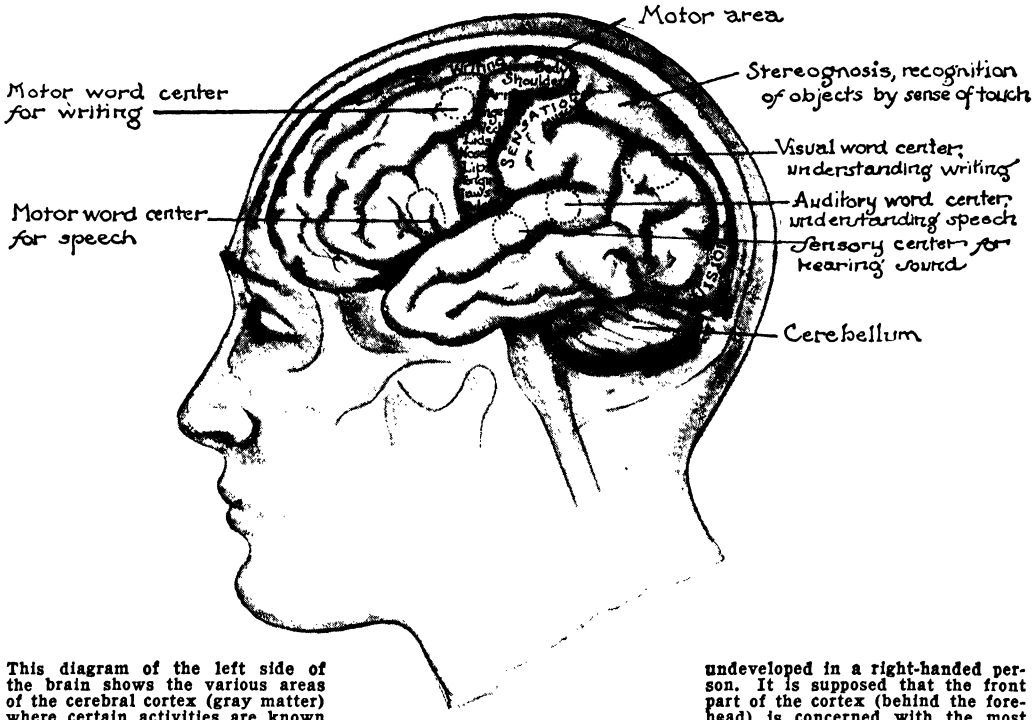
Nearly all animals have a nervous system of some sort. But what a vast difference there is between them! A butterfly, a frog, a horse, a great musician—all of them have nervous systems. Each is able to sense changes in the surrounding world and to react to them. The relations of a butterfly with its surroundings, however, are relatively few and simple. A frog that sits content for hours by the side of its pond can do more things than a butterfly, but it is utterly unable to appreciate the beauty of pond lilies. The fact that two and two make four means nothing to a horse and certainly a horse gets only the simplest satisfaction, if any, from music performed by a skilled musician.

What is the main difference between these creatures? It is the varying complexity of their nervous systems. In the simplest animals, the nervous system can be excited by only a few external events; and the ways in which these animals can react are also strictly limited. A moth instinctively flies toward a flame. It is unable to recognize the danger or to do anything about it.

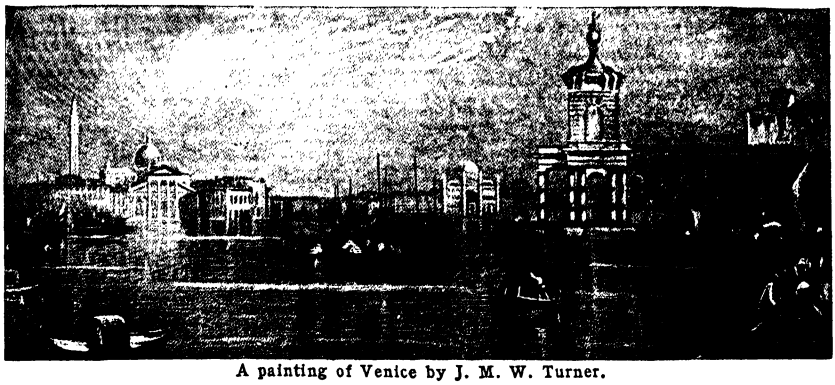
In higher animals, and in man, the number of possible sensations and reactions is increased. The human brain can sense and appreciate and understand a large proportion of the external world; and it can set off a wide variety of reactions to changes in that world. In fact, this ability of the human nervous system to deal more efficiently with all that lies around it than any other nervous system, has given man such control as he has on the face of the earth.

By Mac V. Edds, Jr.

THE NEXT STORY OF OUR OWN LIFE IS ON PAGE 3255.



This diagram of the left side of the brain shows the various areas of the cerebral cortex (gray matter) where certain activities are known to take place. The right side of the brain has the same areas, except that the speech center there is usually undeveloped in a right-handed person. It is supposed that the front part of the cortex (behind the forehead) is concerned with the most complicated kind of thinking—reasoning, judgment. The hearing sensory center is not far from the ear.



A painting of Venice by J. M. W. Turner.

THE WAY WE HAVE COME

A SUMMARY OF EUROPEAN PAINTING

THE story of European painting is one of the stories of human effort and aspiration, a story of long striving to find a better way of expression. Suppose that you have carefully set up a house of cards and find it very pleasing, when along comes a little brother and, with a sweep of his hand, topples it over, shouting: "No! this way!" Then you must watch him set it up again in a way he thinks better than yours. A procession of such rebuildings on new lines has resulted in painting as we know it to-day.

Always men have tried to get free from the limitations that they felt were shutting in art, the "musts" and "must nots" of established forms; and always when they have thrown down the walls of one method of teaching or convention they have set to work to build up new walls of some different method or convention.

First in Italy, think of the city of Florence in the Renaissance, when old Byzantine modes gave way to fresh expression in the minds of Giotto, Fra Angelico, Masaccio, Botticelli, Ghirlandaio and the commanding genius Leonardo da Vinci. But remember that Michelangelo, following close upon these, could not bear any tradition in art, and by the might of his personality founded a new school of his own, creating, as has been said, a race of giants for his use—so full of wonder was he in his study of the human form. Those who tried to copy him, however, could not handle giant forms successfully, because they were not themselves giants in genius.

Think of Venice with the Bellinis, Giorgione, Titian, Tintoretto and Paolo Veronese—the sumptuous lines and colors on their canvases. Think of Raphael, who started in the Umbrian school, gathered up all that was most fascinating in earlier Italian genius, and touched whatever he took with something rare that belonged to himself alone, giving the world a treasure "personal and new." Yet remember how Caravaggio revolted against the idealism and academicism of Raphael's followers, preaching "naturalism" in his own pictures, where street types and violent episodes were presented, instead of festive scenes or figures of saints and angels. And although Caravaggio's method, his tradition, found many admirers and followers through the centuries, it has, very near our day, become the object of attack by the plein-air painters,

who show that his black, heavy shadows are not true to nature outside of walls, but were painted within the limits of a studio.

Influences and reactions between one school and another, between one country and another, crossed and recrossed as the fabric of art grew broader and longer. France and the Netherlands early caught up gleaming threads from Italy; but where "Italian art dreamed of beauty," "Flemish art was in love with truth." And Italy herself learned from the Flemings new processes that added to the beauty and splendor of painting in oils. Among the early Flemings remember the Van Eycks, Hubert and Jan, than whom no greater portraitist has ever lived; remember Roger van der Weyden and Memling—all of them living before America had been found.

The Lute Player, by Caravaggio.

Jan van Eyck, you may recall, made visits to Spain, where the greatest painter in all the world—from the point of technique—was to appear about two centuries later—Velasquez. Spain, in the persons of El Greco, Ribera and Zurbaran, had shown the touch of Italian influence—especially the realism of Caravaggio—before Velasquez awoke to his own strong interesting genius through the study of Titian and other Venetians. Murillo followed, then Goya with his power of realism mingled with dramatic feeling. Spanish painting, from Ribera to Zuloaga, is essentially and unmistakably Spanish, whatever influences may have gone into its development through the changing years.

A Spanish Flower-girl, by Murillo.

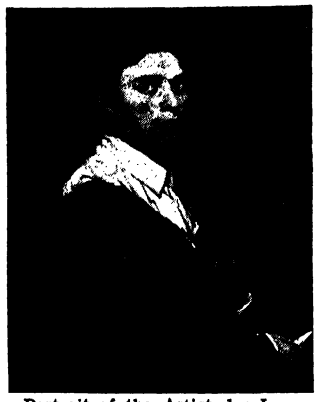
And in the Netherlands we find strong racial characteristics always leading. Nature, whether in portrait or in landscape, is presented truly and simply with an air of at-homeness. Recall the portraits of Frans Hals and of Rembrandt, who, like Velasquez, "created a light all his own." Think of the landscapes of Van Ruisdael and Hobbema; the animal pictures of Cuyp, than whom none ever made better ones, and of Paul Potter; the genre pictures of Pieter der Hooch, Terborch and rare Vermeer, whose few "luminous masterpieces are among the most beautiful works in the world." And Flanders of the seventeenth century offers great names—Rubens, the astonishingly rapid painter of big canvases; Van Dyck, whose many aristocratic portraits of kings and their court circles are an index of his own delicate feelings; Teniers, a great portrayer of peasants.

German painting, early touched with Flemish influence, reached its highest plane in the sixteenth century in the superb performance of Dürer and Holbein—Dürer, like Leonardo da Vinci and Michelangelo, deep thinker as well as artist; and Holbein, the only German painter that shows a leaning toward idealism. The spirit of German art expression may be summed up as controlled by "a combination of the wild and rugged with the homely and tender, by meditative depth, enigmatic gloom, sincerity and energy, by iron diligence and discipline."

In France art consciousness has had peculiarly lively play. There violent changes have taken place, and sharp contests between rival parties have added excitement. There dictators of taste have ruled like kings, and there rebellious spirits have broken down the walls of custom to make way for startling new ideas.

After noting the first efforts at independent French painting we come soon to the Academy, the dictatorship of Le Brun, and the grand style of painting in Louis XIV's reign; Poussin, who was devoted to antique story, and Claude Lorrain, whose landscapes glow with poetic floods of light of a kind that nature never produced. With the eighteenth century came a swing to the gayer, more frivolous pictures of the gallant school—the delicate, radiant work of Watteau and Fragonard, and the more insipid prettiness

of Boucher, which was followed by a violent return to classic severity of style; a sort of frenzy of devotion to things Greek and Roman, led by David, whose sway was unquestioned for the time. So the nineteenth century opened—a period of war and change. With Gros romanticism came forward, to be advanced still further by Géricault and Delacroix, in spite of the fierce protests of Ingres. Pictures telling stories from history or literature or calling gently upon the emotions became the most admired types.



Portrait of the Artist, by Jean Ingres.

Then, a few quiet landscapes by the English painters Constable and Bonington exhibited in France, opened certain eyes to a new vision of nature, and the Barbizon artists, willing to be called "heretics," went forth into the field and the forest to make natural studies, minus Italian towers and fountains and statues—just grass and trees and rocks and sky. There were Rousseau, Daubigny, Dupré, Diaz, Troyon—whose cattle fitted poetically into the scenes he painted; and Corot, a little apart from the rest, "a lyric master of exquisite refinement." With these we place Millet, through whose faithful brush the French peasant became a figure of sincere appeal and charm.

Realism and naturalism, gaining momentum, swept to the very front of art life with Courbet and Manet in the middle of the nineteenth century. Painters of the grand style, classicists and romanticists had all painted different subjects in much the same way. Now came groups that were concerned chiefly with new ways of painting—ways that would convey the feeling of various aspects of light or reproduce an artist's impressions of nature. The technique of Delacroix had shown a boldness leaning toward impressionism, and Corot's later style turned toward the same end. By the opening of the twentieth century impressionism and plein-airism were felt in the work of almost every painter—"light, the principal person in a picture" having become an accepted idea. Not only Monet, Pissaro, Cézanne, Degas, Renoir, but the more idyllic painters, Bastien-Lepage, Lhermitte and Puvis de Chavannes, set themselves to portray this difficult "principal person." Whether details are carefully preserved or passed over as hampering the general effect, whether the picture is painted in the open or under the roof of a studio, light is the most absorbing and alluring factor in the modern painter's problem. And France still leads in the quest for a perfect solution of the problem, the search for the best technique.

After an era of imported painters, of whom Van Dyck did most toward founding a British school, England in the eighteenth century awoke to an art of her own when the independent mind of

The Water Gate, by Charles François Daubigny.

Boats on the River Oise, by Charles François Daubigny.

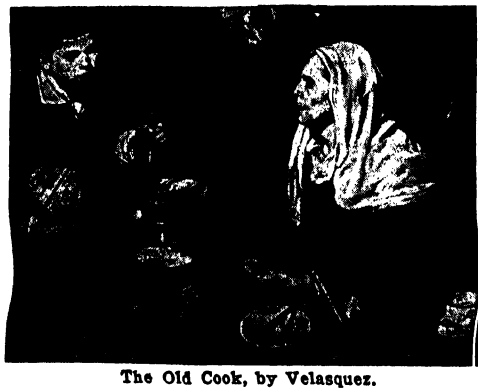
Hogarth found expression through a brush that recorded with vigor and originality the life of society as he saw it. His moral-teaching, story-telling pictures and his portraits were the first in that line of admirable paintings that British art can claim. Living at home for the most part, finding at home the subjects they best loved to spend their care upon, Reynolds, Gainsborough, Hoppner, Romney, Raeburn, Lawrence and the other portraitists, each in his own distinctive way, present to us British men and women and children; and British landscape has found devoted portrayers in Gainsborough, Crome, Constable — the earliest of the modern out-of-door landscapists — and in a host of others. Apart from the rest, Turner, the worshiper of light, surpassed all in expressing the romance of light in color.

Photo, courtesy Metropolitan Museum of Art.
The Calmady Children, by Lawrence.

In the middle of the nineteenth century, when painting had reached a state of stiffness and formality and was becoming meaningless, the Pre-Raphaelites made a zealous stand to halt the downward march. Rossetti, Millais and Hunt, with their sympathetic contemporaries Burne-Jones and Watts, served to make men think, whether in admiration and support or in condemnation of their ideas of beauty and worth.

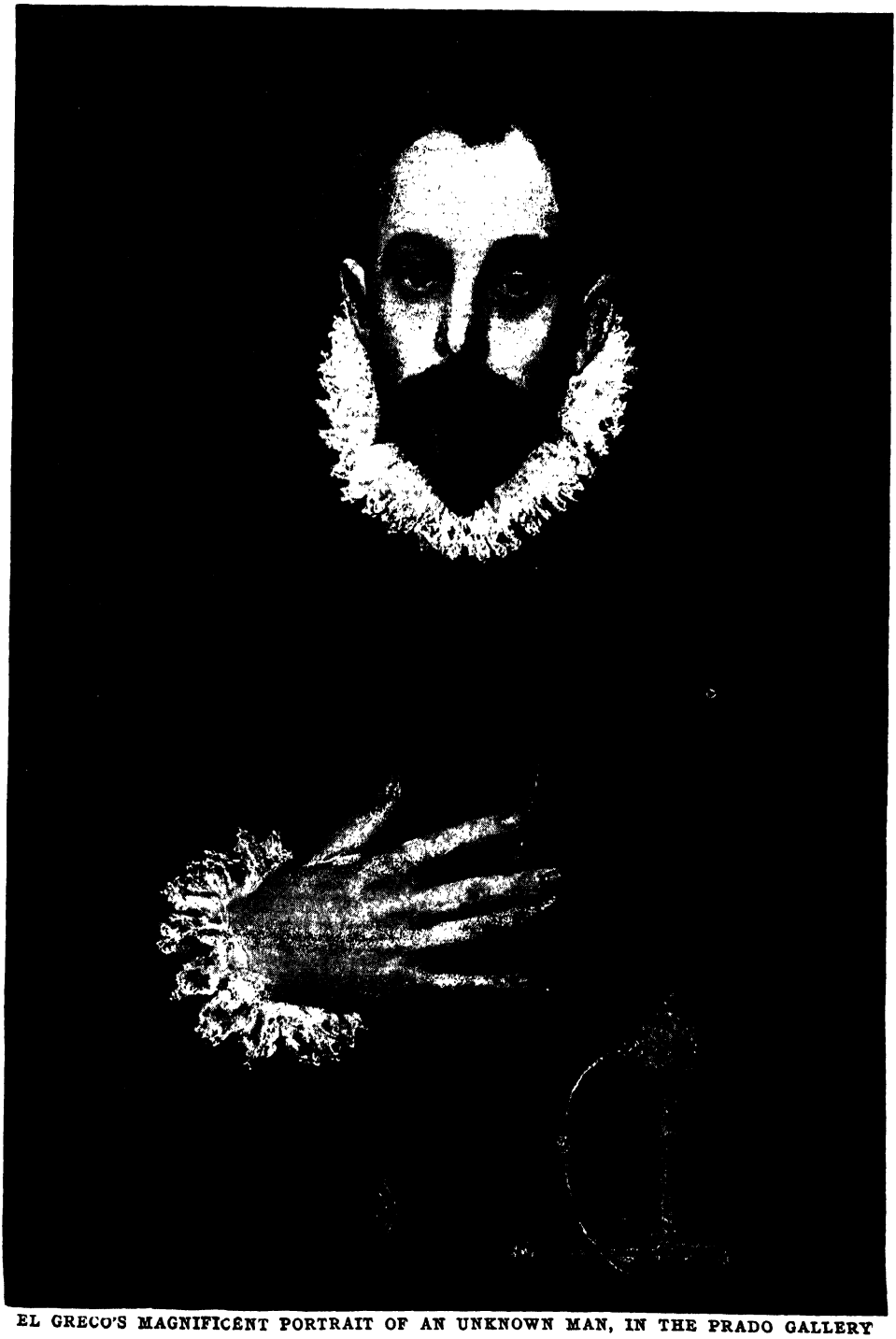
Artists of our own day are almost all eclectics; that is, they select from among the various modes and methods of technique those things which fit into their own experience and tendencies, and if they are true artists with something to give the world, that something which is part of themselves goes into their work. Those who will live on and add new chapters to the story of arts are, like all those who have become immortal in the past, giving their own expression to a spirit that is universal, that can be "understood as long as humanity lives." No matter in what age he is born, no matter what language he may speak, the true artist belongs to all time and can be understood by men of widely differing tongues. The great master is always "modern," always simple and sincere. In great art all parts of the earth and all ages come together.

THE NEXT STORY OF THE FINE ARTS IS ON PAGE 3325.



The Old Cook, by Velasquez.

The Artist's Servants, by Hogarth.



EL GRECO'S MAGNIFICENT PORTRAIT OF AN UNKNOWN MAN, IN THE PRADO GALLERY

DONNA ISABELLA, BY GOYA

A PORTRAIT OF A MAN, BY HOLBEIN

MARIA DE MEDICI, BY A. BRONZINO

THE COOK, BY JOHANNES VERMEER

The Pearl Necklace, by Vermeer of Delft, who created exquisite beauty from scenes of ordinary daily life.

Strength and vitality sparkle from the canvas of this Portrait of a Man and His Wife, by Frans Hals.

Homer's ILIAD

ONCE upon a time, so we are told, the gods and goddesses of ancient Greece were making merry at the wedding feast of Thetis, a sea-goddess. Suddenly there appeared in the room one who had not been invited, Eris, goddess of discord. Just for spite, she threw into the midst of the guests a gleaming apple of gold, inscribed with the words "For the most beautiful."

There was a hush, for a moment, then three tall and lovely divinities stepped forward to claim the prize—Hera, queen of Olympus, wife of Zeus, the king of gods and men; Aphrodite, goddess of love and beauty, who was not born as others are, but rose from a drift of sea foam; and Athene, goddess of wisdom, who sprang full-grown, dressed in bright armor, from the forehead of Zeus. Each thought herself the most beautiful and claimed the apple of gold.

When they besought the gods to choose among them, not one, not even Zeus himself, dared to award the prize and face the anger of the two other ladies.

Since the immortals would not decide the question, the goddesses turned for help to mortal men. Now there was at this time in northern Asia Minor, near the strait we know as the Dardanelles, a prosperous and happy little kingdom of Ilias (or Troy). Priam was its king. He had sons and daughters whom he loved, but, in fact, he loved as though they were his own children all his subjects. His capital city, Ilias (or Troy), was fair to look upon and serene. Round it were stout walls sixteen feet wide, with watchtowers here and there for extra security should an enemy try to approach.

The Trojans, as the people of the kingdom were called, were akin to the Greeks who lived on the islands in the sea to the west, and to those who lived on the mainland on the other side of the sea—the Spartans, Boeotians and others.

To Ilias, then, came the three goddesses; and they laid the case before a young son of Priam, Paris, whom they found tending his father's sheep in the pasture.

Paris could not decide which goddess was most beautiful; and now, so eager had each of these three become to win the apple, and the title, that they offered bribes to the judge. Hera, the queen, offered power to the kingly youth if he would give her the award. Athene promised fame in war. Aphrodite promised him a wife of surpassing beauty; and to Aphrodite, Paris handed the apple of gold. Athene and Hera became bitter enemies of Paris, and that moment was the beginning of the end of Troy.

Not long after this Paris was sent on a visit to the court of Menelaus, king of Sparta. There he fell in love with divinely beautiful Helen, the wife of Menelaus; and through the power of Aphrodite, Helen left her home and fled with Paris to Troy. Menelaus, in grief and anger, appealed to the other Grecian kings to make war against the Trojans, and force Helen to return home.

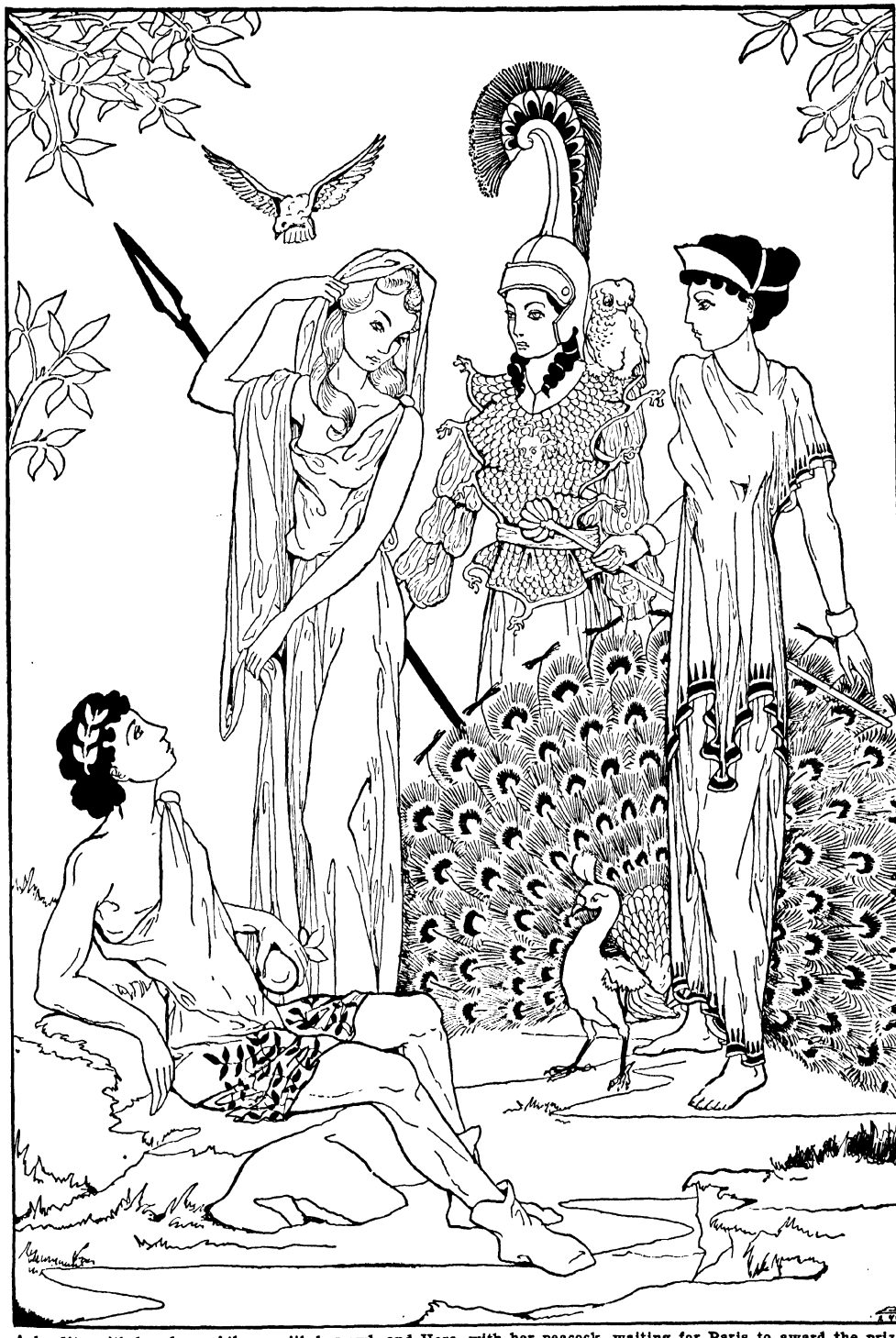
Several of the kings agreed, inspired by dreams of glory or riches to be won, or because Menelaus was an ally, or a relative, or because the gods willed it. The gods, you know, loved to watch a good fight between mortals, and often descended from Olympus to take part in a battle if things were not going to suit them.

It was a good two years later when the expedition set sail, for ships had to be built, and armed fighting men had to be conscripted and fitted out, gods had to be consulted, through oracles and wise men, and, finally, the various forces had to be brought together and put under a supreme command. Agamemnon was chosen for this post. He was king of Mycenae, brother of Menelaus, and a great soldier; and he brought most ships and most men to the expedition. Besides these two kings the Greeks had other leaders of renown—brave, fleet-footed Achilles; wise and shrewd Odysseus (sometimes called "the crafty one"); Ajax, strong as a giant; Diomedes, king of Aetolia; Nestor of Pylos, old, experienced and wise. Some say there were 100,000 in the Greek army!

The Trojans, too, gathered their friends together, so that when the warships of the Greeks had sailed across the Aegean and anchored near the beach below the walls of Troy, one mighty host was pitched against another.

For nine years the fighting went on, and still the Greeks could not storm the walls of Troy. The Trojans, inside the walls,

A BEAUTY CONTEST THAT STARTED A WAR



Aphrodite with her dove, Athene with her owl, and Hera with her peacock, waiting for Paris to award the prize.

would send out battling forces from time to time, but neither side could claim the victory; and it began to look as if the war would never be ended.

In the tenth year, the war did come to an end, in a way that you shall soon hear.

* * * *

How do we know this story? Is there any truth at all underneath all the fairy-tale talk of golden apples? Let us answer the second question first—yes, there is probably some truth in this romantic tale. As you will read in the article Digging Up the Past, the remains of the old city of Troy have been found in modern times. Some of its sixteen-foot walls are still standing, and some of the watchtowers, though the drifting soil of centuries had buried the ruins. Historians believe that a great war with the Greeks did take place at this spot, between 1200 and 1150 B.C.

The details that we have—truth and fairy tale mingled in a wonderful romance—we owe to a poor blind poet, Homer, who composed two epics about the Trojan War—the ILIAD and the ODYSSEY—around 850 B.C.

You know what an epic is—a grand tale of heroes and mighty deeds, not written as a work of imagination, but rather as a collection of popular songs and stories put together at last in good order, and in grand, dignified language. Most epics are in poetry. Homer's ILIAD and ODYSSEY are in stately hexameter (six-foot) verse which Longfellow copied in Evangeline:

> This is the forest primeval, the murmuring pines and the hemlocks.

Some people will tell you that there never was a poet named Homer, that the ILIAD and the ODYSSEY are just collections of "bits and pieces" written by many different men. Certainly the ILIAD and the ODYSSEY are not closely alike in style; yet the same comment can be made about two works by many a writer we know. Little or nothing is actually known about Homer. Some hundreds of years after the epics were written, at least six Greek cities were claiming him as son. Most people accept the fact nowadays that he was a poor blind minstrel who wandered from place to place singing his poetic stories in return for food and lodging. The events in the stories were well known to the people of the time, but Homer retold them, using his own words, and stringing the old tales (for they were 300 years old in his day) together into two long, connected narratives. You could do a similar thing if you set out to write an epic about Superman, using "events" already published. Suppose each one in your class wrote a Superman "epic," starting from the same source material, but adding, subtracting and changing as you went along. The finished epics would all be different, though each would owe a debt to the original stories. (Of course nowadays, with our copyright laws, we may not do such a thing.)

In a later chapter we shall tell the story of the ODYSSEY. Let us now give a brief outline of events traced in the ILIAD.

There are twenty-four divisions, or books; chapters we might call them.

Keep this picture in your mind. The Trojans are behind the walls of their city. The Greeks have built a walled camp on the shore, beneath the walls of Troy. The boats of the Greeks are drawn up on the shore, or anchored near by. Between the city and the camp of the Greeks is a sort of no man's land where most of the fighting is done.

Almost ten years have gone by since the war began. Now there is turmoil within the Greek camp, for Achilles and Agamemnon have quarreled, and Achilles has withdrawn his men from the army. He himself is sulking in his tent.

Achilles' mother is that Thetis whose wedding party started the trouble many years ago. Thetis can not bear to see her son unhappy, so she begs Zeus to punish Agamemnon. Zeus sends a messenger to Hector, bravest of the Trojans, promising him great victories over the Greeks. Made bold by this, the Trojans come forth from the walls of the city.

As Hector and Paris approach the Greek warriors, they see the fair-haired Menelaus leading his soldiers across the plains. Hector scolds Paris for causing this great war by stealing Helen from Menelaus; and Paris offers to decide the outcome by fighting Menelaus in single combat. Hector commands his army to halt and the heralds call forth the challenge. It is agreed that the victory will be given to the army whose champion is victorious.

Then the two armies stand and watch as Menelaus and Paris meet in deadly combat. Paris throws his long, sharp-pointed spear, but the lordly Menelaus catches it upon his shield and turns it aside. The Spartan hurls his spear with mighty force. Through the shield of the proud Paris it passes and through the armor of his corselet, but Paris dodges and is not harmed. Then the fair-haired Menelaus rushes at Paris and smites him upon the helmet, breaking a goodly

sword. Enraged, he seizes the helmet of the Trojan prince and drags him to the ground. But Aphrodite covers her favorite, Paris, with a dark cloud and carries him to his palace within the city walls.

Thus the war would have ended had not the gods decided otherwise. Hera, furious with Zeus for saving Troy from ruin, scolds her husband until he yields and permits the war to continue. The Trojans are aided by Apollo, the archer, and by Ares, the god of war. Bravely though the Greeks fight, the Trojans drive them back toward their ships. Being sorely in need of the might of Achilles and his men, King Agamemnon sends peace offers to Achilles, and the promise of many gifts. All these offers Achilles refuses. He remains in his tent.

Aided by Zeus, the Trojans continue victorious. Agamemnon, Odysseus, and Diomedes are wounded and the Greeks are driven back to their ramparts, and the Trojans follow. Now the fighting is among the very ships. At this point Patroclus, Achilles' dearest friend, begs Achilles to lead his men against the enemy. This Achilles refuses to do, but he does allow Patroclus to borrow his armor. Dressed in Achilles' armor, Patroclus leads Achilles' warriors into the fight, rallies the Greek forces and drives the Trojans all the way back to the walls of their city.

Before the walls of Troy, Hector fights with Patroclus and kills him. Hector strips from him the glorious armor of Achilles and leaves Patroclus lying in the dirt. The Greek warriors come out to claim the body of their fallen comrade, and fierce fighting rages.

When Achilles learns of the death of his beloved friend, great are his grief and rage. Without armor he goes forth and helps to bring the body of Patroclus into the camp. Thetis, Achilles' mother, asks Hephaestus, the blacksmith of the gods, to make new armor for Achilles. The god labors mightily at his forge and creates a great shield of five thicknesses of metal, richly ornamented with gold and silver. He makes a corselet, brighter than a flame, and a helmet crested in gold, and greaves of tin with silver ankle-pieces.

When Thetis brings his new armor, Achilles puts it on, makes peace with Agamemnon and prepares to lead the Greek warriors into battle. Now that Achilles has been honored by Agamemnon, Zeus withdraws his protection from Troy and permits the gods to side as they wish. (Thus in this war gods fought as well as men. Ares, the god of war; Apollo, the archer; Aphrodite, the laughter-loving; and Artemis, the archer-goddess, fought with the Trojans. Hera, the queen of heaven; Athene, the wise; Poseidon, the sea-god; Hermes, the messenger; and Hephaestus, the smith, aided the Greeks.)

Menelaus seizes Paris by the helmet. Paris was not a good fighter, but the goddess Aphrodite protected him.

The Trojans, terrified by the approach of Achilles, beg Hector to retreat within the city walls; but Hector refuses to be frightened. The fierce fighting is renewed; and inspired by Achilles, the Greeks drive the Trojans back to the very gates of the city. The gates swing open so that the Trojans may slip inside. The Greeks, too, make a dash for the gates; but Apollo now puts great courage into the heart of Agenor, a goodly Trojan warrior, and Agenor comes forward to do battle with Achilles. The spear thrown by Agenor bounds harmlessly off Achilles' armor, but when Achilles would have his turn at Agenor, Apollo snatches the brave Agenor to safety and the god stands there in the warrior's place. Apollo, ever retreating, draws Achilles farther from the open gates, until most of the Trojan soldiers are safe within the city walls.

When Achilles learns that the warrior he has been pursuing is a god, he becomes angry at this god, but pursues no farther. He turns and swiftly runs back across the plain toward the gates. There stands Hector eager to do battle with the famous Achilles. In vain do old King Priam, Hector's father and his queen-mother beg him to seek safety within the walls.

But when Achilles comes near with his great spear upraised, Hector is seized with a great trembling. He turns and runs, and Achilles, fleet of foot, runs after him. Three times around the walled city they go, Achilles ever keeping between Hector and the safety of the gate. On the fourth time around, Athene appears to Achilles and tells him to rest for a while; then, taking the form of Hector's friend Deiphobus, Athene appears to Hector and offers to stand by him in the fight.

Thus encouraged, Hector turns to meet Achilles. Achilles lets fly his long spear, but Hector is on guard and avoids it. The spear passes harmlessly over him; but Athene, unknown to Hector, seizes the spear and carries it back to Achilles. Now Hector throws his spear; it strikes the center of Achilles' shield, and bounds harmlessly off. Quickly Hector turns to ask Deiphobus for a new spear; and when he sees that his friend is not at his side, he realizes that he has been deserted by the gods, and doomed.

Hector seizes his sword and Achilles raises his spear to strike again. Hector's body is covered by Achilles' old armor taken from Patroclus' body, but there is an opening at the neck. Right at that point Achilles aims. Hector falls. Achilles has avenged his friend. The fallen Hector says: "I pray you to accept ransom for my body and return it to my home that the Trojans may give me a proper burial."

Grimly Achilles answers him: "Beg me not. The killer of Patroclus shall not have a proper funeral, but he shall lie in a dishonored grave." Then Achilles strips off the armor from Hector's body, fastens the dead man to his chariot and drags him back to the camp where the body of Patroclus awaits burial.

On the walls of the city King Priam and the Queen mourn their fallen son. Hector's wife, the white-armed Andromache, hearing the wailings of the Queen, goes forth and sees the body of her glorious husband being dragged to the Greek tents. Then on the walls of Troy, Andromache mourns the fate of her beloved husband and fears for her orphaned son and for the fair city of Troy.

Within the ramparts of the Greek camp, Achilles makes ready for the funeral of Patroclus. The lord Agamemnon dispatches men and mules to fetch much wood for the funeral pyre. Many of the heroes cut locks of their long hair to lay upon the body of their comrade. Animals are sacrificed and placed upon the pyre, and Achilles in his fierceness kills twelve prisoners and sets them near his friend. All night the huge fire burns. In the morning the flames are quenched and the bones of Patroclus are placed in a golden jar.

Achilles orders games to be played in honor of Patroclus, with noble prizes—for the winner of the chariot race, a slave skilled in sewing and weaving, and a tripod holding two and twenty measures; for the winner of the boxing and wrestling bout, a six-year-old mule; and for the winner of the foot race, a beautiful silver bowl.

All Troy mourns the death of Hector, and grieves because Achilles will not yield the body so that the hero may have a proper funeral. Priam bids his servants yoke his horses to a cart filled with a goodly load of treasure. The aged King himself drives this cart through the city gates and across the plains to the encampment of the Greeks; and he approaches Achilles and begs for the body of his son in return for the kingly ransom. Achilles, moved by pity, accepts the ransom and allows the King to take the body.

* * * * *

Homer's ILIAD ends here with the funeral of Hector. From other stories we learn how the Greeks at last defeated the Trojans. After almost ten long years of fighting far

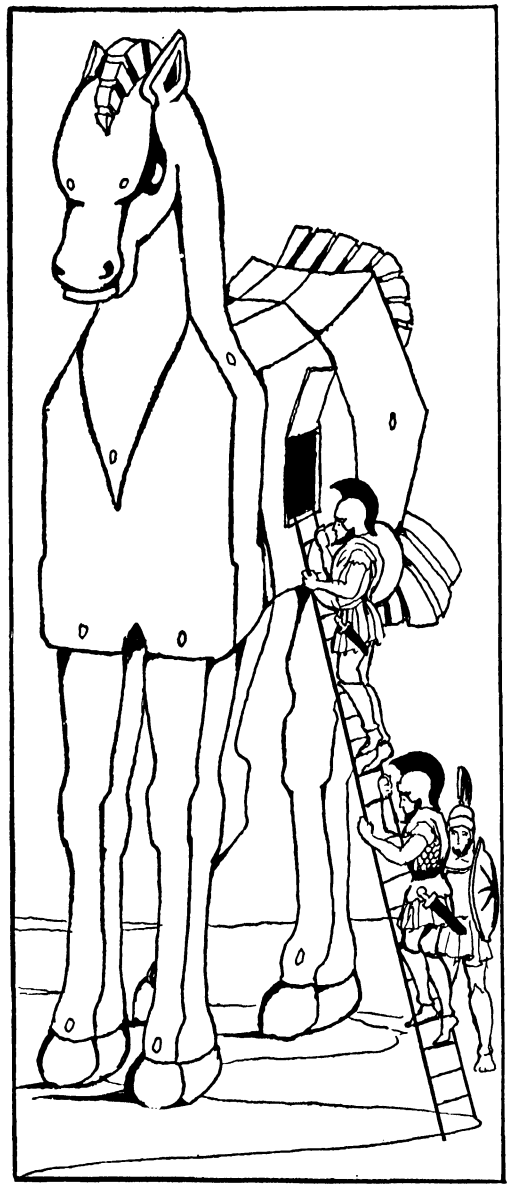
from home, many of the Greeks were ready to give up and return to their beloved land. Then Odysseus suggested a crafty plan. Following his idea, the warriors built a huge hollow wooden horse; into it crept a number of men, including Odysseus and Menelaus. All the rest of the Greeks, save one brave man, went aboard the ships and sailed away as if they had at last given up. The horse was left standing on the beach.

When the Trojans saw the Greeks burn their camp and sail away, there was much rejoicing. Their curiosity was aroused by the strange wooden horse and down to the beach they went; there they found the one Greek left behind, who said that the horse was an offering to the gods. He said that if the Trojans would take the horse within the gates they would be safe. So amid much rejoicing the Trojans dragged the wooden horse inside the city. It was too large to go in through the gates, but they tore down a section of wall to admit it.

In the dark stillness of the night, the Greek ships turned about and sailed back to the Trojan shore; and the warriors stole silently across the plains to the great walled city. Odysseus and the other men came forth from the wooden horse and opened the gates to the attackers. Then were the Greeks successful in their mission. The city of Troy was burned, its people were killed or enslaved, much treasure was seized, and Helen was returned to Menelaus.

The ILIAD and the ODYSSEY are two of the world's greatest adventure stories; but they are important also as books of reference. They tell us much about the life of Greece in those very early days—how the people lived, what they wore and what they ate. Their ways of worship, and of fighting, and of government; their ships, houses, furniture; education, sports, medicine—all these are touched upon, and in many cases thoroughly described. Long descriptions are found in all great epics. The early peoples did not have books and magazines to read; many of them never saw a king or a hero or a richly dressed noble, a fine home or a ship; and so they found pleasure in listening to the minstrels describing all these things, and they treasured in their memories every detail.

The gods of the early Greeks were beautiful men and women with supernatural powers. They never grew old. They lived on top of Olympus, a lofty mountain in northern Greece. They traveled through the heavens in chariots or on winged feet. Like



Odysseus and the other men climb out of the horse.

ordinary mortals, the immortals quarreled and bickered among themselves, were jealous, scheming, changeable, loving, kind, generous, gay, sad and even bored at times. In the ILIAD, Hera scolds her husband Zeus for wishing to save Troy; and Zeus, wearied by her arguments, allows Troy to be ruined.

We learn in the ILIAD about the Greek belief in an after-life. When a man died his spirit was thought to wander about the earth until the body received a proper funeral.

That is why Priam was so disturbed when Achilles refused to give up Hector's body. The bodies of the dead were burned upon a great pile of wood called a funeral pyre. Many of the things dearest to the dead man were burned with him so that he would not be lonely in the next world. Thus, in the description of Patroclus' funeral, we learn that Achilles placed horses, some of the dead man's favorite dogs and many of his possessions upon the pyre.

After the funeral the spirit descended into Hades, the land of the dead. Here the ordinary soul lived an aimless life of wandering; those dear to the gods went to the Elysian Fields (the Happy Fields) where they enjoyed eternal bliss. Those who had offended the gods were given horrible punishment in Tartarum.

The ILIAD tells us that Greece was divided into a great number of small kingdoms. The island of Ithaca, from which Odysseus came, is a small island, yet Odysseus was not the only king there. A ruler could not make any important plans or laws without the consent of his freemen. The ILIAD tells how Agamemnon called a meeting of all the warriors to decide whether to continue the siege of Troy or to return home. At that meeting one commoner spoke against the leaders, and his words were heard with respect.

According to Homer's descriptions, the arrangement of the king's palace yards must have been somewhat like the grouping of buildings in a medieval castle. Lesser folk lived in simple dwellings outside the castle walls. The people lived mainly by farming and stock-raising, and even kings like Odysseus plowed their own fields and were proud of their ability to make deep, straight furrows. The women also knew how to work. Helen, Andromache and Odysseus' wife, Penelope, all wove cloth to be used in garments for their families. Nausicaa, a princess, washed the family clothes, as we shall see when we read the story of the ODYSSEY.

Food was simple fare—a great deal of meat and a variety of cereal grains. Watered wine was drunk with all meals. Before the wine was drunk, a libation was poured to the gods, a form of asking a blessing. The wine and water were mixed in a goblet and a few drops poured upon the hearth, if in the house, or upon the ground, if outside. After the ceremony, the meal proceeded.

Homer also tells us a great deal about weapons. Shields were made of bullhide. Warriors used long spears with bronze tips, and bronze swords. Men knew the uses of iron, too, for Homer mentions this in his writings. The Greeks used armor to protect their bodies; Homer describes warriors' bodies covered by a corselet, or breastplate, and legs encased in greaves, plates of armor shaped to cover the front of the legs and fastened by metal strips around the ankle.

The poet describes in great detail the beautiful armor made for Achilles by the god Hephaestus. Many people believe that here he described armor far more beautiful than any which the Greeks of that time could make. Of course the gods would be able to produce any object the mind of man could imagine!

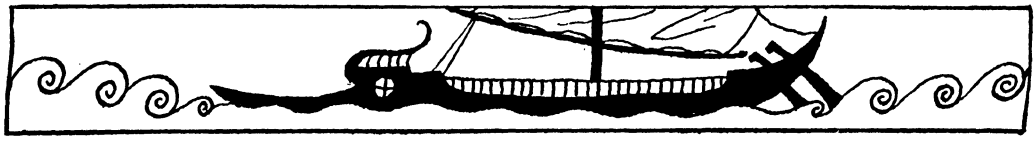
The early Greeks were sailors as well as farmers. Their ships were small sailing vessels equipped with rowing benches and many oars so that the ship was not completely dependent upon the wind. Homer mentions some ships with forty oars and some with twenty. These ships were small and not too seaworthy. However, the seas around Greece were dotted with islands and the sailor was rarely out of sight of land unless the dangerous voyage to Egypt was undertaken. At night the sailors usually beached their ships and slept on the shore. If an expedition was to remain in one place for any length of time, the ships were moved up on the beach, completely out of the water. This was done to prevent the ship from becoming waterlogged.

Your public library probably has Andrew Lang's fine translation of the ILIAD into English. If you like stories of adventure, you will certainly enjoy this one.

Other chapters in THE BOOK OF KNOWLEDGE that you may want to read at this time are The Odyssey, The Story of Ancient Greece, The Sacrifice of Iphigenia, History's Patchwork Quilt (first two pages), Who Were the Old World Gods?, Our Unwritten Literature and Digging Up the Past. Look up their titles in the Index.

By FLORENCE V. GEEHR.

THE NEXT STORY OF FAMOUS BOOKS IS ON PAGE 3744.



Dick Whittington and His Cat

DICK WHITTINGTON was an English country lad who, having lost his father and his mother, went to London to make his fortune. His only friend in the world was a cat which he had picked up and fed when it was starving; and a very good friend it was to him, as we shall see.

Dick used to think that the streets of London were paved with gold, but he found that they were covered with hard stones, and on these stones he had to sleep with his cat for many nights. At last he got a place in the house of a rich merchant. Dick had to do all the rough work in the kitchens: he washed the dishes and turned the spits upon which the meats were roasted. Still he had a merry heart and might have been happy but, unhappily, the cook was a wicked woman, and she beat him every day and made him sleep in a garret overrun with rats and mice. These, however, were soon killed by Dick's cat, for the cat was an excellent mouser.

The rich merchant in whose kitchen Dick worked used to fill his ships with all kinds of goods and send them to far countries, where the goods could be sold at a great profit; and being a kind man, he allowed all his servants to put in his ships anything that they wished to sell.

One day, when he was about to send a ship to trade with the inhabitants of a far-distant country, his pretty daughter Alice came into the scullery and said to Dick: "Now, what are you going to put in for sale?"

"Nothing," said Dick sadly. "I've nothing in the world but my cat."

"Well, put in your cat," said Alice.

And to please her he parted with the only friend he had in the world.

But Dick soon began to miss his cat. The rats and the mice crept back to his garret and kept him awake at night, and the cook beat him more than she had done before. So hard did Dick's life become that one morning he tied all his things up into a bundle and set out to walk back to his village, bidding London good-bye forever.

After a while he grew tired and sat down by the side of the road to rest. Just then the bells in the steeple of Bow church began to chime the hour. Dick listened to the sound as it traveled across the fields, and it seemed that the bells were speaking to him. He listened very attentively, and he heard his name,

and soon he made out the message of the bells

"Turn a-gain, Whitt-ing-ton,
Thrice Lord Mayor of London."

That was what the ding-ding-dong of the bells seemed to say to him. He walked on a little farther, but

"Turn a-gain, Whitt-ing-ton,
Thrice Lord Mayor of London,"

said the Bow bells. Still he walked on and still, though more faintly, he heard

"Turn a-gain, Whitt-ing-ton,
Thrice Lord Mayor of London."

"After all," said Dick, "it's only the cook who treats me harshly. How kindly Alice spoke to me! I will turn again, as the bells say, and see what happens."

As soon as Dick reached his master's house, he learned that his cat had been sold in a foreign land at a great price.

On arriving in the far-off land, the captain of the ship went to the king of the country and was invited to dine at the palace. There he saw an amazing sight. A beautiful meal, consisting of all kinds of game and meat, tropical fruits and elaborate sweetmeats, was served in honor of the guest. As soon as the dishes were placed on the tables, a vast crowd of rats and mice rushed out and devoured all the food.

"Oh dear!" cried the king, "I shall not get anything to eat again to-day."

"Good gracious!" said the captain. "You ought to keep a cat in your palace to kill all these rats and mice."

"A cat?" said the king. "What's that? Is it a new kind of lion? I have bought hundreds of lions and tigers of all sorts, but none of them would ever kill a mouse for me. I am becoming thinner and thinner day by day."

The captain sent a sailor to the ship to get Dick Whittington's cat. When the king saw how quickly it killed rat after rat and mouse after mouse, he shouted with joy.

"Will you take six sacks of gold for this wonderful little animal?" he asked.

The captain agreed, and the ship returned to London with the six sacks of gold for Dick Whittington. The merchant gave Dick all the money, and had him brought up as if he were his own son, and years afterwards Dick married Alice. He was made Lord Mayor of London three times, as Bow bells had foretold.

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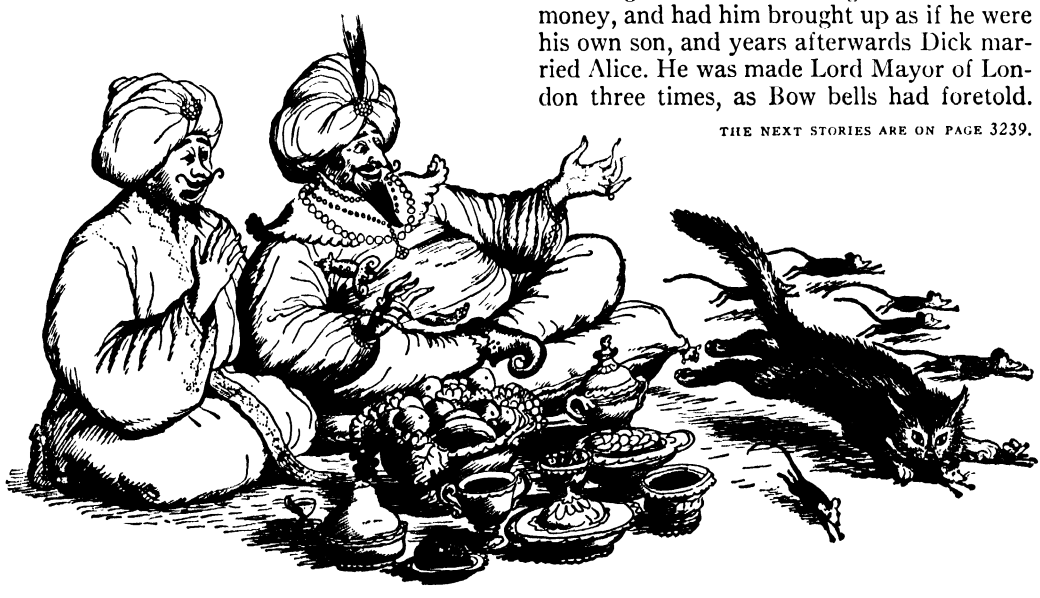


Augustin Rischgitz

On this altar of a Chinese Buddhist temple, the three figures of Buddha have been given Chinese features.

ASIA'S GREAT RELIGIOUS LEADERS

ASIA, where, most probably, the race of mankind first saw the light of day, was also the cradle of man's religious thought and inspiration. Jesus, and before Him, Moses, lived and taught in Asia Minor, as you know. They founded religions which spread westward over much of the globe, but made only slow progress eastward. Look at the table on page 3098, and you will see that even today there are relatively few Jews and only 34,000,000 Christians on the whole continent of Asia with its billion souls.

The table will show you what religions most of the people of Asia profess. You will see that some are Mohammedans, others are Hindus, Buddhists, Taoists, Confucianists, or Zoroastrians; and still others belong to smaller groups. This article will tell you about the founders of the main religions of Asia.

We do not know who founded Hinduism; we can not even be sure that it was established by a single man. Today's Hinduism is an outgrowth of an earlier religion, Brahmanism, so named after its priests, the Brahmins. Brahmanism, or Hinduism, is the oldest religion of India that is still practiced. It has undergone many changes during the long centuries of its existence, but it is still, as it was a thousand years ago, a social pattern of life as well as a religion. The caste system, which we describe in the article on India, is part of the pattern. (The Brahmins, or priests, belong to the highest caste.)

Brahmanism was based on a collection of sacred writings known as the VEDA. Some parts of the VEDA are of very great antiquity, the earliest of all being a set of hymns to Nature that are grand, exalting pieces. There is much of beauty and of inspiration to the good life in the VEDA.

Yet Brahmanism did not satisfy all the people, and some five hundred years before the birth of Christ two men were born in India who were to influence the religious thought of countless millions. These were Gautama and Vardhamana.

Gautama was born some time between 570-560 B.C. and died between 490-480 B.C. He was the son of an influential man, some say

a rajah, or king. The boy was brought up in a palace, and the world was kept hidden from him until he married. While he lived in the palace Brahmanism satisfied him. But alas, his first excursion into the world shattered his beliefs. He saw a broken-down old man, then a sick person, and at last a corpse. These things seemed terrible to his soul. He felt that life was a horror. He sought to escape from it.

The Bettmann Archive
Statue of Buddha.

Leaving his wife, his newborn babe, his father, his friends, his wealth and his palace, Gautama went out into the wilderness, alone, penniless and homeless, to think about life. He came to the conclusion that all solid and material things are useless and unworthy of men's affections, because they have the germ of death in them and will pass away. He accepted the conclusion that man is born on this earth, not once, but many times; and each time his spirit is filled with foolish and vain desires. The great object of life should be to destroy all desire. When once a man has learned to wish for nothing, absolutely nothing—when his spirit is filled with a complete willingness to perish—then at death he passes out of the world forever, enters a state called Nirvana, and is blessed forever. Gautama preached this doctrine and called himself the Buddha, which means "the Enlightened One."

Here is a typical story of the Buddha. A poor woman came to him one day with a dead child in her arms. She was wild with grief and implored the Buddha to give her medicine which would heal her child. Whatever herbs he needed for this medicine she would fetch him, even if she had to go to the ends of the earth. He told her to fetch a little common mustard seed—from a house in which no son, husband, parent or slave had died. The woman went eagerly to fetch the simple mustard seed.

"Here is mustard seed," she was told. But when she asked if any had died in that house, the answer was: "The living are few, but the dead are many."

For a long time she journeyed, and then, seeing the truth of things, namely, that death is common to the race, she left her dead baby and returned.

"Have you the seed?" asked the Buddha.

"My lord," she answered, "the people tell me that the living are few, but the dead are many."

Then the Buddha taught her the sadness of life and filled her with the desire no longer to exist.

Buddhism has no place for God as a ruler. A great scholar has said that Buddhism does not recognize "beings with greater supernatural power than any man is supposed capable of attaining to by virtue, austerity and science." The Buddhist believes in a future life, to be sure, but that life is simply a change. He passes into another form of life, perhaps a beggar or an ox or worm. When this form dies he

Metropolitan
Museum of Art

Grief at the death of Buddha is portrayed in these remarkably lifelike glazed-pottery figurines.

passes into another form, or incarnation.

The Buddhist believes that life is a curse rather than a blessing. To gain Nirvana one must cease to feel desire of any sort, must be indifferent to pleasure or to pain, even to life itself. There are certain things which help toward reaching this peace of mind. One should not take the life of any living creature, nor should one lie, steal or become drunk. Those who enter the religious life must dress in rags, possess nothing, beg their food from door to door, and eat only one meal a day, and that before midday. Though one should feel love, it should not be for any particular person or thing: it must be a general benevolence to all who are not so far advanced toward conquering their impulses.

The practice of certain virtues tend directly toward the attainment of Nirvana. These are almsgiving, purity, patience, courage, contemplation and knowledge. This is not all of Buddhism. In fact, few Western people can understand just what Buddhism teaches.

During his lifetime the Buddha made many converts. He traveled much and preached to the people, and sent out missionaries to preach the new religion. He established an order of monks, and his own son became a Buddhist monk. Many Brahmins and other high-caste Indians adopted Buddhism. Gautama was about eighty years old when he died, and his religion was by that time spreading rapidly over a wide area.

Northward into Tibet it went, and eastward throughout the vast empire of China, thence to Korea and Japan. The island of Ceylon is a stronghold of Buddhism.

Now here is a strange thing. Buddhism has all but died out in India—less than 10 per cent of the people are Buddhists; while more than half are Hindus. Most of the three hundred million Buddhists in the world today live in Tibet, Ceylon, Burma, Siam, French Indo-China, Mongolia, the Soviet Union, Japan and most of all in China. Just as Christians are divided, so Buddhists are. The Buddhist religion of Tibet, for instance, is called Lamaism. The head of all the priests, or lamas, is called the Dalai, or Grand, Lama. Buddhism in China and Japan has taken on features of older religions in those countries.

Vardhamana (?599-527 B.C.), as we have said, was also born in India. When he was quite young he thought deeply and long about life, and man's journey through it, about the body and the soul; and he worked out a faith that satisfied him. Little is known about this man. Some writers say that he was not really the author of the new religion, but that he took a faith that had been held by twenty-three wise men before him, and set it forth in an orderly manner. The religion of Vardhamana is called Jainism. It still has many features of Brahmanism, including the caste system.

The Hindus regard some animals as sacred, particularly the cow. The Jains go much further. They do not believe in God; but they think that divine spirit pervades all matter, living and non-living. The spirit in non-living matter is sleeping. Because all living things have soul-substance, Jains are forbidden to take life, even the life of a worm, or an insect, or a dangerous animal.

It is the fate of this soul-substance to journey from body to body for millions of years. This is called transmigration. Finally

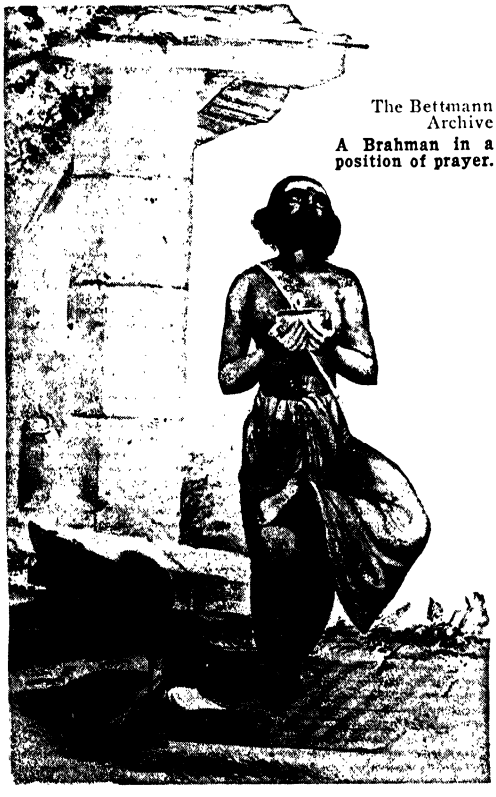
The Bettmann Archive

Kanishka, conqueror of northern India in the first century A.D., helps to begin the formal worship of Buddha as a god.

The Bettmann Archive

The Hindu Trinity: Brahma, the creator of the world; Vishnu, the preserver; and Siva, the destroyer.

the spirit is delivered from body-substance and reaches a state of peace and perfection, unlike the Buddhist Nirvana. Buddhist Nirvana is a state of nothingness. The Jains believe the soul-substance is eternal, and therefore continues to exist, even when freed from body-substance.



The Bettmann Archive

A Brahman in a position of prayer.

There are three chief ways of achieving perfection (three jewels); by knowledge, by faith and by virtue.

About a century before the existence of these two teachers in India there lived two teachers at one and the same time in China. The one was Lao-tse, who founded what is called Taoism; the other, K'ung-Fu-Tse, whom we call Confucius, was the founder of Chinese philosophy.

The meaning of the title Lao-tse is "Old Boy," and legend has it that this teacher was born in a miraculous way. He was no less than eighty years old at the time of his birth, and his head was covered with white hair. A venerable beard descended from his chin.

Lao-tse (about 604 B.C.- ?) was born in a hamlet, and became librarian to the king. In the royal library he pondered over the mysteries of life, and after many years he came to the conclusion that the great thing, the supreme virtue, is humility. Desiring to hide himself, he left the palace and set out for the wilderness. As he was passing through the gate the warden, who knew him for a holy man, said: "You are about to withdraw yourself from the world. I pray you write me a book before you go."

Lao-tse thereupon sat down and wrote a

book about half the size of St. Mark's Gospel. He gave this to the warden, passed through the gate, and no man knows where he went or where he died.

The little book is the gospel of Taoism. From those few pages grew up an immense religion. If Lao-tse could stand in that gate now he would be amazed to see the effect of his farewell to the warden. Let us see how much we can understand of Taoism.

The word "Tao" is the despair of translators. It means "the way," but it means "the wayfarer" as well. It is man and his destiny; God and humanity. We can not say exactly what a Chinese understands by it. Lao-tse's advice is that we should think and act without reflection. We should become like young children. The grass grows without taking thought: man should live with a similar freedom from anxiety. Everything should be spontaneous and should be done on the impulse. "It is the way of Tao not to act from any personal motive, to conduct affairs without feeling the trouble of them, to eat without being aware of the flavor, to account the great as small and the small as great, to recompense injury with kindness."

Lao-tse hated war; he did not like to see men put to death. He felt no interest in art, culture and refinement. Life should be without effort. There could be no beauty where there was strain. The pilgrim of existence should never be in haste about anything, never be anxious.

We see that, unlike the two teachers of India, this old philosopher wanted people to be happy; but we can not help feeling that here also is that same fatalism—the belief that everything is prearranged to happen, whatever man may do—which is the ruling idea of the East.

A different man is Confucius, the sage of China. He (?551 B.C.-478 B.C.) was born of an ancient and honorable family, but he was poor. In order to earn his living he studied hard in childhood. He was fond of music and played on the lute, singing to its music. His favorite game with other children was what we should call "playing at being a clergyman." He liked to dress himself up, to strike attitudes and to conduct religious ceremonies. He was married at nineteen, and became a keeper of stores and later the controller of parks and herds.

He was twenty-two when he set up as a teacher, and it is said of him that he never refused a scholar who was too poor to pay his fees. But he used to say that when he had explained one corner of any subject, if the pupil could not understand the other three corners for himself, he gave up teaching that lesson.

His fame spread as a teacher, and he became a minister to one of the rulers. So great was his success that he became "the idol of the people, and flew in songs through their mouths." He put down injustice and banished crime. He was just, honest, fearless and good. But the ruler began to grow jealous of his power, and Confucius had to go.

The rest of his life is a pathetic tale of homeless wanderings. Accompanied by his

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One legend of Vishnu relates that he appeared as a fish.

The Bettmann Archive
A fanciful idea of the good Lao-tse's ascent to heaven.

disciples, he journeyed from state to state seeking some ruler wise enough to accept him as teacher and minister. He told his disciples that the greatest reform was to make people understand the meanings of such names as "ruler," "father," "son." If those words were properly understood, unhappiness and misery would vanish.

On these wanderings he frequently encountered hermits—men who had retired from the world in disgust. These hermits could not understand how Confucius could be so stupid as to live in a wicked world trying to alter what was unalterable. Confucius said it was impossible to withdraw from men and live with beasts and birds. "With whom should I associate," he asked, "but with suffering man?" So he walked on and on, teaching his disciples, comforting the poor, and seeking for a kingdom to rule.

He found no kingdom. But his teachings have lived from the day of those sad wanderings down to our own time, and Confucius now reigns as no other emperor can reign in the hearts of millions and millions of the human race.

One of his sayings shows the great difference between him and Lao-tse: "The cautious seldom err." But his whole gospel was more generous than that. He taught the golden rule that we should live exactly as we would have others live: "What you do not like when done to yourself, do not to others." His whole teaching shows that we should do good to others, whether there is need for us to do so or not. He said nothing chivalrous or noble about women, and he gave no attention to a life after death. "While you do not know life," he said, "what can you know about death?" All his ideas of goodness concerned man's life on this earth. It is wonderful that a teacher who left wholly out of account life after death should have had, and still does have, such immense influence over men. There are about 350,600,000 Confucianists and Taoists in the world.

THE RELIGION OF THE ANCIENT PERSIAN PHILOSOPHER, ZOROASTER

Farther back in time than any of these men is the founder of Zoroastrianism, the ancient religion of Persia. The founder's name was Zarathustra; but the Greeks called him Zoroaster, and it is as Zoroaster that he is generally known. Some say Zoroaster lived before the battle of Troy (1184 B.C.); others say Zoroaster was really Ezekiel, and others say that he was Ham, Moses or Abraham. There is no end to the theories about Zoroaster. The legends about him are also legion. It is said that he began to laugh the day he was born; that the palpitation of his brain was so vigorous that it repelled any hand that might be put upon his head; that he dwelt twenty years in the wilderness and lived upon a single cheese which never grew stale. It is also said that as he came down from meditation on a mountain, fire burst out from heaven which did not consume him; that he desired to be killed by a thunderbolt, and that in this manner he did die, after having taught the Persians all there is to know about this world and the next. We may be certain that a man named Zoroaster, or Zarathustra, did live, that he taught the Magi, or wise men, of Persia, and that his character was sufficiently unusual to make him revered and honored and obeyed by his disciples.

ORMAZD, THE GOD OF LIGHT; AND AHRIMAN, THE GOD OF DARKNESS

Zoroaster divided everything into good and evil. According to him, there is a good god and there is an evil god. Some of the ani-

mals, birds, fishes and plants are made by the good god and some by the evil god. He taught that sacrifices should be made to the good god in order to win blessings and favors from him; and to the evil god also, that he might guard the faithful from dangerous, hurtful and unpleasant things. Light belongs to the good god, and darkness to the bad. The name of the good god is Ormazd, and that of the evil god, Ahriman. Life after death will be either good or evil, and a man's eternal life is determined by his existence here. The soul after death passes over the Accountant's Bridge; its deeds are examined in the book where everything is written; if there are more good than evil deeds, the soul goes straight to bliss; if the evil deeds tip the balance, the soul goes straight to pain; and if they balance, the soul waits in a land of shadow for the final decision of the Great Judge.

You sometimes hear the modern Zoroastrians called Parsees, because the religion was founded in Persia, or Parthia, as Iran used to be called. You remember the three Wise Men who brought gifts of gold, frankincense and myrrh to the Holy Babe in His manger? These Wise Men, or Magi, were priests of Zoroaster, who followed a strange star to Bethlehem, where they found the Holy Babe.

There are only a few thousand followers of Zoroaster in Iran today; Mohammedanism has for hundreds of years been the dominant religion in the country of Zoroaster's birth.

A copper engraving of Confucius.

Both pictures, The Bettmann Archive

Riding in an ox-drawn carriage, Confucius leaves his own country.

There are something more than 300,000 Parsees in India; but they no longer worship many gods and divinities. Their religion is now monotheistic (following one god); but they still worship fire, as did the ancient Persians.

And now, last of all, we come to the most recent of religious founders—Mohammed, who is the prophet to millions of the human race. The truth is that Mohammed probably knew not only the Old Testament but also the teachings of Christ.

Mohammed (about 569-632 A.D.) was born at Mecca, Arabia. You will see his name written Mahomet, Muhammad, Mahmoud, and in other ways. In Europe and America Mohammed is the best-known spelling. Left an orphan early, the boy was brought up by an uncle. He was a good boy. At a marriageable age he was sent to act as master of the camels of an elderly woman who traded in Syria. This woman fell in love with her young servant and married him. At forty years of age he was the father of a family, with married daughters.

The Koran, the scriptures of Mohammedanism, is a wonderful book. The Mohammedans teach that Mohammed was inspired by the angel Gabriel to dictate it or have it written. In it there are fables the most

monstrous and horrible; but in it, too, there are aspirations toward immortality and expressions of repentance which are beautiful.

Mohammed had a deep, burning consciousness of the majesty of God. In his travels he encountered men of all races, heard what they said, saw how they behaved, and pondered on the conflicts between the religions of mankind. Then, as he sat on his camel's back and rode through "the starlit Arabian waste," he would turn his thoughts on all he had heard and seen. There must be, he felt, one true religion—true for men of all races, essential for the happiness of mankind. It came to him that this true religion could be uttered in a single phrase: There is one God. He considered the God of the Jews a tribal god, but Mohammed's god was to be the God of all mankind.

The Arabs believed in magic and worshiped many gods, and when Mohammed began to speak about the One God there were many of his race who regarded him as a renegade. For years only a handful of people would listen to him. Quietly and intensely he spoke of this great matter to his household and friends, and after some years the people of the city began to notice with dismay his growing list of converts. Then Mohammed had to flee from Mecca.

He went first to Taif; later, in great fear of his life, he fled to Medina. This flight is known by its Arabian name, the Hegira, and is still commemorated by the faithful. Mohammed was welcomed at Medina; men listened to him, and in time he became judge and ruler of the city. His next step was to take the sword, to win by blood new converts to his faith.

We must not judge Mohammed by any of our standards. He was an Arab. His world was utterly unlike our world. His thoughts were altogether different from our thoughts. In that wild and restless mind, set on fire by the thought that God was speaking to him, stirred all the passions of his Arab nature. It was not for him to submit to his enemies. It was not in his character to go calmly to a martyr's death. On the contrary, to be faithful to God he must be ready to fight for God. Those who opposed him opposed God; they were enemies to be slain by the sword.

So it came about that the religion of Mohammed took the sword, and by the sword propagated itself in Arabia. Mohammed was growing old; before God should call him he must leave this true religion firmly established. How could he do this unless he overthrew the enemies of his faith?

But it was not by the sword alone that he got his victory. Mohammed's preaching drew men to his side. Something in the hearts of the Arabians responded with gladness when he denounced idol-worship and spoke of the invisible God of all mankind. His teaching was stern, vigorous and uncompromising; and the Arabs heard him gladly.

The Bettmann Archive
Zoroaster, the Persian philosopher.

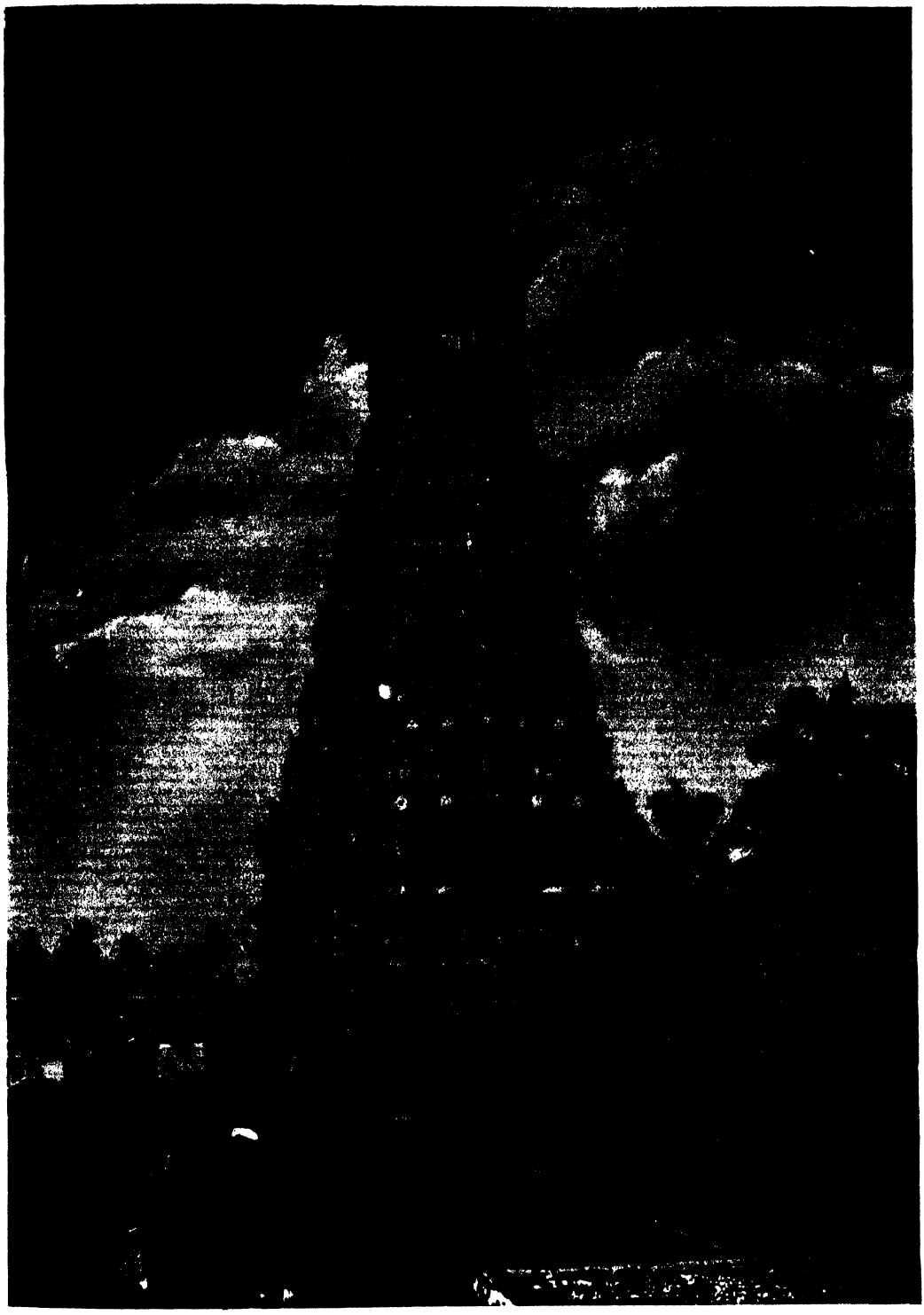
After his death, in 632, thousands of Arabs acclaimed him the Prophet of God, and felt that life for them lay in one thing only—the spreading of his teaching. To them there was no other method of doing this but by the sword. They became a military power. Under their Caliph Omar, who lived at Medina, they swept through Syria, Palestine, Persia and Egypt, shouting their cry of "There is one God, and Mohammed is his Prophet," flashing their swords in the air, carrying all before them. We see the idea of a solitary deep-thinking man spreading swiftly across the earth.

Carlyle has described in vivid words the home of the Arab people:

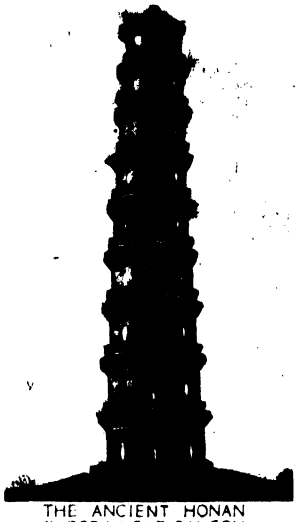
> Savage, inaccessible rock-mountains, great, grim deserts, alternating with beautiful strips of verdure; wherever water is, there is greenness, beauty; odoriferous balm shrubs, date trees, frankincense trees. Consider that wide-waste horizon of sand, empty, silent, like a sand sea, dividing habitable place from habitable.
>
> You are all alone there, left alone with the universe; by day a fierce sun blazing down on it with intolerable radiance; by night the great deep heaven with its stars.

An idea entering the mind of man in such

TEMPLES OF THE EAST

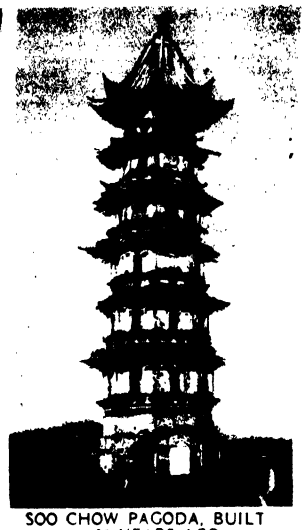


THE WONDERFUL HINDU TEMPLE AT MADURA, IN INDIA, DECORATED WITH HUNDREDS OF CARVED FIGURES



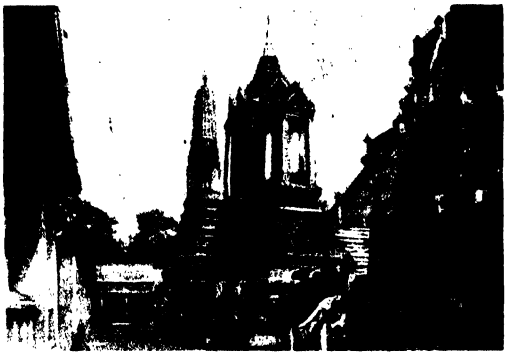
THE ANCIENT HONAN PAGODA NEAR CANTON

A MODERN TEMPLE AT KADO, IN BURMA



SOO CHOW PAGODA, BUILT 1,600 YEARS AGO

THE SPLENDID TEMPLES AT KAPURTHALA, INDIA

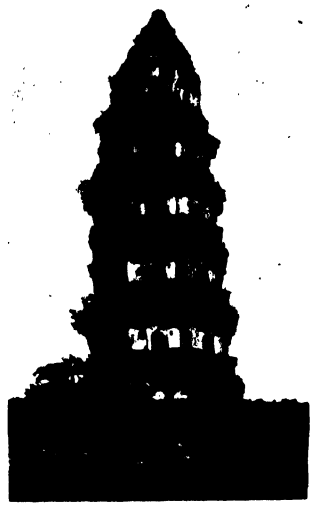


THE TEMPLE OF WAT CHENG, SIAM

MINOBÙ TEMPLE, JAPAN

A PAGODA AT SOO CHOW, IN CHINA.

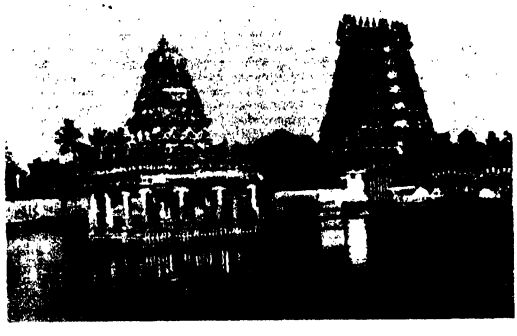
THE TEMPLE OF HEAVEN AT PEIPING



THE TIGER HILL PAGODA IN CHINA

THE GORGEOUS MOSQUE OF SHAH ZADE AT ISTANBUL

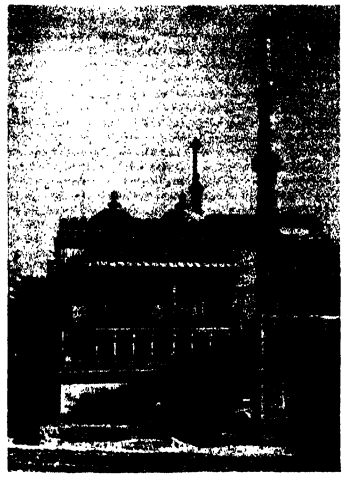
A JAIN TEMPLE ON MOUNT ABU, IN INDIA



THE TEMPLE OF NAGARCOIL, NEAR CAPE COMORIN, IN INDIA

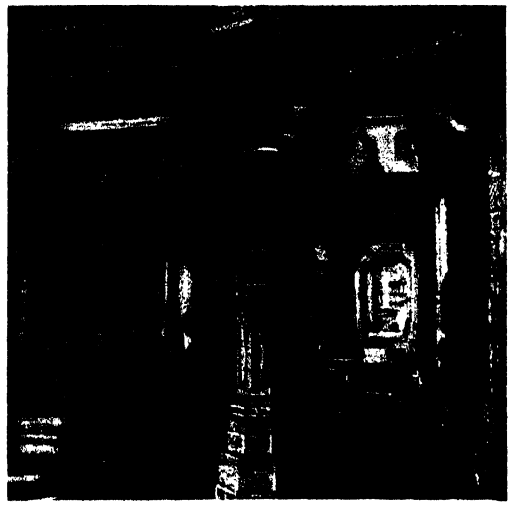
A JAIN TEMPLE IN CALCUTTA

A FIGURE OF BUDDHA IN BUDDH GAYA TEMPLE, INDIA



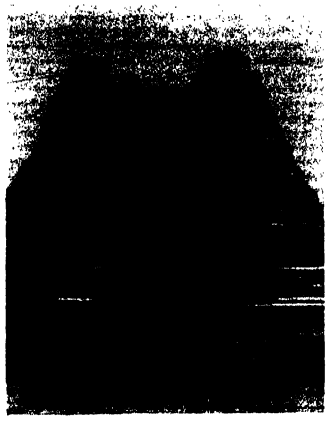
THE MOSQUE OF RANEE SEPREE AT AHMEDABAD

THE RICHLY CARVED INTERIOR OF THE GOSAIN TEMPLE IN BENARES

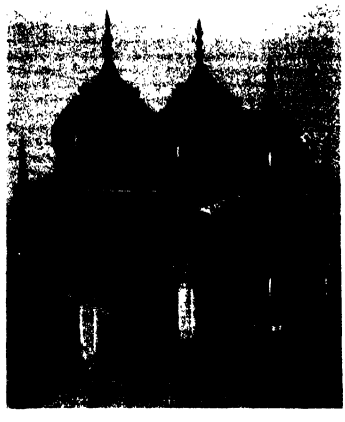


THE HIGHLY DECORATED COLUMNS OF A JAIN TEMPLE IN UDAIPUR, INDIA

THE APPROACH TO SHWE DAGON PAGODA AT RANGOON



BORO BUDUR, THE ANCIENT BUDDHIST TEMPLE IN JAVA



THE PEARL MOSQUE AT AGRA, IN INDIA

The pictures on these pages are by Bourne & Shepherd, E.N.A., Herbert G. Ponting, Lowell Thomas, Underwood & Underwood, and others

a setting as this would lay firm hold on his life. No distractions in that "wide-waste horizon of sand" would call his attention from the one thought burning in his soul as the one sun was burning in the sky. No enticements of cities would beguile him into wondering whether this idea of his was really true. No scholar would bid him pause to think it out well before he took action to make other men share it with him—this huge idea towering up in this soul to the very magnitude of God. No; he would live in communion with this idea till it mastered him, till he became its slave, till it became himself.

So to the Arab came the thought of Mohammed that there is one God. And in that vast desert this solitary thought took possession of the whole Arab race, finally breaking over those inaccessible rock-mountains, flowing over those grim deserts and flooding far away into Eastern lands. Then it turned like an ocean tide and flooded westward as if to submerge the lands of struggling Christianity.

Culver Service

Mohammed, founder of Islam, preaching his fiery gospel.

Descendants of many Eastern peoples flocked to the standard of Mohammed, calling themselves Moors. They conquered territories in Africa, and crossing the sea, advanced into Europe as far as Spain.

For centuries Christians were taught to regard these Moors with detestation. Thus it came about that a hatred which has not even now ceased to sunder East from West grew up in the hearts of men. The Mohammedans called the Christians "infidels," while the Christians called the Mohammedans "heathens."

Now see what this hate did for mankind. It caused the death and mutilation of millions of human beings: it wasted human life. Civilization was held back by it, prevented by it from advancing the happiness of all the world. Knowledge was pushed aside that men might arm themselves with swords and march backward and forward burning, killing, laying waste and destroying, all in the name of God! It is only within recent years that this warfare ceased. It is acknowledged now that Islam, as Mohammed's religion is called, rescued many millions of men from a shameful idolatry and gave them the nobler idea of One God. The number of Mohammedans in all countries today is 209,020,000.

Mohammed himself taught that Jesus was a prophet from God, and many of the beautiful thoughts of Jesus passed into his mind and became a part of his religion. For instance, he taught compassion; that masters were to feed and clothe their slaves as they themselves were fed and clothed. He taught that in the sight of God all men are equal, and, like Jesus, he taught that prayer is simply communion of the soul with God.

Yet there were things in his teaching which tended to hold back the spirit of man. For example, he regarded women as little more than slaves. But these teachings of Islam are now yielding to Western influences. They might have vanished hundreds of years ago but for the gospel of hate preached with the sword by Moor and Christian alike. Contact with Western education is bringing a new viewpoint to the leaders of the chief Mohammedan countries.

As you look at the gravure pages, you will note that the Hindu temples are mostly tall, with carved and decorated towers. Mohammedan mosques have domed roofs, and slender towers, called minarets, with balconies from which a holy man calls the faithful to prayer. Pagodas are many-story towers, with eaves curling out from each story. They are now used as places of worship by Hindus, Buddhists and others; but they were originally temples of certain nature-worshipers in China. Jain temples are usually very costly and beautiful, elaborately carved with delicate, lovely designs. Mohammedan mosques may have carving in scrolls and twists and turns (arabesques, these designs are called), and may have screens of lovely lacework in stone. But it has always been against Mohammedan law to make any picture or carving of a living thing. So when you see a temple with a statue or a picture of a man, beast or flower, it is not a Mohammedan place.

The two chief religions in Japan are Shinto (or Shintoism) and Buddhism. Shinto, which

Culver Service

"For the glory of Allah," Mohammed and his followers ride forth to win converts to his religion by the sword.

means the Spirit-way, was originally a very primitive nature-worship, combined with ancestor-worship. As you know, Chinese learning, art and ways of life were taken up by the Japanese in, and after, the fourth century. Shinto became mingled with Confucianism and also with Buddhist ideas. Centuries later—about 1868—Shinto was purified of these foreign elements. The emperor was at the head of Shinto, and was called the Son of Heaven. However, after the Japanese were defeated in World War II, it was announced that the emperor was no longer to be considered a god. Ancestor-worship was taken over by Buddhism; it is a powerful force in Japan and China.

You will notice in the table that a number of people are classed as animists. The religion is called animism (from the Latin word *anima* meaning soul) and takes many different forms among primitive tribes. Animists believe that in every natural object—a man, a bee, a stone—there dwells a soul.

THE NEXT STORY OF MEN AND WOMEN IS ON PAGE 3381.

RELIGIOUS POPULATION OF THE WORLD

RELIGION	NORTH AMERICA	SOUTH AMERICA	EUROPE	ASIA	AFRICA	OCEANIA	TOTAL
Roman Catholics..	40,000,000	61,000,000	220,000,000	7,000,000	2,000,000	1,500,000	331,500,000
Orthodox Catholics	1,000,000	.....	120,000,000	20,000,000	3,000,000	.....	144,000,000
Protestant churches	75,000,000	900,000	115,000,000	7,000,000	3,000,000	6,000,000	206,900,000
Coptic Christians..	.....	.....	.....	.....	10,000,000	.....	10,000,000
Jews	4,510,000	100,000	10,000,000	1,000,000	500,000	30,000	16,140,000
Mohammedans ...	20,000	.....	5,000,000	160,000,000	44,000,000	.....	209,020,000
Buddhists	180,000	.....	.....	150,000,000	.....	.....	150,180,000
Hindus	150,000	.....	.....	230,000,000	.....	.....	230,150,000
Confucianists and Taoists	600,000	.....	.....	350,000,000	.....	.....	350,600,000
Shintoists	.....	.....	.....	25,000,000	.....	.....	25,000,000
Animists, etc.	50,000	.....	.....	45,000,000	90,500,000	100,000	135,650,000
Unclassified	25,000,000	2,000,000	5,000,000	18,000,000	.....	870,000	50,870,000
TOTAL	146,510,000	64,000,000	475,000,000	1,013,000,000	153,000,000	8,500,000	1,860,010,000

WHAT MAKES THE KETTLE BOIL?

WE must know what it is that forms the bubbles when water boils. They are bubbles of water. If you hold a cold plate over boiling water you will find drops of wet water form upon it, though you can see no water passing upward between the surface of the boiling water and the plate.

The truth is that, though we always think of water as something that is liquid and wet, just as we think of air as something that is always gas, we have no right to do so.

Water happens to be usually fluid, but we all know that when it is cold it becomes solid. Ice is simply solid water. And we must now learn that, when it is hot enough, water becomes a gas like air. Indeed, the air contains a quantity of water-gas, or water-vapor, as it is usually called, and when we find the weather close and muggy, as we say, it is usually because there is more of this water-vapor in the air than we like. When water boils, then, the bubbles are bubbles of water-gas, or water-vapor, and if this vapor strikes a cold surface, like a cold plate, it becomes liquid or wet again.

One of the things that decides whether anything shall be solid or liquid or a gas, is heat; and so, of course, the simple answer to the question, What makes the water boil? is *heat*. We apply heat to water, and it begins to turn into gas, which makes the bubbles and then the steam.

If we go on boiling the water, of course, we boil it all away as gas, until there is none left. In an ordinary way water always begins to boil when it is at a certain *temperature*, or hotness, and this is called the boiling-point of water. It is not possible in an ordinary way to have wet water any hotter than this point, no matter how much heat you apply to it.

We said "in an ordinary way," because water can be made to boil without being nearly as hot as boiling water usually is. One of the things that decides the boiling-point is the pressure of the air, at the bottom of which we live. If you take water up to the top of a high mountain, where the pressure of air is much less because there is not so much air above you, and if you heat the water, it begins to boil when it is nothing like so hot as it needs to be made before it will boil at the bottom of the mountain. On the *mountain there is less pressure of air squeezing the water, and so it can more easily expand into bubbles of gas*. So, if you put an egg in the water at the top of the mountain, you may boil and boil as long as you please, but you will never boil the egg hard, simply because you can never make the water hot enough to make the egg as hard as it can be made at sea-level. Water in a vacuum also boils at a lower temperature than in an ordinary open vessel.

WHY DO FARMERS GROW CLOVER ONE YEAR AND WHEAT THE NEXT?

In early times it was discovered that if wheat were grown year after year on the same soil in the same field, the crop became poorer as time went on. The Romans knew this, and therefore they made a practice of leaving a field bare, or fallow, in some years, to give it time to recover.

In the seventeenth century A.D., however, another discovery was made: that it is unnecessary to leave a field fallow for a year. A different crop can be cultivated for a year, then wheat the next year, and the wheat will actually be improved. The different crop leaves something in the soil which the wheat needs. This "something" is nitrogen.

Among the crops that supply nitrogen are clover and alfalfa; and these are also valuable foods for animals. They may be harvested for cattle feed or the green crop may be plowed into the land and left to enrich the soil. In such cases the crop is called "green manure."

When wheat is grown in a field one year and clover or alfalfa the next, then wheat again, and so on, the practice is called rotation of crops. A four-year rotation (the Norfolk rotation) is favored by some farmers: turnips, barley, clover, wheat.

WHAT IS INFANTILE PARALYSIS?

Our muscles are controlled by a special set of nerves called motor nerves. Infantile paralysis is a disease which sometimes destroys these nerves—usually in the spinal cord—and so makes the muscles useless. It is caused by a deadly substance too small to be seen by a microscope and too small to be held back by the finest filter or sieve that has ever been made. It is called *infantile* paralysis because most of its victims are children. No one knows how it starts but when a few cases appear in a community the disease may spread over the entire region. Generally, epidemics break out in summer or fall.

The illness usually starts with fever, headache, nausea and drowsiness, and there is a great deal of pain. Later, one or more of the limbs may become paralyzed and even the nerves of the brain may be affected. The period of attack may last only a week but recovery is slow and may take many years. Sometimes the patient never recovers full use of the afflicted muscles.

Serum from the blood of a person who has recovered from the disease is injected for treatment. When recovery is going on, massage, special baths, exercise and electrical treatment are used.

WHAT IS MEANT BY INSURANCE?

Every one of you has heard this word many times. Your father may have insurance on his life, fire insurance on his house or furniture, liability insurance on his motor car, and perhaps other kinds. What is alike in all of these?

Insurance means the sharing of risk, and the cost is based upon the law of averages. Let us take a simple example. Perhaps you live in an old house which has been standing a hundred years. On the other hand, a new house on the next street burned down last week. There is always a chance, though a small one, that your house may go any day, and perhaps your father would not have the money to build again. So he and perhaps 10,000 other owners of houses agree to share the risk of fire.

While no one can say when any particular house will burn, it has been found that only a few of 10,000 houses will burn in any one year, and this number does not vary much from year to year. So each of the 10,000 or more owners pays a small sum every year to the fire insurance company, and the owners of the few houses that do burn will receive many times as much as they paid the company. In other words, every one of the 10,000 owners has shared the risk of all others.

The sum each owner pays is called the premium, and the rate is a certain number of dollars on every thousand dollars of value. This rate depends upon many things; on whether the house is built of wood or brick; on whether it stands alone or is close to other houses; on whether there is a good water supply, a good fire department, and on many other things.

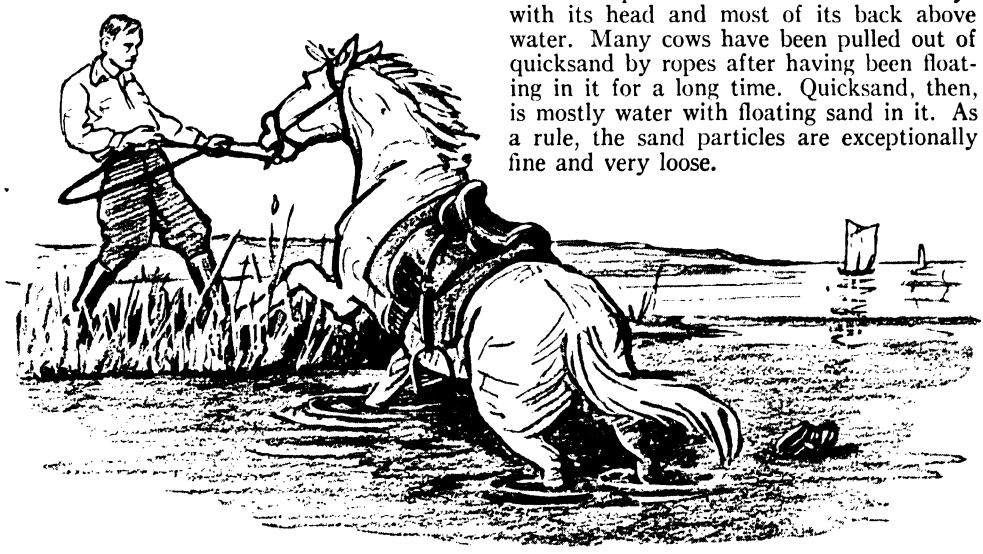
The writer has driven a motor car for many years, and has never hurt any one. Nevertheless he has paid every year a considerable sum to a liability insurance company which makes a contract with him that it will pay all damages up to $100,000 if he should have a motor accident. He is so afraid of hurting some one that he would not drive a car if he did not have this contract, which is called a policy. Other owners of motor cars do the same thing. So every one of us shares the risk with the others.

Life insurance is both similar and dif-

ferent. Though a house may never burn, every one must die some time. Some men and women die young; others live to the age of seventy-five or more, but death may come at any time from disease or accident. Here again comes the law of averages. Though no one can tell when any man may die, it has been found, for example, that for every 10,000 men, aged thirty, the number dying every year is almost exactly the same. Since this is true it is easy to calculate the cost of the risk for a year. As men grow older the risk of death increases, but experience has shown just what the average risk is. The companies charge a yearly sum that is more than necessary to cover the risk while a man is young. They do so because as a man grows older and the risk of death becomes greater, his premium is not large enough to pay for the risk.

This is what is called straight life insurance, because a man pays a certain sum as long as he lives, depending upon the age at which he begins. There are many other types of insurance policy. For example, a man may pay a larger sum every year for twenty years, say, and then cease paying, but he will be insured as long as he lives. There are many other kinds of policies. They are all forms of insurance against the unknown future.

Ships and cargoes may be insured. In fact, this was the earliest form of insurance. One may insure against burglary, against sickness, against accidents. The risk in all of these is carefully calculated and the cost depends on the law of averages, as we said above.



WHERE DOES PUMICE STONE COME FROM?

Pumice is a light, spongy stone almost like hardened foam, that we rub against our skin to take off ink spots. (Its name comes from a Latin word for foam.) It is spongy, or foamy, because it was formed under intense heat, and the spaces in it were filled with gas when it was made. Pumice is volcanic rock found deep in the earth and thrown out from the crater of a volcano. It has a particular interest to geologists for its composition tells something of the deeper parts of the earth's crust.

WHAT IS THE CAUSE OF A QUICKSAND?

There is nothing magical or mysterious about quicksand, in spite of all the odd tales we hear about it. When water flows upward under enough pressure so that the upward force of the flowing water is equal to the downward weight of the soil grains, the grains "float," and quicksand results. The water is under pressure because it flows underground from a higher level; that is why quicksand almost always occurs in low ground or in a valley.

Quicksand is a thick liquid like molasses, but, of course, not so sticky. Because it is denser, or heavier, than ordinary water, one can float higher in quicksand than in water. But, because it is so thick, or viscous, it is hard to move one's arms and legs in it. That is why so many people get frightened when they sink in quicksand. When a cow sinks in quicksand it can float for days with its head and most of its back above water. Many cows have been pulled out of quicksand by ropes after having been floating in it for a long time. Quicksand, then, is mostly water with floating sand in it. As a rule, the sand particles are exceptionally fine and very loose.

HOW IS IT THAT FISHES ARE NOT SALTY WHEN CAUGHT?

We must remember that the fish, like ourselves, has the power of taking into its blood from the food it swallows just those substances that it needs. When we study the whole animal world, we find that the proportion of salt in the bodies of many different creatures is much the same. The cells that make muscle, or flesh, are not very different in their way of living, or in their needs, whether they are in a bird, a fish, a cow or ourselves. A fish that has lived in salt water does not taste saltier than one that has lived in fresh water.

WHAT IS THE SECRET OF LUMINOUS PAINT?

Certain chemical substances, such as the sulfides of calcium and barium, have the peculiar property of absorbing light when exposed to it and of giving out this light in darkness. The amount of light is not very great, and gradually diminishes; though on being again exposed to light the material recovers its light-giving power. The secret of this luminous paint is impurities in the calcium or the barium. Small traces of bismuth, vanadium or rare earths give the peculiar effect.

Sulfide of calcium is made by heating powdered oyster shells and sulfur together in a closed crucible, and the product is then mixed with a varnish to form the luminous paint that is used for clock dials, numbers on street doors, and other purposes.

A very small proportion of radium mixed with a special zinc sulfide gives "radium paint." This is luminous paint of another kind. It shines because the radium in it is giving off rays. Radium paint is used on the figures and hands of watches, clocks and other instruments so that they can be read in the dark.

WHERE DOES SPRING WATER COME FROM?

Spring water comes from the sky. If we live in the country we soon find that the springs are dependent on the rain, and when there is little rain, or none at all, the springs dry up. This is true even though the spring water is seen coming from the earth, for what we see then is rain water that has soaked into the earth and found its way to the surface again at the spring. Spring water runs at last into a lake or a river, and so to the sea, from which the sun sucks it up again, to send it down as rain. This goes on ceaselessly. The same water passed through spring, sea, sky and earth millions of times before we were born and the cycle still goes on. Spring water has a good deal of air dissolved in it, and this gives it its fresh, pleasing taste. Some spring water bubbles up through the ground that contains mineral salts; these flavor the water. We call it mineral water, then.

DOES A ROCK BREATHE?

Rocks are not alive. They do not have lungs. They do not take in oxygen and then give out carbon dioxide, as we do. But they do take in oxygen. Long ago, when they were being formed, rocks took in huge amounts of oxygen. It is reckoned that there is as much oxygen contained in a layer of rocks a few feet deep as in the air above them. The intake of oxygen still goes on, though in much smaller degree. Due to this process many types of rocks are slowly crumbling away; though the action of rain and wind must be taken into account as well, in the crumbling.

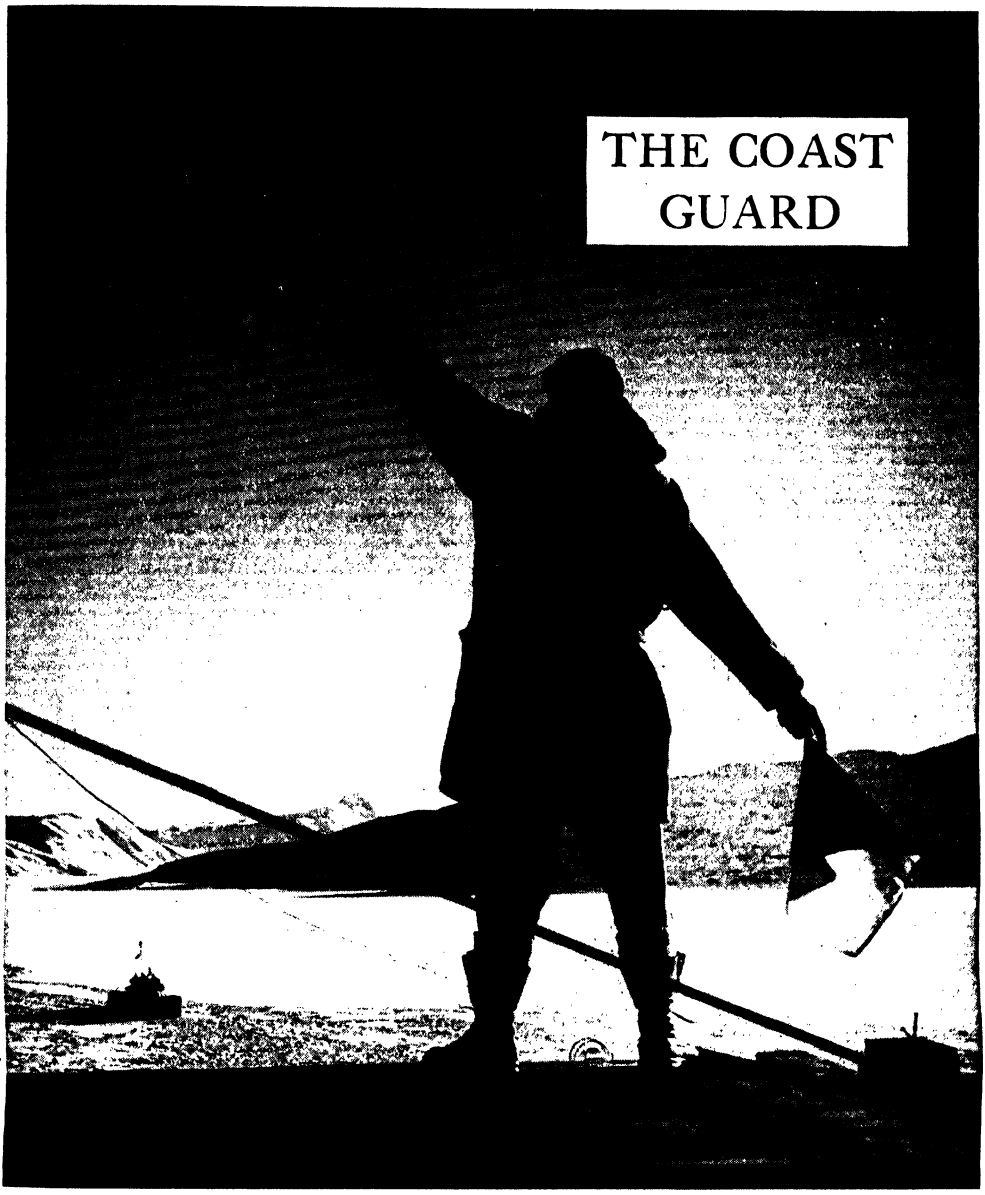
WHAT IS A PATENT?

If a man invents a new device and wants to make money from it, he first applies for a patent. The government patent office examines his description of the article, to make sure it is not a copy of some other invention and to be sure it will be useful. If it passes this examination, the inventor is granted a patent. That means that he can sell his idea to a manufacturer or he can manufacture the article himself, and sell it.

Not only machines but also plants, foods, medicines and other products may be patented. Articles that are improvements upon other patented products may be patented. A patented article must be marked with the word "Patented" and the date of issue. Like any other property, a patent may be sold or transferred. In the United States a patent is effective for 17 years; the term in Canada is 18 years. In other countries the terms vary from 12 to 20 years. After the term is completed the patent becomes public property. An article patented in one country may be patented in any other country that has patent laws. The illegal use or sale of a patented article without the owner's consent is known as an infringement. In such a case the owner may bring a lawsuit against the guilty person.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3177.

THE COAST GUARD



All pictures, official U. S. Coast Guard photos

THIS is the only organization of its kind in the world today; no other country maintains a service in any way like it. It is ordinarily a peacetime force and is under the Treasury Department, but in time of war it is under the Secretary of the Navy and acts as a part of the Navy.

The history of the Coast Guard goes back to the earliest days of the Republic. The Federal Government had imposed customs duties on imports in order to raise enough money to meet Federal expenses. Many people resented this tariff, and smuggling started on a large scale. To protect its chief

One of the lighthouses, Roamer Shoals, manned by the Coast Guard. It stands between Gedney and Ambrose channels, at the entrance to New York Harbor.

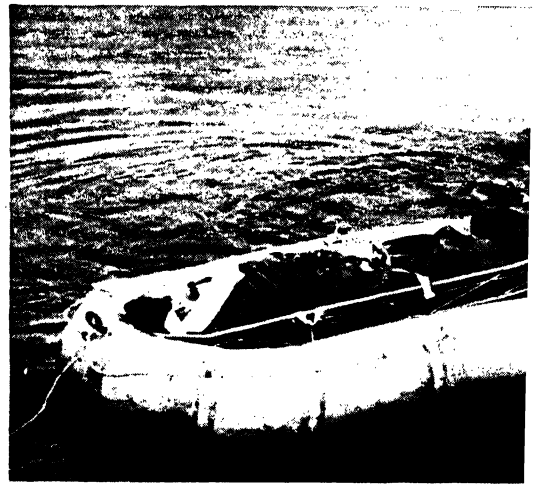
source of revenue, Congress passed a bill in the year 1790 establishing the Revenue Cutter Service to enforce the customs laws. The Government obtained ships for this purpose, and before long the coast was being patrolled successfully.

The service has entered upon many other duties since that time. In 1915 it was combined with the Life Saving Service, and the name was changed to United States Coast Guard. In 1939 the Lighthouse Service was transferred from the Department of Commerce and combined with the Coast Guard. Three years later, the Coast Guard took over many of the duties of the Bureau of Marine Inspection and Navigation. This means that the service now supervises the discipline of crews and the construction and equipment of merchant ships; it also investigates deaths and injuries on board ship.

The Coast Guard protects the entire American seacoast, the Great Lakes and all the navigable waters. It warns shipping of dangers to navigation; it enforces the laws against smuggling and other laws governing the operation of shipping. When a ship is in distress, the Coast Guard sends a vessel or even a plane to its aid at once. The service saves thousands of lives and millions of dollars' worth of ships and cargo each year. It gives aid to the sick and injured on ships and fishing boats. Sometimes it gives advice by radio or signals; at other times, when necessary, it brings patients ashore by plane. It cares for and transports shipwrecked and destitute persons and carries on relief work during flood, hurricane, fire and similar disasters. It breaks ice on the Great Lakes and other United States waterways.

Another important service performed by the Coast Guard is the International Ice Patrol. Every spring great icebergs drift south with the Labrador Current from Greenland. When they reach the Grand Banks off Newfoundland, they begin to melt. Here, in the path of North Atlantic shipping, a fog often covers this dangerous area. During the spring months, the great, inert masses of ice, seven-eighths submerged and often masked by the fog, float into the paths of the ships.

For centuries this graveyard of the North Atlantic, as it was called by sailors, took a toll from shipping. Finally, in 1912, the great new liner Titanic, on its maiden voyage from England, struck a berg while going at full speed through the fog. She sank, and more than 1,500 people lost their lives. The

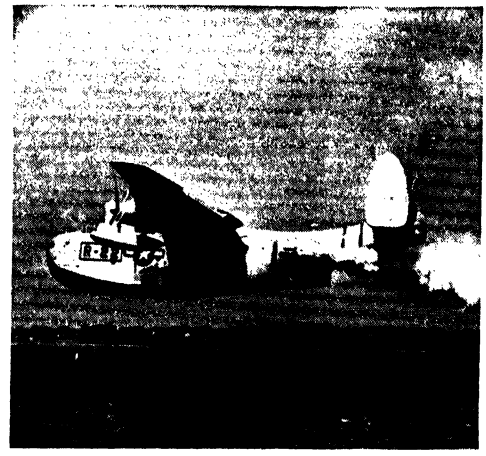


Rubber rafts are used in rescue work at sea. Here a

disaster to this new luxury liner aroused the shipping nations to action. In 1914, they signed an agreement to maintain an ice patrol and observation service in this area for the benefit of all shipping. Each nation was to bear a part of the expense, and the United States was asked to carry out the actual work. The Coast Guard took over the task, and has performed it faithfully and efficiently. The danger period generally begins in March and lasts until about the first of July, when the Ice Patrol is discontinued for the year.

Another important part of the Coast Guard's work is the operation of Ocean Weather Station vessels, under a United Nations agreement. There are a number of sturdy cutters in this service, which is in operation every day of the year. Each cutter on duty stays at a fixed position at sea, for three weeks at a time, and then another cutter takes its place. These ships and the men on them work regardless of storms or bad weather. Their job is to act as mid-ocean weather stations to help air liners navigate above the ocean. In 1948 the cutters contacted 13,631 planes at sea, and used radar to give accurate "fixes" to 8,756 airplane pilots asking for their positions.

The Bering Sea Patrol is another vital service. It was established in 1868, in order to conserve wild life in the North Pacific, Bering Sea and Alaskan waters. In 1911, it was extended to pelagic (deep-sea) sealing, as the result of an agreement among Japan, Russia, Great Britain and the United States. Besides conserving wild life, the Bering Sea Patrol carries mail, holds courts of law and examines vessels. It gives dental and medical aid to natives and seafarers and carries food and supplies to distressed communities. It plays a most important part in the life of those isolated and primitive regions. Under a law passed in 1799, the Coast Guard has co-operated with the Navy in all the nation's wars at sea. In World War II the Coast Guard protected vessels and ports from sabotage. It maintained beach patrols along the coasts of the United States, and it convoyed merchant vessels. It helped to develop methods for invasion landings; vessels manned by the Coast Guard took part in all important Pacific and European landings. A Coast Guard Women's Reserve did office work and other tasks and freed regular Coast Guard men for combat duty. The members of the Women's Reserve were known as Spars, from



Planes help in search and rescue work. Above, a PBM-5 makes a jet-assisted take-off. Below, a helicopter lands on a tablecloth-size air strip.

survivor of a plane crash is being towed to safety.

the motto of the Coast Guard: *Semper Paratus.* (These Latin words mean "always ready.")

The Coast Guard maintains more than 36,000 aids to navigation, such as lighthouses, buoys, fog signals and radio beacons. It has a total of 2,000 craft of all sizes, ranging from 327-foot cutters to 10-foot motor boats. The cutters are fast, seagoing ships, much like cruisers. The Coast Guard operates 96 fixed-wing aircraft and 14 helicopters; these planes are used chiefly for search and rescue operations.

In its communication work, the Coast Guard uses the latest scientific developments, such as loran (LOng Range Aid to Navigation), radar beacons and radio direction finders. Loran radio transmitting stations enable vessels to get their latitude and longitude positions. Radar beacon stations give the distance of any airplane or ship from the station and supply its bearings as well.

The service in 1949 consisted of about 22,000 officers and men as well as 5,000 civilians. The commandant of the service ranks with a full admiral in the Navy or a full general in the Army. Other officers include rear admirals, commodores, captains, commanders, lieutenant commanders, lieutenants, lieutenants (junior grade) and ensigns. The pay of officers and men is the same as in the Navy. The assistant commandant and engineer-in-chief have the rank of rear admiral. Warrant officers include boatswains, gunners, machinists, pharmacists, photographers, radio electricians, carpenters, pay clerks, ship's clerks and electricians. The term of enlistment for enlisted men is three years.

At New London, Connecticut, is the Coast Guard Academy, where future officers take a four-year course like that given naval officers at Annapolis. To enter the academy one must pass a competitive examination, which is held about the middle of February each year in fifty-five different cities. The age limits are from 17 to 22 years, and the applicant must be in good health and a high-school graduate. It is even better if one has had a year of college. The course includes military science, navigation, engineering and cultural subjects. There is a regular program of athletics, and each year there is a practice cruise. Cadets receive $936 a year, and on graduation they are commissioned as ensigns in the service.

This, then, is the United States Coast Guard. Its traditions are second to none; it stands ready to serve in peace and war.

Cadets march in precise formation on parade grounds of the Coast Guard Academy, at New London, Connecticut.

THE MONROE DOCTRINE

A MESSAGE THAT MADE HISTORY

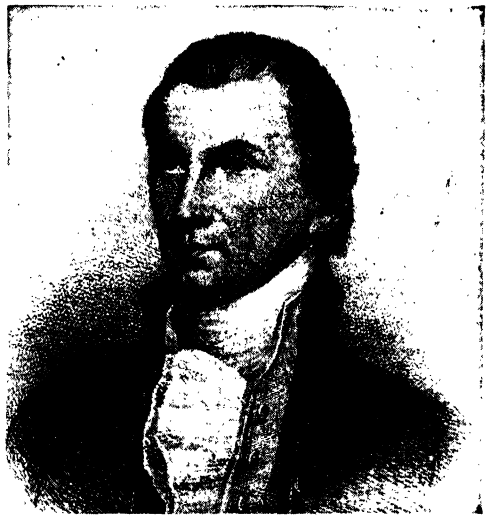
AGAIN and again, in the course of the last century, the Monroe Doctrine has figured in the news. We have even heard such phrases as a Monroe Doctrine for Europe, or a Monroe Doctrine for Asia. Why is there such interest in the doctrine in the United States and in other lands, too? Do foreigners understand what the Monroe Doctrine has meant and what it means today?

The Monroe Doctrine is really a statement of the belief of the people of the United States that the Western Hemisphere should not be interfered with by the Eastern. Though most people in the United States would declare that they believe in the Monroe Doctrine, few understand all that it means.

This belief was first put into definite words by President Monroe in a message to Congress in 1823. The reasons were these: Russia was extending settlements and trading posts from Alaska along the Pacific Coast, and had forbidden any United States vessels to trade north of 51°; and Spain, aided by other European powers, was reported to be planning to recapture her American colonies which had gained their independence between 1806 and 1821.

In the message President Monroe used the following phrases: "The American continents . . . are henceforth not to be considered as subjects for future colonization by any European powers"; and further, referring to the former possessions of Spain, he said, that "we could not view any interposition for the purpose of oppressing them, or controlling in any other manner their destiny by any European power in any other light than as the manifestation of an unfriendly disposition toward the United States."

Put into simpler words, President Monroe meant two things. The first is that the United States would not permit any European nation to found a colony in the Americas, even in unoccupied territory. The second is that when the United States had



President Monroe, who stated this American Doctrine.

recognized the independence of any American nation, it would not permit any European nation to conquer that nation.

Congress took no action, but the message was received with enthusiasm by the people. The Government of Great Britain also approved and let the fact be known in Europe. Russia agreed at once to make no settlements south of 54° 40′, and Spain made no attempt to retake her former colonies, either from fear of the United States or of Great Britain.

Since the region south of the United States was colonized chiefly by French, Spanish and Portuguese, which are called Latin nations, the region is often called Latin America. Most of the applications of the Monroe Doctrine have been concerned with Latin America.

It must be remembered that the doctrine is not formal law, but the expression of an attitude. From time to time the ideas in the original statement have been given new applications by presidents or Secretaries of State. For example, it has been declared several times that the United States would not allow a colony of one European power to be transferred to another, for it might fall into the hands of an unfriendly power.

When Britain and France were trying to persuade independent Texas not to seek admission to the Union, President Polk wrote a message in 1845 warning both countries to desist, and, in 1848, another message was sent warning Great Britain and Spain that neither would be allowed to make a protectorate of Yucatan.

The United States has in many other cases

acted upon the principles of the doctrine. It opposed the action of France in setting up Maximilian as Emperor of Mexico, and the French troops were withdrawn. When Great Britain and Venezuela differed over the boundary between the latter state and British Guiana, President Cleveland compelled Great Britain to arbitrate. In 1902 President Theodore Roosevelt objected, with success, to the attempt of Germany to collect debts from Venezuela by force.

When the United States, at the end of the Spanish War, took Puerto Rico, Guam and the Philippines from Spain, the distinction between the two hemispheres, which President Monroe had stressed, broke down, since the United States had taken over European possessions in both the Old and the New Worlds. Nevertheless, the United States did not give up the policy of watching the Western Hemisphere.

THE UNITED STATES HELPS SPANISH AMERICA IN DARK DAYS

During the first years of the twentieth century the influence of the United States was extended over considerable parts of what had been Spanish America. Some of these nations could not, or would not, pay debts due European nations or their citizens, and some were unable to keep order. Revolutions, which often caused the death of Europeans, were frequent. European nations resented the fact that the United States prevented them from securing satisfaction. Therefore, the United States interfered lest foreign countries should be tempted to take action. In some cases Marines were sent to keep order. Elections were supervised, and in two cases the custom houses were taken over. Part of the revenue collected was used to pay debts due foreigners.

There is little doubt that, but for the attitude of the United States based upon the Monroe Doctrine, Latin America would long ago have been divided—just as Africa has been—into colonies governed by European nations. Though the South Americans realize this fact and have been glad to accept help against Europe, there has, nevertheless, been considerable jealousy and dread of the "Colossus of the North." Some political leaders have expressed fear that the United States was intending to annex some or all of the states it was supervising. This ill-feeling was sometimes increased by the efforts of foreign agents. It persisted in spite of assurances from the United States.

The Monroe Doctrine was from the beginning unilateral (one-sided). The United States determined upon a course, and acted, though occasionally the advice of a few other nations was asked. When the administration of President Franklin D. Roosevelt began, he announced that he favored a "Good Neighbor" policy, and that he wished to change the Monroe Doctrine into a multilateral (many-sided) policy. That is, he wished all the American nations to act together for the general good.

To prove the good faith of the United States, the Platt Amendment, which limited the freedom of Cuba, was repealed by Congress; wherever troops had been stationed, they were withdrawn; every effort was made to strengthen the influence of the Pan American Union.

THE PANAMA CONFERENCE PLACES A WAR-FREE ZONE AROUND THE AMERICAS

An important meeting with the purpose of strengthening the Monroe Doctrine was held at Panama City, October 1-3, 1939. Delegates from the twenty-one republics of the hemisphere were present, and agreed unanimously to set up a "security belt" 300 to 600 miles from the Atlantic coast of the United States and South America, from which submarines should be barred, and warships of warring nations should have only legal entry of twenty-four hours. It was also voted to set up in Washington a committee which had the power to act quickly should the need for defense arise.

Another conference was opened at Havana on July 20, 1940, with all the American republics represented. Though there were differences of opinion on methods the conference voted in the Act of Havana to exercise temporary administration over any threatened European colony in the New World. It also voted that each country should prepare to the best of its ability for continental defense, and that measures should be taken against "Fifth Columnists." For the first time in the memory of man, all the American republics agreed upon joint action for defense. Since that time there have been other pacts, bringing together more closely the nations of the New World. For the present, at least, Latin-American dread of "Yankee Imperialism" seems to have been quieted.

So far the revised and broadened form of the Monroe Doctrine seems to be successful. Whether it can survive the conflict of varying interests and jealousies of the twenty-one states, time alone can tell.

THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 3141.

STORY POEMS

Illustrated by Dorothy Bayley Morse

The Jumblies

By EDWARD LEAR (1812-1888)

THEY went to sea in a sieve, they did;
In a sieve they went to sea;
In spite of all their friends could say,
On a winter's morn, on a stormy day,
In a sieve they went to sea.
And when the sieve turned round and round,
And every one cried, "You'll all be drowned!"
They called aloud, "Our sieve ain't big;
But we don't care a button; we don't care a fig:
In a sieve we'll go to sea!"
Far and few, far and few,
Are the lands where the Jumblies live:
Their heads are green, and their hands are blue;
And they went to sea in a sieve.

They sailed away in a sieve, they did,
In a sieve they sailed so fast,
With only a beautiful pea-green veil
Tied with a ribbon, by way of a sail,
To a small tobacco-pipe mast.
And every one said who saw them go,
"Oh! won't they be soon upset, you know?
For the sky is dark, and the voyage is long;
And, happen what may, it's extremely wrong
In a sieve to sail so fast."

The water it soon came in, it did;
The water it soon came in:
So, to keep them dry, they wrapped their feet
In a pinky paper all folded neat:
And they fastened it down with a pin.
And they passed the night in a crockery-jar;
And each of them said, "How wise we are!
Though the sky be dark, and the voyage be long,
Yet we never can think we were rash or wrong,
While round in our sieve we spin."

And all night long they sailed away;
And, when the sun went down,
They whistled and warbled a moony song
To the echoing sound of a coppery gong,
In the shade of the mountains brown,
"O Timballoo! How happy we are
When we live in a sieve and a crockery-jar!
And all night long, in the moonlight pale,
We sail away with a pea-green sail
In the shade of the mountains brown."

They sailed to the Western Sea, they did,—
To a land all covered with trees:
And they bought an owl, and a useful cart,
And a pound of rice, and a cranberry tart,
And a hive of silvery bees;
And they bought a pig, and some green jackdaws,
And a lovely monkey with lollipop paws,
And forty bottles of ring-bo-ree,
And no end of Stilton cheese:

And in twenty years they all came back,—
In twenty years or more;
And every one said, "How tall they've grown!
For they've been to the Lakes and the Torrible Zone,
And the hills of the Chankly Bore."
And they drank their health, and gave them a feast
Of dumplings made of beautiful yeast;
And every one said, "If we only live,
We, too, will go to sea in a sieve,
To the hills of the Chankly Bore."
Far and few, far and few,
Are the lands where the Jumblies live:
Their heads are green, and their hands are blue;
And they went to sea in a sieve.

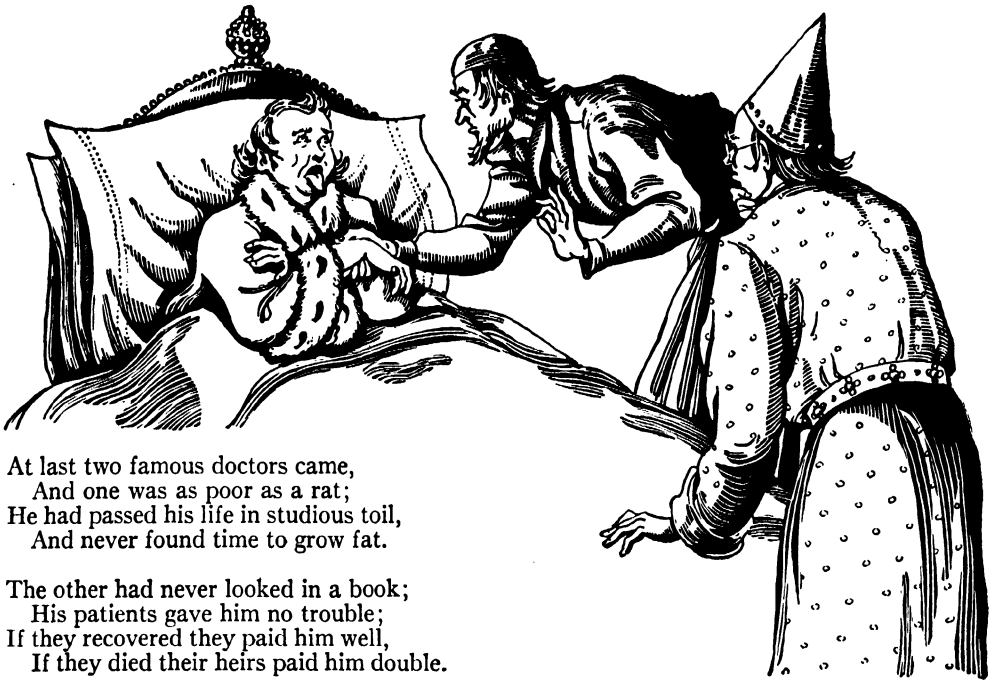
The Enchanted Shirt*

By JOHN HAY (1838-1905)

THE King was sick. His cheek was red,
And his eye was clear and bright;
He ate and drank with a kingly zest,
And peacefully snored at night.

But he said he was sick, and a king should know,
And doctors came by the score;
They did not cure him. He cut off their heads,
And sent to the schools for more.

*Copyright 1871, 1880, 1889, by John Hay.



At last two famous doctors came,
And one was as poor as a rat;
He had passed his life in studious toil,
And never found time to grow fat.

The other had never looked in a book;
His patients gave him no trouble;
If they recovered they paid him well,
If they died their heirs paid him double.

Together they looked at the royal tongue,
As the King on his couch reclined;
In succession they thumped his august chest,
But no trace of disease could find.

The old sage said, "You're as sound as a nut."
"Hang him up!" roared the King, in a gale—
In a ten-knot gale of royal rage.
The other leech grew a shade pale.

But he pensively rubbed his sagacious nose,
And thus his prescription ran—
The King will be well if he sleeps one night
In the shirt of a Happy Man.

Wide o'er the realm the couriers rode,
And fast their horses ran;
And many they saw, and to many they spoke,
But they found no Happy Man.

At last they came to a village gate,
A beggar lay whistling there;
He whistled and sang and laughed and rolled
On the grass in the soft June air.

The weary couriers paused and looked
At the scamp so blithe and gay;
And one of them said, "Heaven save you, friend!
You seem to be happy to-day."

"O yes, fair sirs!" the rascal laughed,
And his voice rang free and glad;
"An idle man has so much to do
That he never has time to be sad."

"This is our man," the courier said;
"Our luck has led us aright;
I will give you a hundred ducats, friend,
For the loan of your shirt to-night."

The merry blackguard lay back on the grass,
And laughed till his face was black;
"I would do it, God wot," and he roared with the fun,
"But I haven't a shirt to my back."

Each day to the King the reports came in
Of his unsuccessful spies,
And the sad panorama of human woes
Passed daily under his eyes.

And he grew ashamed of his useless life,
And his maladies hatched in gloom;
He opened his windows and let the air
Of the free heaven into his room.

And out he went in the world and toiled
In his own appointed way;
And the people blessed him, the land was glad,
And the King was well and gay.

The Sea-King's Burial

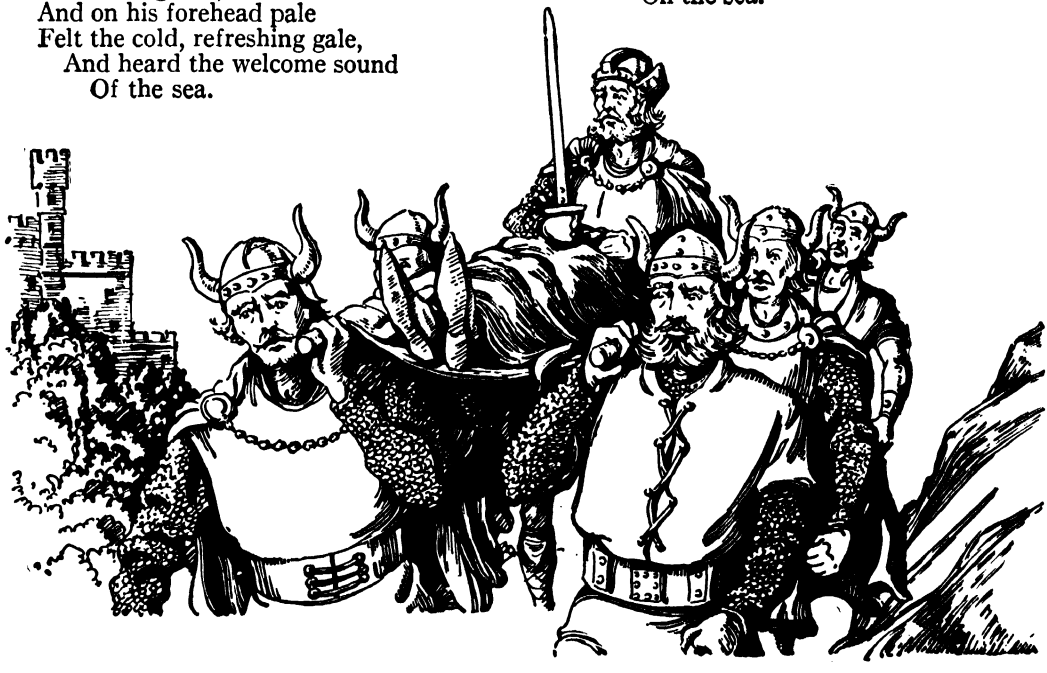
By CHARLES MACKAY
(1814-1889)

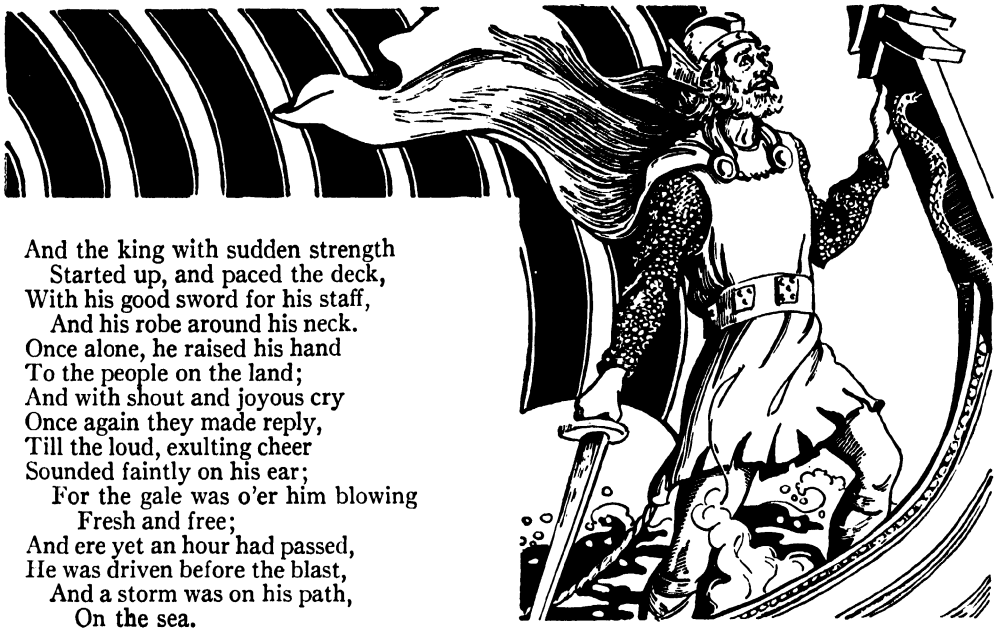
"My strength is failing fast,"
Said the sea-king to his men,
"I shall never sail the seas
Like a conqueror again,
But while yet a drop remains
Of the life-blood in my veins,
Raise, oh, raise me from my bed;
Put the crown upon my head;
Put my good sword in my hand,
And so lead me to the strand,
Where my ship at anchor rides
Steadily;
If I cannot end my life
In the crimsoned battle-strife,
Let me die as I have lived,
On the sea."

They have raised King Balder up,
Put his crown upon his head;
They have sheathed his limbs in mail,
And the purple o'er him spread;
And amid the greeting rude
Of a gathering multitude,
Borne him slowly to the shore—
All the energy of yore
From his dim eyes flashing forth—
Old sea-lion of the North—
As he looked upon his ship
Riding free,
And on his forehead pale
Felt the cold, refreshing gale,
And heard the welcome sound
Of the sea.

They have borne him to the ship
With a slow and solemn tread;
They have placed him on the deck
With his crown upon his head,
Where he sat as on a throne:
And have left him there alone,
With his anchor ready weighed,
And his snowy sails displayed
To the favoring wind once more
Blowing freshly from the shore,
And have bidden him farewell
Tenderly,
Saying: "King of mighty men,
We shall meet thee yet again,
In Valhalla, with the monarchs
Of the sea."

Underneath him in the hold
They had placed the lighted
brand:
And the fire was burning slow
As the vessel from the land,
Like a stag-hound from the slips,
Darted forth from out the ships.
There was music in her sail
As it swelled before the gale,
And a dashing at her prow
As it cleft the waves below;
And the good ship sped along,
Scudding free;
As on many a battle morn
In her time she had been borne,
To struggle, and to conquer
On the sea.





And the king with sudden strength
Started up, and paced the deck,
With his good sword for his staff,
And his robe around his neck.
Once alone, he raised his hand
To the people on the land;
And with shout and joyous cry
Once again they made reply,
Till the loud, exulting cheer
Sounded faintly on his ear;
For the gale was o'er him blowing
Fresh and free;
And ere yet an hour had passed,
He was driven before the blast,
And a storm was on his path,
On the sea.

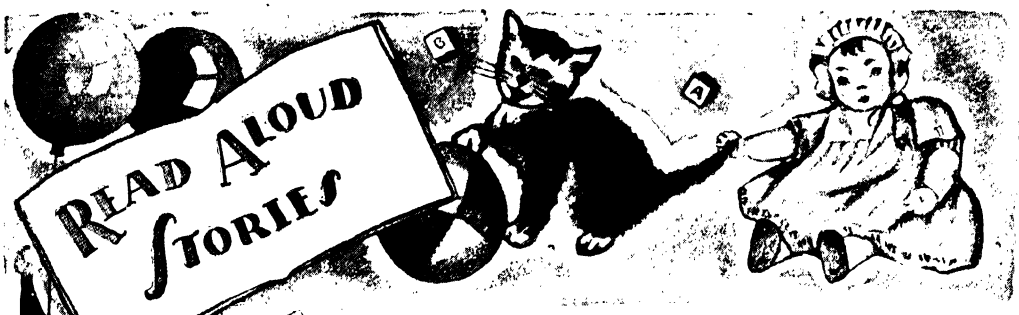
"So blow, ye tempests, blow,
And my spirit shall not quail;
I have fought with many a foe,
I have weathered many a gale;
And in this hour of death,
Ere I yield my fleeting breath—
Ere the fire now burning slow
Shall come rushing from below,
And this worn and wasted frame
Be devoted to the flame—
I will raise my voice in triumph,
Singing free;
To the great All-Father's home
I am driving through the foam,
I am sailing to Valhalla,
O'er the sea.

"So blow, ye stormy winds—
And, ye flames, ascend on high;
In easy, idle bed
Let the slave and coward die!
But give me the driving keel,
Clang of shields and flashing steel;
Or my foot on foreign ground,
With my enemies around!
Happy, happy, thus I'd yield,
On the deck or on the field,
My last breath, shouting 'On
To victory.'
But since this has been denied,
They shall say that I have died
Without flinching, like a monarch
Of the sea."

And Balder spoke no more,
And no sound escaped his lip;
And he looked, yet scarcely saw
The destruction of his ship,
Nor the fleet sparks mounting high,
Nor the glare upon the sky;
Scarcely heard the billows dash,
Nor the burning timber crash;
Scarcely felt the scorching heat
That was gathering at his feet,
Nor the fierce flames mounting o'er him
Greedily,
But the life was in him yet,
And the courage to forget
All his pain, in his triumph
On the sea.

Once alone, a cry arose,
Half of anguish, half of pride,
As he sprang upon his feet,
With the flames on every side.
"I am coming!" said the king,
"Where the swords and bucklers ring,
Where the warrior lives again,
Where the souls of mighty men,
Where the weary find repose,
And the red wine ever flows.
I am coming, great All-Father,
Unto Thee!
Unto Odin, unto Thor,
And the strong, true hearts of yore—
I am coming to Valhalla,
O'er the sea."

THE NEXT POEMS ARE ON PAGE 3337.



ROBIN'S CHRISTMAS SONG

ONCE on a sunny morning an old gray pussy-cat went down by the waterside, and there she saw Wee Robin Redbreast, hopping on a briar.

And Pussy-Cat said, "Where are you going, Wee Robin?"

And Wee Robin said, "I am going away to the king, to sing him a song this good Christmas morning."

And Pussy-Cat said, "Come here, Wee Robin, and I will let you see the bonny white fur around my neck."

But Wee Robin said: "No, no, Gray Pussy, no, no. You ate the wee mousie, but you shall never eat me."

So Wee Robin flew away and away, until he came to a stone wall on the border of the wood, and there he saw a gray greedy hawk sitting.

And the gray greedy hawk said, "Where are you going, Wee Robin?"

And Wee Robin said, "I am going away to the king, to sing him a song this good Christmas morning."

And the gray greedy hawk said, "Come here, Wee Robin, and I will let you see the speckled feather in my wing."

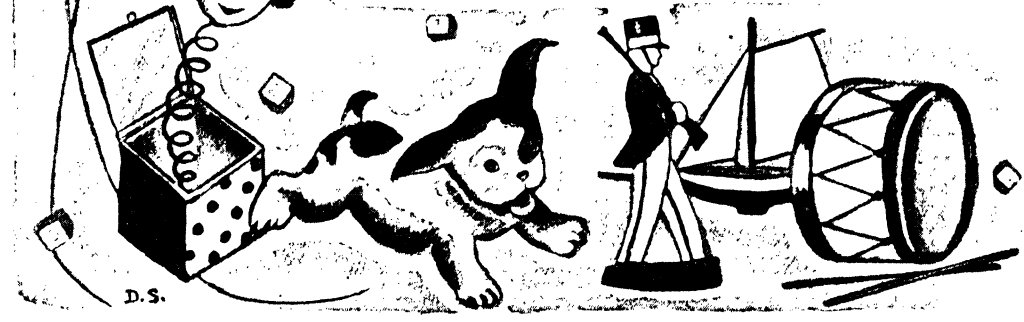
But Wee Robin said: "No, no, gray Greedy Hawk, no, no. You pecked at the wee sparrow, but you shall not peck at me."

So Wee Robin flew away until he came to the side of a great rock, and there he saw a sly fox sitting.

And the sly fox said, "Where are you going, Wee Robin?"

And Wee Robin said, "I am going away to the king and sing him a song this good Christmas morning."

And the sly fox said, "Come here, Wee Robin, and I will let you see the spot on my tail."



But Wee Robin said: "No, no, Sly Fox, no, no. You bit the wee lambie, but you shall never bite me."

Wee Robin flew away until he came to the banks of a rivulet, and there he saw a wee boy sitting, and the wee boy said, "Where are you going, Wee Robin?"

And the Wee Robin said, "I am going away to the king, to sing him a song this good Christmas morning."

And the wee boy said, "Come here, Wee Robin, and see the crumbs in my pocket."

But Wee Robin said: "No, no, Wee Boy, no, no. You caught the wee goldfinch, but you shall never catch me."

So Wee Robin flew away and away, until he came to the king, and there he sat on a window sill and sang to the king a bonny song.

And after a fine Christmas dinner Wee Robin flew home to the waterside and hopped on a briar.

DRAKESTAIL

This Version is by Margaret Lima Norgaard

DRAKESTAIL was a tiny black duck, but he was a very wise duck, and he had a lot of money. Now the king of the country borrowed some money from Drakestail, but he never paid it back. So after waiting one year, then two years, then three years—Drakestail became uneasy, so much so that at last he resolved to go and see the king and get repaid.

So one fine morning Drakestail, very spruce and fresh, takes the road, singing:

"Quack, quack, quack!
When shall I get my money back?"

He had not gone far when he met friend Doggy.

"Good-morning, neighbor," says the dog. "Where are you off to so early?"

"I am going to the king for what he owes me."

"Oh, take me with you!"

Drakestail said to himself: "One can't have too many friends." Aloud he says, "I will, but going on all fours you will soon be tired. Make yourself quite small, get into my throat—go into my gizzard, and I will carry you."

"Happy thought!" says friend Dog. He takes bag and baggage, and, presto! is gone like a letter into the mail-box.

And Drakestail is off again, all spruce and fresh, still singing:

"Quack, quack, quack!
When shall I have my money back?"

He had not gone far when he met his friend Ladder, leaning on her wall.

"Good-morning, my duckling," says Ladder, "whither away so bold?"

"I am going to the king for what he owes me."

"Oh! take me with you!"

Drakestail said to himself: "One can't have too many friends." Aloud says he: "I will, but then with your wooden legs you will soon be tired. Make yourself quite small, get into my throat—go into my gizzard, and I will carry you."

"Happy thought!" says my friend Ladder, and nimble, bag and baggage, goes to keep company with friend Dog.

And "Quack, quack, quack," Drakestail is off again, singing and spruce as before. A little further he meets his friend River, wandering quietly in the sunshine, her water rippling happily over stones and sand.

"Thou, my cherub," says she, "whither so lonesome, with arching tail, on this muddy road?"

"I am going to the king, for what he owes me."

"Oh, take me with you!"

Drakestail said to himself: "One can't have too many friends." Aloud says he: "I will, but you who sleep while you walk will soon get tired. Make yourself quite small, get into my throat—go into my gizzard, and I will carry you."

"Happy thought!" says my friend River.

She takes bag and baggage, and glou, glou, glou! she takes her place between friend Dog and my friend Ladder.

And "Quack, quack, quack," Drakestail is off again singing.

He arrived thus at the capital, and threaded his way straight up Main Street, still running and singing:

"Quack, quack, quack!
When shall I get my money back?"

to the great astonishment of the good folks, till he came to the king's palace. He knocks on the door: "Toc! toc!"

"Who is there?" asks the porter, putting his head out of the wicket.

" 'Tis I, Drakestail. I want to speak to the king."

"Speak to the king! That's easily said. The king is dining, and will not be disturbed."

"Tell him that it is I,
And I have come he well knows why!"

says Drakestail, and the porter shuts his wicket and goes up to say it to the king, who was just sitting down to dinner with a napkin round his neck, and all his ministers.

"Put him with the turkeys and chickens," said the king, laughing. "He's only an impudent little duck! I have no intentions of paying back his money!"

So the porter put Drakestail into the poultry yard. Fancy how vexed Drakestail was!

"So that's it," says he. "Quack, quack, quack!" he began to sing with all his might, so that the king might be sure to hear him. "When shall I get my money back?"

But when the turkeys and chickens heard the noise he was making, they rushed at him all together, to overwhelm him with pecks.

"I am lost!" said Drakestail to himself, when by good luck he remembers his comrade, friend Dog, and he cries:

"Oh, Dog, so brave,
come out of your earth,
Or Drakestail's life
is of little worth."

Then friend Dog, who was only waiting for these words, hastens out, throws himself on the wicked fowls, and quick! quack! he strikes them down with his big paws, and tears at them with his big teeth, and they rush, clucking and gobble-gobbling to their roosts. And Drakestail, quite content, began to sing again:

"Quack, quack, quack!
When shall I get my money back?"

When the king, who was still at table, heard this refrain, he was terribly annoyed. He ordered them to throw this tail of a drake into the well, to make an end of him, and it was done as he commanded.

Drakestail was in despair of getting himself out of such a deep hole, when he remembered his lady friend Ladder.

"Ladder, Ladder, come
out of thy hold,
Or Drakestail's days will
soon be told."

My friend Ladder, who was only waiting for these words, hastens out, leans her two arms on the edge of the well; then Drakestail climbs nimbly on her back, and hop! he is in the yard, where he begins to sing louder than ever:

"Quack, quack, quack!
When shall I get my money back?"

Well, when the king heard him, he was so VERY angry that he commanded that the furnace be heated and this tail of a drake thrown into it.

The furnace was soon hot, but this time Drakestail was not so afraid; he counted on his sweetheart, my friend River.

"River, River, outward flow,
Or to death Drakestail must go."

My friend River hastens out, and errouf! throws herself into the furnace, which she floods, with all the people who have lighted it. After which she flowed growling and bubbling into the hall of the palace, and on into the dining-room where the king and his ministers were still at table. And when the king saw that fierce water rushing toward him he quite lost his head, and not knowing where to run to, he jumped pell-mell out of the window, and all his ministers jumped with him. And then they got up and ran clear out of the kingdom, with the river flowing after them. And for all I know, they are running still.

Drakestail, left alone in the king's palace, set to work to hunt for his dear money. But in vain he rummaged in all the drawers. He found nothing. All had been spent.

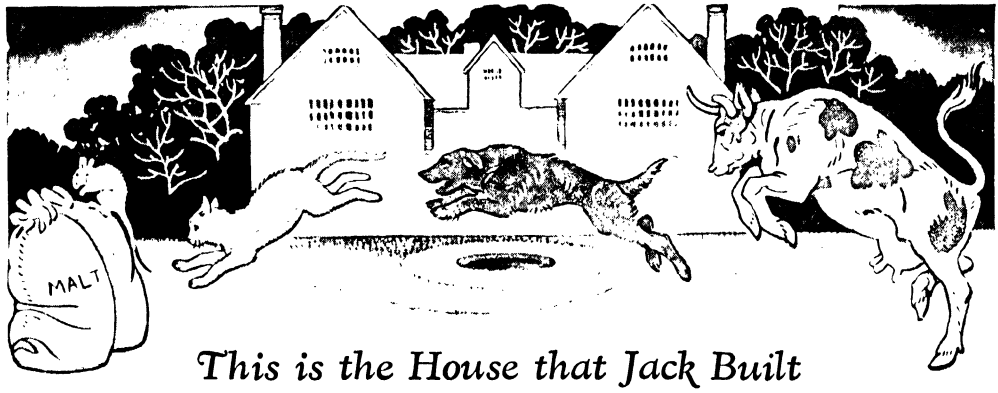
Ferreting thus from room to room, he came at last to the one with the throne in it, and feeling tired, he sat himself down on it to think over his adventures. He was still sitting there when the people came back into the palace, and when they saw Drakestail on the royal seat, they all broke out into loud cries of surprise and joy:

"The King is dead; long live the King!
Heaven has sent us down this thing."

Then the crowd found a golden crown which they placed on Drakestail's head. Thus he became king.

"And now," said he after the ceremony, "ladies and gentlemen, let's go to supper. I am so hungry!"

THE NEXT READ ALOUD STORIES ARE ON PAGE 3711.



This is the House that Jack Built

THIS is the house that Jack built.

THIS is the malt that lay in the house
that Jack built.

THIS is the rat that ate the malt
That lay in the house that Jack built.

THIS is the cat that killed the rat
that ate the malt
That lay in the house that Jack built.

THIS is the dog that worried the cat
That killed the rat that ate the malt
That lay in the house that Jack built.

THIS is the cow with the crumpled horn
That tossed the dog that worried the cat
That killed the rat that ate the malt
That lay in the house that Jack built.

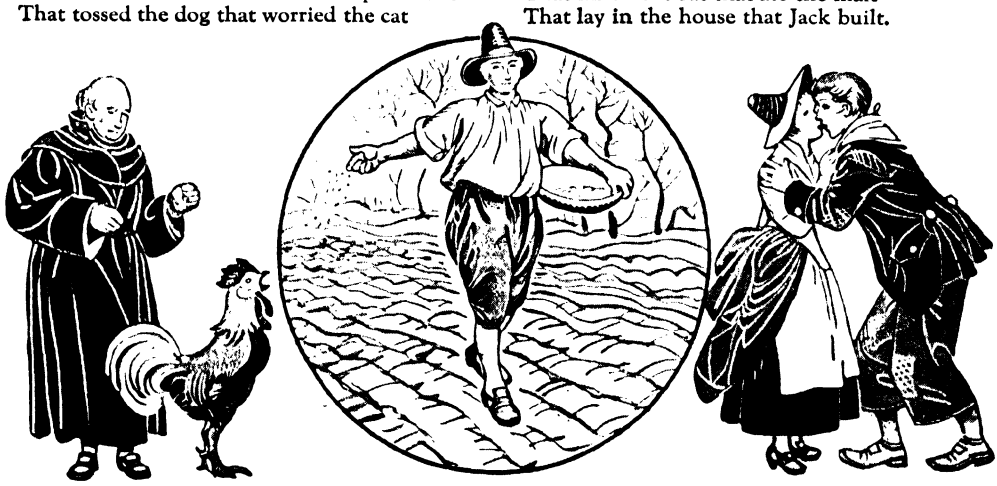
THIS is the maiden all forlorn
That milked the cow with the crumpled horn
That tossed the dog that worried the cat
That killed the rat that ate the malt
That lay in the house that Jack built.

THIS is the man all tattered and torn
That kissed the maiden all forlorn
That milked the cow with the crumpled horn
That tossed the dog that worried the cat
That killed the rat that ate the malt
That lay in the house that Jack built.

THIS is the priest all shaven and shorn
That married the man all tattered and torn
That kissed the maiden all forlorn
That milked the cow with the crumpled horn
That tossed the dog that worried the cat
That killed the rat that ate the malt
That lay in the house that Jack built.

THIS is the cock that crowed in the morn
That wakened the priest all shaven and shorn
That married the man all tattered and torn
That kissed the maiden all forlorn
That milked the cow with the crumpled horn
That tossed the dog that worried the cat
That killed the rat that ate the malt
That lay in the house that Jack built.

THIS is the farmer sowing the corn
That kept the cock that crowed in the morn
That wakened the priest all shaven and shorn
That married the man all tattered and torn
That kissed the maiden all forlorn
That milked the cow with the crumpled horn
That tossed the dog that worried the cat
That killed the rat that ate the malt
That lay in the house that Jack built.



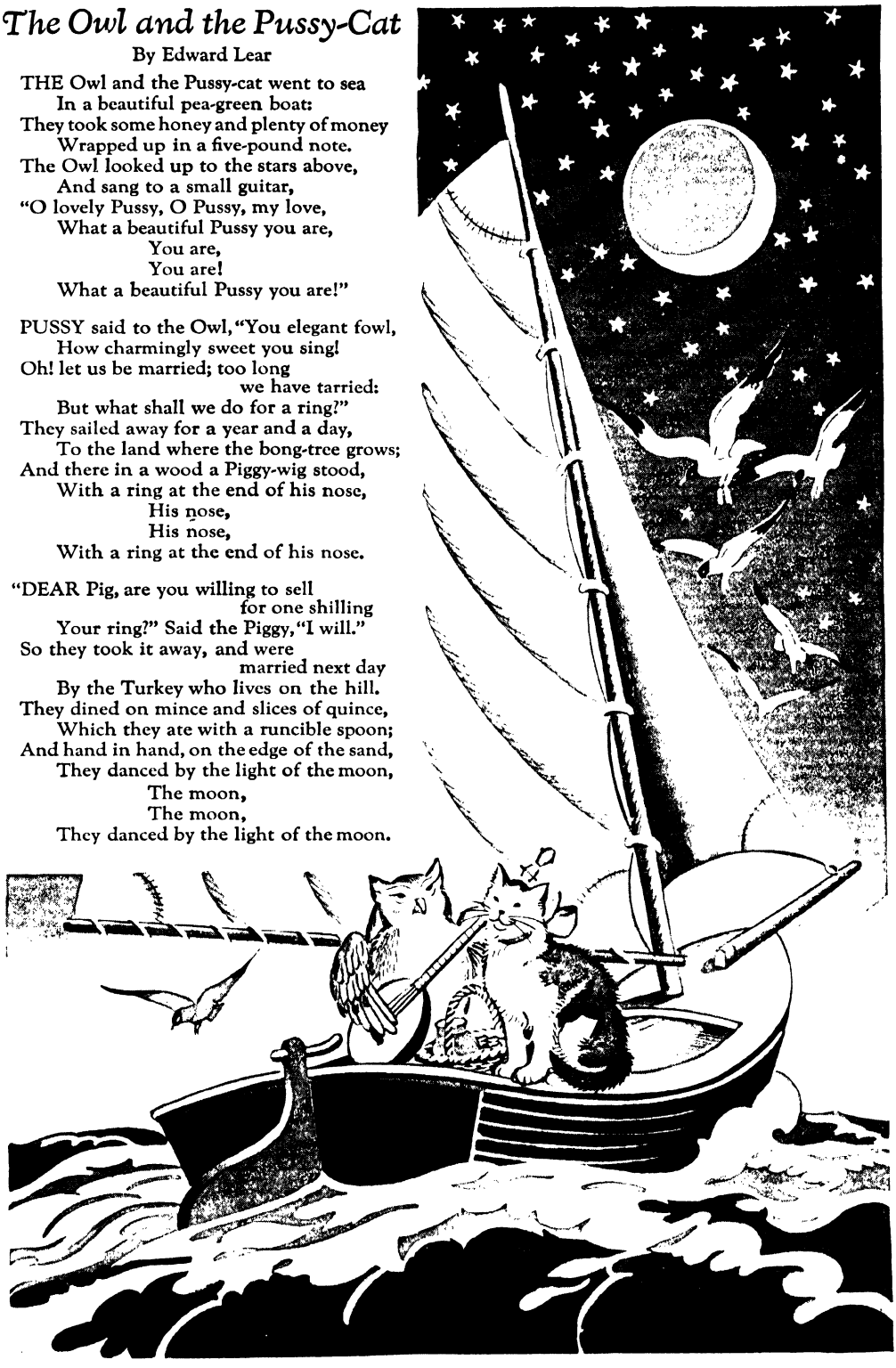
The Owl and the Pussy-Cat

By Edward Lear

THE Owl and the Pussy-cat went to sea
In a beautiful pea-green boat:
They took some honey and plenty of money
Wrapped up in a five-pound note.
The Owl looked up to the stars above,
And sang to a small guitar,
"O lovely Pussy, O Pussy, my love,
What a beautiful Pussy you are,
You are,
You are!
What a beautiful Pussy you are!"

PUSSY said to the Owl, "You elegant fowl,
How charmingly sweet you sing!
Oh! let us be married; too long
we have tarried:
But what shall we do for a ring?"
They sailed away for a year and a day,
To the land where the bong-tree grows;
And there in a wood a Piggy-wig stood,
With a ring at the end of his nose,
His nose,
His nose,
With a ring at the end of his nose.

"DEAR Pig, are you willing to sell
for one shilling
Your ring?" Said the Piggy, "I will."
So they took it away, and were
married next day
By the Turkey who lives on the hill.
They dined on mince and slices of quince,
Which they ate with a runcible spoon;
And hand in hand, on the edge of the sand,
They danced by the light of the moon,
The moon,
The moon,
They danced by the light of the moon.



A SIMPLE PERISCOPE

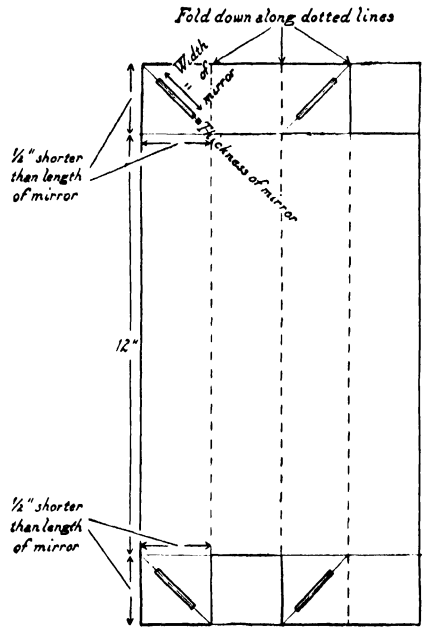
YOU have undoubtedly read of the ingenious periscope that enables an officer in a submerged submarine to see what is on the surface of the water (we tell about submarines on page 197). Periscopes are also used on dry land for various purposes. For example, with this instrument you can see a parade passing by, even though grownups are standing directly in front of you. Any boy or girl can easily make a periscope out of some cardboard and two pocket mirrors identical in size.

Study the diagram shown in Figure 1; this is to be drawn on a piece of stout cardboard. You will observe that at top and bottom you have a series of identical squares. Each side of these squares will be ½ inch shorter than the length of your mirrors. After marking out the squares, draw diagonals on two of them at the top and two at the bottom, as shown in Figure 1. Along each diagonal draw a rectangle, as shown, which is to be equally distant from the two corners connected by the diagonal. The length and width of each rectangle will correspond to the width and thickness of the mirrors that are to be used.

Cut out the cardboard along the heavy lines shown on the diagram; also cut out the slits formed by the four rectangles. Next, fold downward along the dotted lines. In order to make the fold easily, place a ruler along each dotted line, and run a penknife lightly through the line.

When the cardboard has been folded, adjust it so that it forms a chimney-like affair with a square base (see Figure 2). The two free edges are fastened together by means of Scotch tape (Figure 2).

The mirrors are now inserted through the slots provided for them at the top and bottom; they will protrude ¼ inch at each end. Fasten the mirrors in place by means of Scotch tape (Figures 3 and 4). Finally, cut out two squares of cardboard, each equal in dimension to the base of the periscope.



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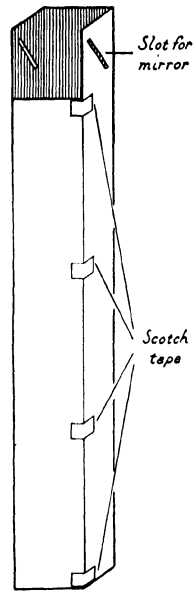

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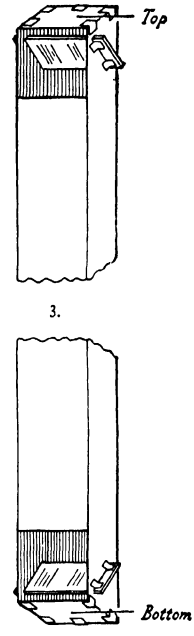


4.

One of these two squares will form the top of the periscope; the other will form the bottom. They are to be set in place by means of Scotch tape (Figures 3 and 4). By looking at the bottom mirror you will have a clear view ahead, even though another object is directly in front of you—if the top mirror is above this object. You can easily remove the mirrors if you must use them for some other purpose.

HOW TO REMOVE STAINS

HERE are some useful suggestions to follow if you wish to remove stains of various kinds from clothing, from articles of furniture and from carpets.

INK STAINS

INK stains are not difficult to remove if you set to work as soon after the accident as possible. First dip the stained part in clear water until some of the ink has disappeared; then put the material in warm milk and rub the spot gently. Milk is used to remove ink stains from white and colored goods alike. Baking soda, too, will be found effective for this purpose. If the spot is very stubborn, try oxalic acid. This acid is very strong. Therefore you should use it very carefully, as it may eat a hole in the goods unless it is washed out at once after being applied.

If ink is spilled on the carpet, sponge it up at once with warm wet cloths and then rub the spot well with a cloth dipped in cold milk. Wash out with clear hot water; then sift on a little cornmeal or dry sawdust. Starch or flour may also be used.

FRUIT STAINS

FOR a fruit stain on a dress, rub on a little salt or borax, and then pour boiling water through the stained part. If the dress has been stained for some time, use a weak solution of oxalic acid, taking care to wash it out again immediately after. Tomato juice and salt may be applied and the dress then hung out in the sun.

ALCOHOL SPOT ON WOOD

IF you spill alcohol on an article of furniture, a white spot in the wood may be the result. Instead of wiping up the alcohol at once, put a little linseed oil on the spot. The alcohol will mix with the oil and will not leave an ugly spot. Rub the place with a little kerosene, and no trace of the alcohol will be left.

STAINS ON THE CARPET

SOMETIMES boys soil a carpet by tracking into the house crude oil or dirt from the street. With a whiskbroom remove as much of the dirt as possible. Then rub the place with flour or salt.

MUD STAINS

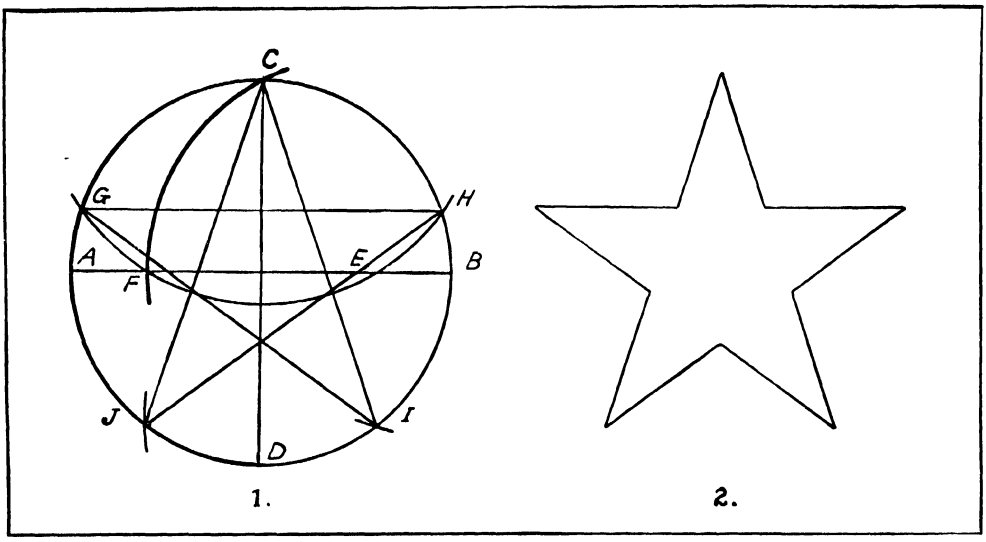
IF a dark cloth dress is splashed with mud, wait until it dries, and then give it a brisk brushing with a stiff whiskbroom. If a little mark still remains on the dress, rub it with grated raw potato.

TAR STAINS

IF you should rub against a greasy automobile part or touch a bit of tar, you know what the result will be—an ugly grease spot which nothing but turpentine will remove. First put a little lard on the spot to loosen the dirt, and with a knife scrape off any loose particles. Then sponge the place with turpentine and hang the dress on the line to let the air blow through it.

A PERFECT FIVE-POINTED STAR

IT sometimes happens that you are required to draw a star or several stars for some design or other—perhaps in connection with a school project or for the cover of a notebook. A star seems to be a difficult sort of figure to draw, but it really isn't difficult, if you only know how. And we are now going to show you how!



1. 2.

First, draw a circle taking up as much space as the star you wish to draw—that is, the points of the star will fall on the circumference of the circle. Draw two diameters—AB and CD—at right angles to each other (Figure 1). Divide in halves the line from the center of the circle to B; the halfway point is to be called E. Set the compass so that the point is at E and the writing tip at C. Draw an arc from C to F; F is the place where the arc meets the diameter AB. Next, put the point of the compass at C and the writing tip at F. With C as a center, draw an arc from G to H, as shown. Keeping the compass set in the same way and with H as a center, mark off point I on the circumference; then, with I as a center, mark off point J.

Draw straight lines connecting points C and J, C and I, H and G, H and J, I and G. Erase all unnecessary lines and you will have the perfect star shown in Figure 2.

A HOMEMADE ARTESIAN WELL

FOR this interesting experiment you should provide yourself with a bucket or pail and an empty tin can, from which the top has been removed with a can-opener. First of all, you are to punch a hole in the bottom of the tin can by means of a hammer and a nail. Next, you are to fill the bucket or pail half full of water. Press the can, bottom side down, into the water. The water will spout freely from the hole that you made in the bottom of the can with the hammer and the nail.

This experiment will give you a fairly good idea of the principle of the artesian well. This type of well, named after the province of Artois, France, provides water for communities in many parts of the world. We find artesian wells in valleys where the surface layer of earth—generally made up of sand or sandstone—is porous, and where there is an underlying layer—often of clay—that is impervious to water. (When we say that something or other is impervious to water, we mean that water can not pass through it. Rubber, for example, is impervious to water.) Artesian wells are found particularly in valleys surrounded on all sides by slopes that form a sort of cup. Since the slopes dip toward the center of the valley, the water that has collected underground at this point is pressed upon constantly by the water that has collected along the slopes.

When the lowest point of the valley is tapped, the pressure that is always exerted at this point causes the water to gush out. In the same way, the pressure of the water at the bottom of the can, in the experiment, causes the water to spout.

THE NEXT THINGS TO MAKE AND TO DO ARE ON PAGE 3247.

HOMES and HOUSING

THE STORY OF SHELTER

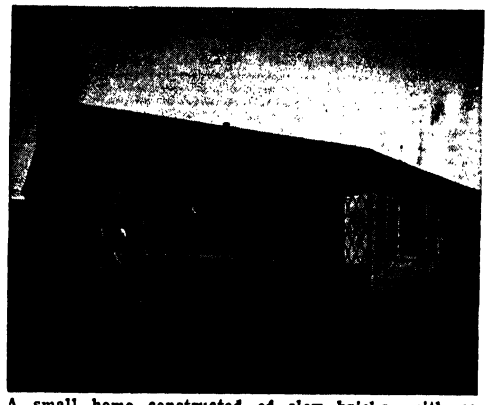
THE story of man's shelter is the story of his development from an untaught creature living in caves to his present highly complicated way of life. Shelter first meant protection from the weather and from attack by other men and by animals. Gradually it came to include comfort, beauty and man's sense of pride in owning fine things.

Throughout the centuries it has also stood for something above and beyond these ideas of safety, comfort and beauty. "Home" is one of the most beloved words in the language. You often hear quotations like "There's no place like home," "East, West, home's best," "Home is where the heart is," and "Home is the sailor, home from the sea." They all show how important this idea of "home" is to each and every one of us.

We say that "a man's home is his castle." Here we try to put into a few words all the many thoughts that the four letters of the simple term "home" bring to mind. In his own home an ordinary man is a king.

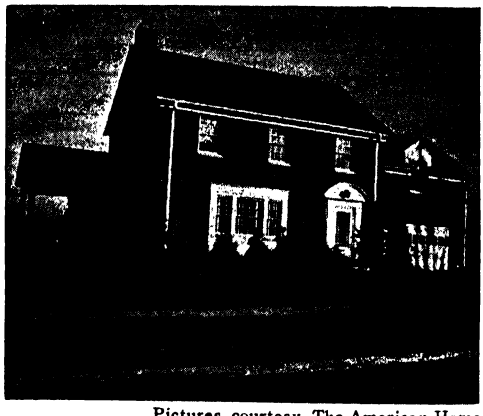
We do not know much about man's first homes. But we do know that ever so long ago in Europe men lived in natural caves in the limestone cliffs. Many of these caves have been explored, and in them have been found stone arrows and spear heads, remains of fire, bones and utensils made of burnt clay. In Spain, in large caves where many families once lived together, there are wonderful and beautiful pictures on the walls. These pictures of men hunting bison, deer and other animals were painted in earth colors on the walls probably by the flicker of animal-oil lamps. They are the earliest pictorial art in the world. Perhaps, too, they are the first move toward what later became architecture, or the art of building for beauty and comfort as well as for protection.

Later some men were living in wooden huts built on posts in the water of lakes.



A small home constructed of clay bricks, with an outside finish of stucco, a plaster-like preparation that is usually made from gypsum. Such a home is well suited to warm, dry climates.

The exterior finish on the attractive home above is made of clapboard, or boards lapped one on the other. Steep roofs are built in regions of heavy snowfall, so that the snow can slide off easily.



Pictures, courtesy, The American Home

In a brick or stone home, the side walls sometimes rest directly on the foundation walls of the house. There is a fine, simple dignity to a brick house, suggesting long life and usefulness.

Courtesy, Johns-Manville Corporation

A house may be insulated against the heat and the cold. This means that the space between the inside and outside walls is filled with a material that does not allow heat to pass through easily. The insulation may be blown into the spaces under the roof (left) or it may be packed in as batting (right). Walls are treated in the same way.

These people did not know how to put up strong buildings to keep out their enemies, so they protected themselves with water. Many thousands of years later men dug moats, or artificial lakes, around great stone castles for the same purpose.

All ancient peoples, and until very recently all modern peoples, too, built with the materials they found near at hand. They used wood in the great forest countries and stone where it could be quarried; they made bricks where there was clay. In the South Seas they used bamboo and leaves and mud; in the Arctic they used ice.

Everywhere in the civilized world, the houses of ordinary folk were made of wood or brick, while the houses of princes and the temples of the gods were made of stone and marble. This was because it was easy to obtain wood and brick and because these materials could be easily and quickly put together. Stone had to be cut out of the hills with great labor, and the big pieces were hard to move and hard to fit together, so generally stone was used only for important buildings. A few places had stone which lay close to the surface and which split easily. In such cases the ordinary houses, as well as the mansions of the wealthy, were made of stone.

Wood, brick and stone are still among the most important building materials for houses. Wood is cut from native trees and allowed to dry out so that all of the twisting and shrinking, as the wood loses moisture, will be done before the house is built. There are two principal kinds of wood, hard and soft. Most deciduous trees (trees that shed their leaves), like oak and maple, provide hardwood, although there are some of these deciduous trees that are soft, such as the poplar. Those that keep their leaves, like the pines, are fast growing, soft but strong.

Some woods have beautiful grain or color, and many of these are used not so much for construction as for finishes, like the frames around doors, and the doors themselves. Until recently wood surfaces could only be as big as a board cut from a big tree; when large surfaces were wanted, the wood was cut in slices, matched for grain and color and joined together to make panels. Today logs are cut by a rotary method that makes very thin sheets of great length. These sheets are then glued to flat sheets of wood or other material, under heat and pressure, to make what is called plywood.

Brick is made from clay, a kind of dirt that dries hard in the sun and gets very hard indeed when burned. The earliest bricks were made of clay mud with straw which held them together, and sun-dried. They were stuck together with more clay, and, like the adobe or clay houses of some American Indians, made very good shelter in hot, sunny lands. Bricks as we know them are very ancient. Long ago they were molded by hand and baked in furnaces called kilns. Probably somebody got the idea from pottery clay utensils which hardened over the cook-fire. Bricks were made in all kinds of shapes and sizes, and in different colors, depending on the kind of clay that was used and the minerals in it. Brick was the first "prefabricated" building material. It is still made today much as it was two thousand years ago, except that the molding and cutting to size are done by machines.

Clay is also made into hollow blocks and used for walls, which then are often covered with a brick veneer on the outside, or perhaps with a veneer of stucco, a plaster and cement preparation. (A veneer is a layer of material used to cover another material.)

Stone is used in various ways. Some stone —granite, for instance—is too hard to use very much, and is not found in very many places. It takes a high polish, and is often very beautiful. Sandstone, on the other hand, is soft and coarse and crumbles after some years of exposure to the weather. The most useful of the stones for building are the limestones, of which there are many kinds. Nearly all of them are fine-textured, can be cut easily and slowly harden in the air. Marble is a kind of limestone.

When limestone is crushed and burned and water is added to the powder, it makes lime mortar which holds bricks and stone together. When it is burned with slag and other things it makes Portland cement.

Slate is another useful stone, very hard and brittle, and with a strong grain so that it splits easily. It is not good for walls, but is used for roofing and walks.

Plaster, a man-made material, is not a structural (building) material, but it is very good for finishing. It used to be made of lime, but today it is made of gypsum. Plaster is spread over walls and troweled smooth and makes an even, jointless surface: it is a plastic.

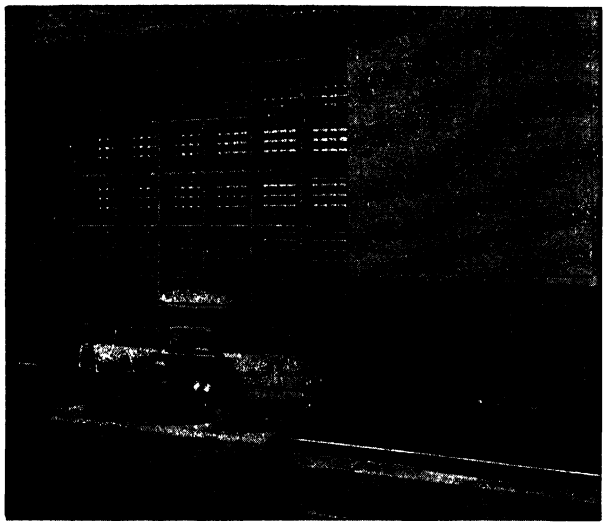
Those are the principal natural building materials which have come down to us through the ages and which are still used in very much the same way as of old. Besides these there are newer, manufactured materials: steel, copper, aluminum, glass and concrete.

Steel is used mostly for making columns, which are the upright pieces of a building, and for beams, which are the horizontal pieces that hold up the floors. When several beams are held up by another one, the latter is called a girder. Steel, as you know, is a form of iron; like iron, ordinary steel rusts easily so it must be protected from the weather by painting. A hot fire will soften steel, so that when it is used for the structural parts of a building it must be covered with a fireproof material such as concrete or burnt-clay products. New rustless steel alloys are being made, but they are still too expensive for structural use. Galvanized iron is iron in which tin has been mingled. It will not rust, and galvanized-iron sheets are sometimes used for shed walls or for roofs, and most water pipes are made of it.

Copper is used to make waterproof joints in roofs and sometimes in walls. It is comparatively soft, is easily bent in place and does not rust. It is also used for electric wires, because it is one of the best conductors of electricity; and for water pipes, because it resists certain kinds of chemical action, including rust. In the form of bronze, which can be cast in molds and which is much harder than ordinary copper, it is used for all kinds of ornaments, from great doors to little door-knockers.

Courtesy, Owens-Illinois Glass Company

Copper is a metal that finds many uses in the home. It is comparatively soft, is easily bent into place and does not rust. In the sketch we see how copper is used in the water system, the drainage system and in various construction details.



Courtesy, Owens-Illinois Glass Company

Light enters a room softly through glass bricks; and they are not transparent, which makes their use ideal for kitchens.

Aluminum, which is a strong but very light metal, will be used more and more in buildings, and so will magnesium, another strong, light metal. Both are rustless and can be made in silvery sheets, or pushed through dies to make long structural pieces (this is called "extruding"), or cast in molds.

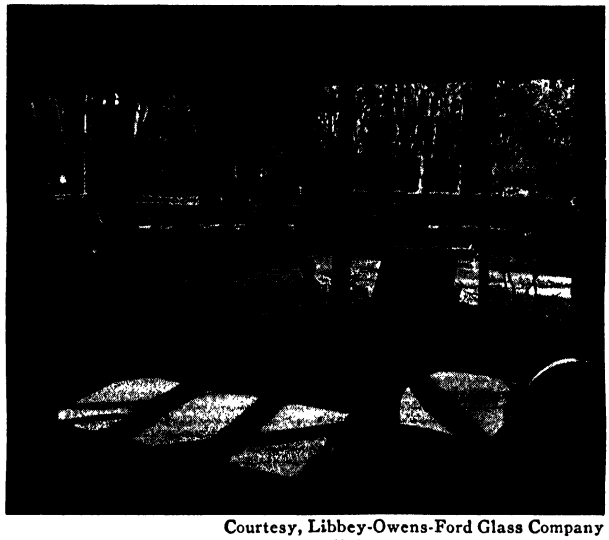
Glass is used, of course, to keep out the weather and to let in light. It lets the sunlight and the ordinary heat rays of the sun pass through into a building, but does not permit the heat to pass out again easily. Ordinary glass, however, keeps out the short light-waves (ultraviolet) which are healthful; new kinds of glass are now being made which will keep out or let in various wave-lengths. These developments may in time influence the design of houses.

Concrete is a mixture of Portland cement, sand and coarse material, called aggregate. Aggregate is made up of broken stone, cinders, sawdust or other things, depending on the strength and kind of concrete wanted. Concrete can be reinforced with steel bars. It is poured in place to form monolithic construction—that is, construction in the form of a single big block—for great dams, or it can be reinforced with light wire mesh and used for the strong and delicate arches of bridges. For houses it is cast in blocks with hollows in them; these blocks are used for walls and partitions.

The first thing to be done in building a house is to dig a hole for the foundation. This is called excavating. Then the footings are laid. Footings are slabs of stone or concrete resting directly on the ground and wider than the foundation walls above them will be. Making them wider spreads the load of the walls over more ground. They help to prevent the building from settling unevenly and cracking.

Footing and foundation walls are almost always stone or concrete. Even with no cellar, such walls are carried down below the frost line to keep the house from being lifted up when the ground freezes.

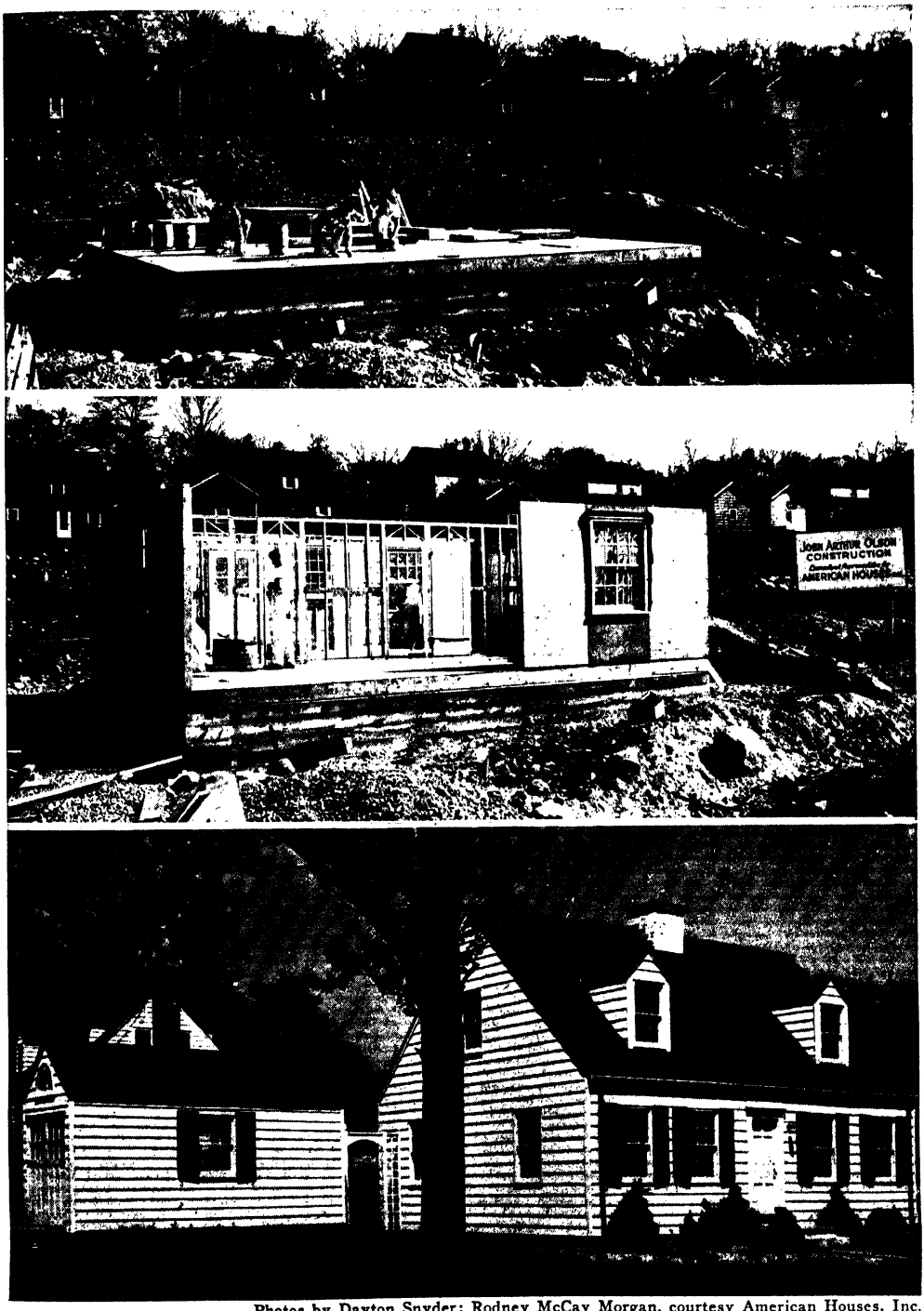
If it is a brick or stone house, the walls rest directly on the foundation walls. If it is a wood, or "frame," house, as it is usually called, a wood sill is bolted to the foundation. This sill is made of long pieces of wood carefully placed horizontally so as to be absolutely level all around the house. Upright pieces, or studs, are nailed to it, and the floor joists rest on it. If there is a second floor, the joists for that floor rest on a horizontal piece called a plate, or a girt, or a



Courtesy, Libbey-Owens-Ford Glass Company

The outdoors becomes part of the living-room when one wall is made of glass. This type uses the sun's rays to aid heating.

THE ASSEMBLY OF A PREFABRICATED HOUSE



Photos by Dayton Snyder; Rodney McCay Morgan, courtesy American Houses, Inc.

By "prefabricated homes" we mean homes that have been largely made beforehand. Factories turn out pre-made parts in great quantities; putting the pieces together takes only a short time—days, instead of weeks.

ribbon. The piece at the top on which the roof rafters rest is always called a plate. The whole construction, from sill to the ridge of the roof, is called the frame.

INSULATION SAVES FUEL AND MAKES THE HOUSE MORE COMFORTABLE

The outside of the frame is covered with rough boards, or with sheets of pressed wood or fiber, and these in turn are covered with tar paper to make them airtight and waterproof. If the house is to be insulated, the spaces between the studs may be filled with material which keeps heat from going through too fast. The attic space, or underside of the roof, is today usually insulated whether the side walls are or not. This insulation saves fuel and makes the house more comfortable. Outside the building paper comes the exterior finish: a layer of brick, perhaps; or shingles; or lapped boards called clapboards; or perhaps a finish of metal lath and stucco.

Inside, the house is usually finished with lath and plaster, or with plaster board, or with large sheets of plywood.

The roof is treated much like the walls. Where the roof is sloping, shingles are generally used. These may be of wood or slate. Nowadays shingles are mostly composition: that is, made up of two or more elements—asbestos or a base mixed with asphalt, and various minerals to give wearing quality and color. Such composition shingles are better than wood shingles because they will not catch fire easily.

A WATER SYSTEM REQUIRES MANY DIFFERENT PIPES, INSIDE AND OUTSIDE THE HOUSE

The walls, floors, roof, partitions (inner walls dividing one part of the house from another), doors, windows and stairs are the shell of a house. To make it livable, mechanical equipment is needed. First there is plumbing; that is, a system of pipes to bring water in and to take waste out. The water comes either from a city water system with big supply pipes under all the streets, into which your house is tapped; or else it comes from a well and pump on your own grounds. Similarly, the waste goes out into a city sewer system, or else into a septic tank and field somewhere on your own land. The plumbing pipes go to the fixtures—the sink in the kitchen, the tub, toilet and washstand, the laundry sinks and the faucets for the garden. Pipes also go to the hot-water heater, which sometimes is part of the heating system, and sometimes has a separate little heater and tank, or boiler.

We also need a heating supply of some kind. Usually this is a central source of heat called the furnace. The fire in the furnace heats water or air, which is carried in pipes or in metal boxes called ducts to various other parts of the house. Heating is generally by steam, hot water or hot air, although progress is being made in the use of electricity, mostly as a source of radiant heat. If the air is heated directly from a small, very hot heating surface it is convected heat. If very large surfaces are heated only to a low temperature so that they radiate warmth, it is radiant heat. The sun, of course, is the best example of radiant heat. Proper design of a house will make use of this solar heat, and will add it to the artificial supply.

ELECTRICITY IS MEASURED BY AN ACCURATE METER AS IT ENTERS YOUR HOUSE

Besides plumbing and heating we need electricity to give us light at night and to run many of the appliances we use. Electricity comes from a generating plant which makes electric power for the whole city or for a whole county. Electricity is carried into the house by wires from the main lines in the street. Right inside the house it goes through a meter-box which measures off the current we use and keeps a record of it. From there wires take it to the point of use—lighting fixture, wall-plug or motor.

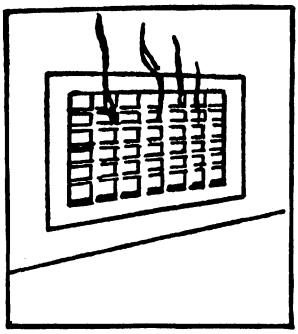
Gas is also used for cooking in many homes, and for heating some houses; it is piped to the house from a central source, and a meter measures off the amount that is used.

Before the house is built, architects carefully figure out the size of water and gas pipes, the size of furnace, pipes or ducts, the number and size of electric wires and where they have to go. All these things must be neither so small as to be ineffective, nor so large as to be wasteful. They must be built into the house as it goes up, and they must be in the right place when the house is finished.

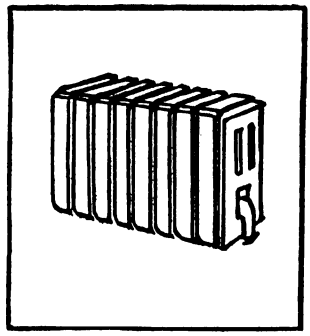
Now for the finishing touches of the house—the painting and decorating. Walls are papered or painted; the woodwork is painted or waxed, so that all exposed surfaces, inside and out, have some kind of protective coating.

PREFABRICATED, OR "READY-BUILT," HOMES ARE QUICKLY PUT UP

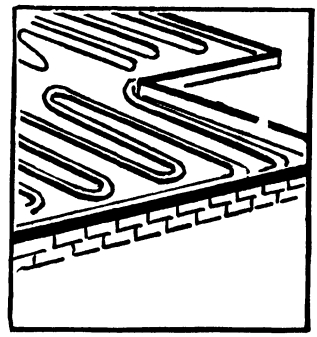
Putting a house together in this way requires many different trade skills, and a very complicated way of bringing things to the



Hot-air heating means warming air at a furnace, and then directing it around the house.



When water is heated and circulated in pipes, the system is called hot-water heating.



Radiant heating by electricity requires heating elements under the floor, or in the wall.

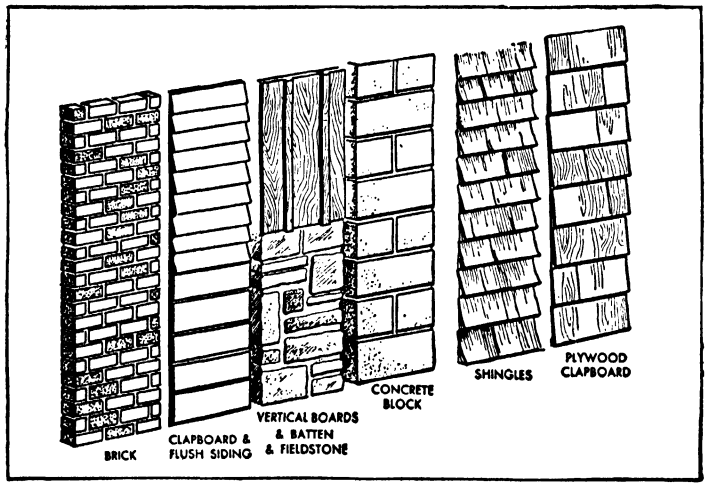
job and getting them in place. Prefabrication is an attempt to make the process simpler. The word means "made beforehand"; and prefabrication is not a new thing in housebuilding. Bricks have been prefabricated for thousands of years. Today a great many things are made in the factory ready to put in place: for example, windows complete with frames, glass, venetian blinds and curtain rods; glass itself; oil-burners. The list is almost endless.

Prefabricators today aim to assemble so many things ahead of time that a house could be delivered in a few large pieces and fastened together on its foundation. No one is quite certain about the advantages of prefabrication. It is hoped, for one thing, that it will lessen construction costs so even persons with a quite small income will be able to afford a house. But, after all, the house is only one part of the cost; there are land and sewers and water to be paid for, cost of upkeep and taxes.

You can see that building a house is a complicated affair. In order to do it, someone has to make plans so that all the material can be ordered and put in the right places, so that the house will be put in its right place on the lot and connections can be made for sewers, water, gas and electricity. The person who does this is called an architect. Another part of his job is to see that all the rooms are arranged conveniently to suit the family for which the house is being built and that nothing is forgotten. He must also see to it that the house looks attractive.

The architect draws plans that show precisely where everything is to go. He also writes specifications, which tell the builder what kind and quality of materials and equipment are wanted. After studying the plans and specifications, builders bid for the work, that is, each one tells how much he will charge to put up this house. When a builder is selected, the owner makes a contract with him, and then work starts. The builder sees to it that materials and workmen come to the job at the right time, and the architect makes sure that the owner gets what the plans and specifications call for.

Houses may be planned in many ways to suit the tastes and living habits of different



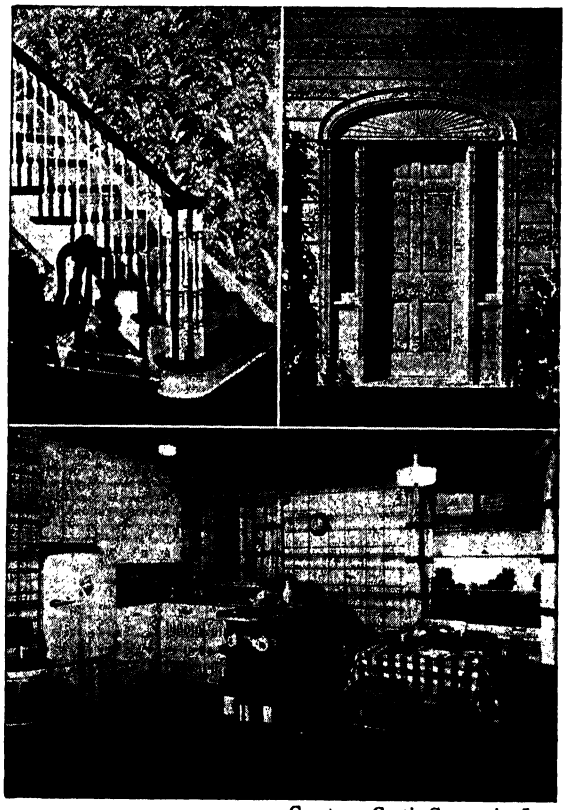
Diagrams, courtesy, Small Homes Guide

The diagram above shows, in order of preference, the many different types of material that are available for constructing outside walls of houses.

people. For instance, we may have a separate dining-room or we can have our meals in the living-room. We may use a part of the kitchen for laundry work, or part of the furnace room for a workshop.

This multiple use of space has been made easier in recent years. First of all, central heating and insulation have made it possible to heat larger spaces evenly, and to make use of much more glass. Secondly, kitchens are neater, better arranged and better ventilated, so that they can be more a part of the eating and living space. Architects now make houses appear more spacious by letting the living and eating parts "flow together." Instead of partitions that go up to the ceiling, low partitions or built-in pieces of furniture are used as dividers. Big windows let in sun and light, air and view.

When this is done the garden and terraces seem to become part of the house and must be planned with it. The outside space, also, has various uses that must be kept distinct—the garden for living in; the service yard for deliveries, garbage removal and laundry-drying; and the vegetable garden, if the house has enough grounds for one.



Courtesy, Curtis Companies Inc., Manufacturers of Curtis Woodwork, Clinton, Iowa

Painting the inside and outside surfaces of a house serves to give them a protective covering and an attractive appearance. Papering inside walls is also a popular means of decoration.

The architect must use skill and judgment in designing the outside of the house. Since the inside of it, where people spend their lives, is more important than the outside, a good exterior design is based on the plan of the house. Straightforward, simple use of materials makes a beautiful house. Elaborate effects soon become tiresome and are seldom in good taste.

So-called "modern" architecture—it is a bad name, because every architectural style once was modern—follows these principles of developing from the plan and using materials simply. Because today we know more about the strength of materials than our grandfathers knew, we can use lighter framing, thinner walls and more glass than our ancestors could. The increased use of glass changes the whole appearance of houses. Georgian, Colonial and other styles of the past began at a time when we had no central heat and not much glass, and lived in a much more formal way.

It is sensible, in planning a house, to consider the design of the other homes in the neighborhood. There should be harmony in the general appearance of these homes. A house does not exist alone as an independent thing any more than a person does. It is part of a community.

Each family is connected by bonds of friendship with neighbors. If the character of a neighborhood changes, something in the life of the family changes, too. Not all life is lived in the house: people go to and from work; they must have places where they can play or be amused; children need schools; Mother must have convenient places for shopping. The really modern idea of architecture is to plan not only the house but all these other necessary things as well, so that a family can live and work happily with its principal wants cared for, and with plenty of light, clean air and space.

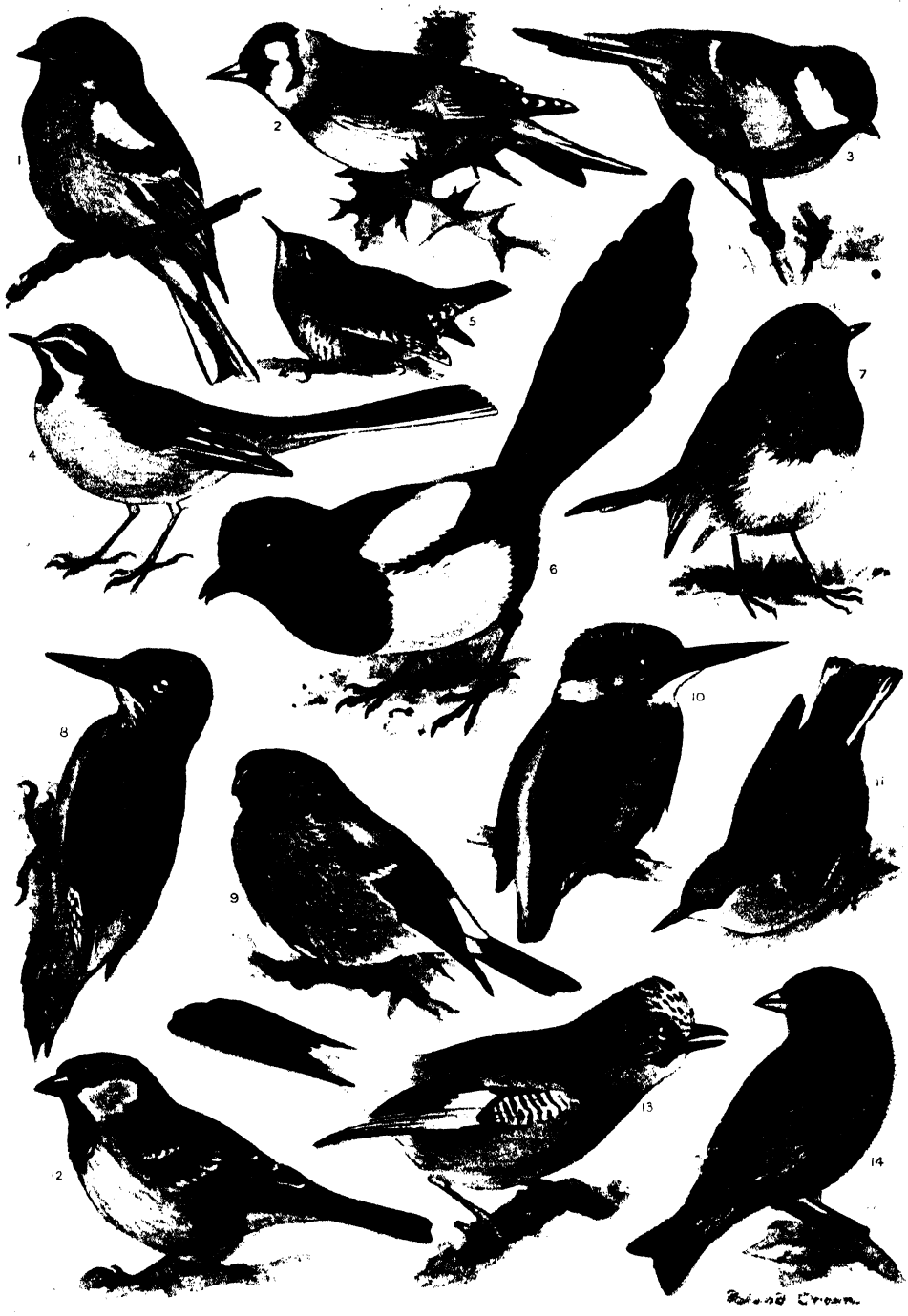
By HENRY S. CHURCHILL.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 3317.

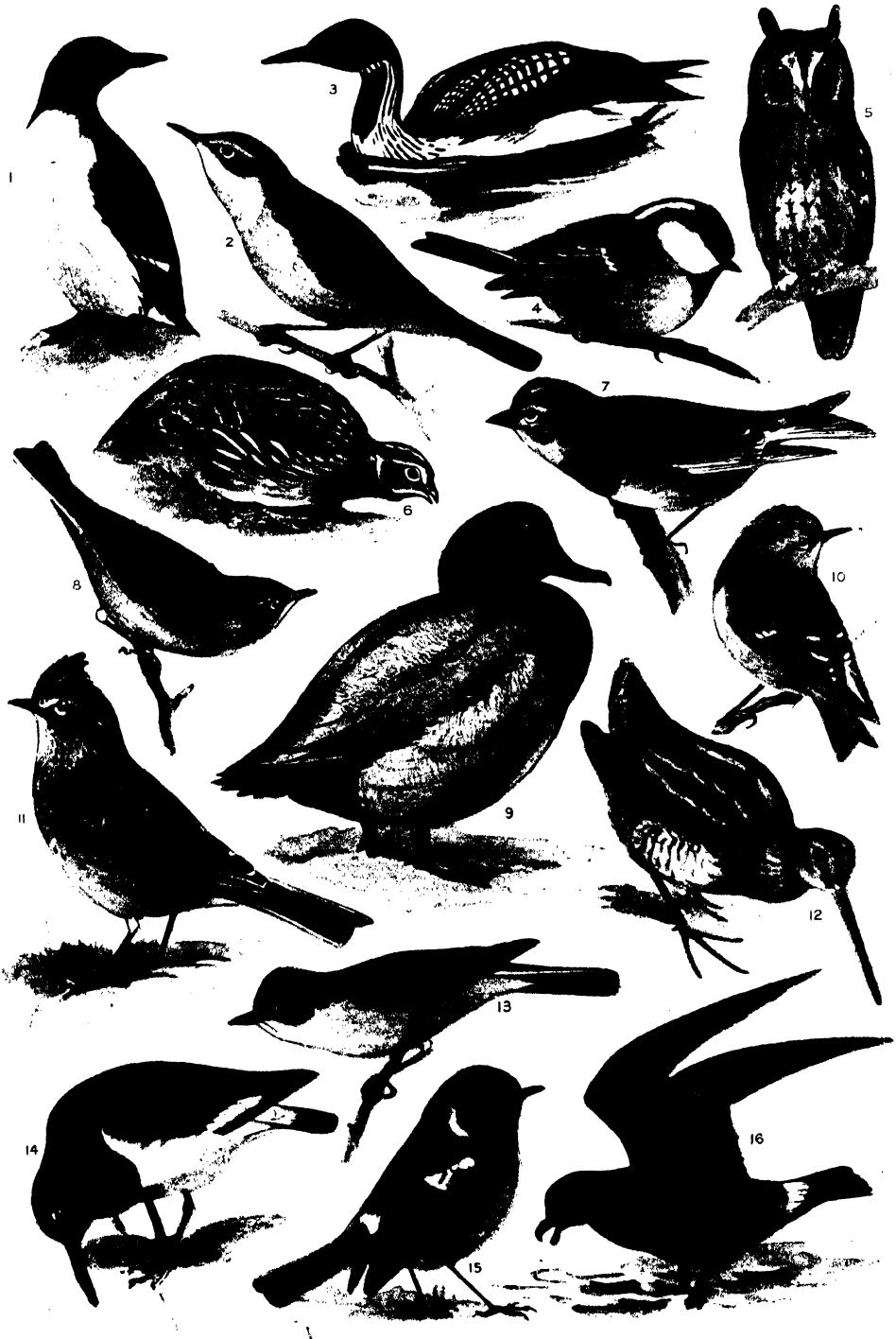
BIRDS OF THE NORTHERN HEMISPHERE (II)

1. Brown or Tawny Owl. 2. Marsh Hawk. 3. Red Grouse. 4. European Yellow Hammer. 5. Roseate Tern. 6. Spotted Flycatcher. 7. Wheatear. 8. Golden Eagle. 9. Bank Swallow. 10. Dartford Warbler. 11. Blue-headed Wagtail. 12. Goosander. 13. Tufted Duck. 14. Bittern.

1. European Kite. 2. Kentish Plover. 3. Curlew. 4. Blackbird. 5. Pied Flycatcher. 6. Hoopoe. 7. Ring Ousel. 8. Least Tern. 9. Redshank. 10. Short-eared Owl. 11. Cormorant. 12. Grasshopper Warbler. 13. Great Skua. 14. European Stock Dove. 15. Greenshank. 16. Shoveler.



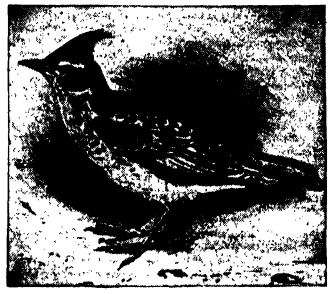
1. Chaffinch. 2. Goldfinch. 3. Great Tit. 4. Gray Wagtail. 5. Wren. 6. Magpie. 7. English Robin. 8. Green Woodpecker. 9. Bullfinch. 10. European Kingfisher. 11. Nuthatch. 12. English Sparrow. 13. European Jay. 14. Greenfinch.



1. Murre. 2. Marsh Warbler. 3. Black-throated Loon. 4. Coal Tit. 5. Long-eared Owl. 6. European Quail. 7. Linnet. 8. Willow Warbler. 9. Pochard. 10. Golden-crowned Kinglet. 11. Skylark. 12. Snipe. 13. Lesser Whitethroat. 14. Oyster Catcher. 15. Stonechat. 16. Storm Petrel.

The Great Gray Shrike.

The Fieldfare.



The Crested Lark.

THE LARKS AND THEIR FRIENDS

A BRITISH child of humble birth has a rare possession which the wealthiest American may envy, for America has neither skylarks nor nightingales. The Old World has given the New horses and cattle, sheep and pigs and goats, poultry and pigeons, bees and fruits, along with white men. They have all thrived here past belief, and turn again to feed and sustain and clothe the original givers. But certain gifts America cannot keep, though she would gladly do so.

Numbers of skylarks, nightingales and English robins have been brought to North America. But these natural jewels do not fit into that rich setting. The little songsters vanish here, perishing in the fierce competition they have to face from native birds, or they fly so far asunder, on being released from their captivity, that they never meet at mating time, and die desolate.

And so dwellers in the New World, when they find Shakespeare and Shelley writing in ecstasy of the sweet-throated vocalists of England, experience the same sort of wonder which the English feel when they read of humming-birds, and they envy the children into whose ears these marvelous hymns of praise are poured so lavishly.

There are quite a hundred species of larks, but the one best known is the Skylark. Some birds are foolishly named, but the man who gave this bird his title merits our admiration. Skylark! There is the very essence of homely poetry and music in the name. The little soloist nests humbly amid rough grass or concealed in a wheat-field, but he takes his song near heaven from which it came. He is born in a cluster of grass among the clods, but he springs up into the blue depths of the sky, and makes the sunlit air the platform for his streaming song.

To perfect the rapture the townsman feels in the country he must have a lark singing overhead. And the wonder and splendor of a city may be crowned by the song of this bird. A writer has told of a family of larks which carols blithely all the day within four miles from Charing Cross in the heart of London.

The fact that larks are plentiful near cities where never a blade of wheat is grown, is part answer to the charge that these birds are harmful to the grain. They are seed-eaters, and they do, from time to time, claim a little wheat; but for every grain of wheat that they eat they pay in labor of the most beneficial kind. They are great hunters of insects, and the young larks depend entirely in their nursery days upon thousands of insects for diet. If we are to deny the lark his tiny portion of grain we must censor our poets, for this bird has inspired some of the finest poems ever written.

There are two species of lark which

sing in England. How shall we distinguish the skylark from the Woodlark? In the first place, the woodlark is less common, its range is much more restricted. We are less likely to meet it in the north of England than in Egypt, Morocco, Spain and Central Europe. It is numerous in Devonshire and the southwestern counties generally, and there the puzzle of identity has to be solved.

The skylark has a long two-pointed tail; the woodlark's tail is short and more nearly square. This bird keeps more to woodland bordering its feeding grounds in the fields than the skylark, and though it rises into the air to sing, it does not soar to such heights. The eye might follow the woodlark's song up to a clearly perceptible bird, whereas the skylark rises to such heights that it is but a wandering cascade of jubilation, heard but not seen.

There are few Crested Larks in Great Britain, but the bird is common in Central Europe, where it spends the summer, proceeding south through Spain, presumably to Africa for the winter. No birds could be more shy than these, but once they reach their home quarters in Germany and Hungary they become as confident as sparrows, and hop about the highways of town and village as trustfully as tame pigeons. The few specimens seen in England are probably carried there by winds; perhaps now and again by erratic instinct which carries a bird adventuring out of its course. At any rate, they have never settled there.

THE WANDERING LARK WITH THE VERY SHORT TOES

The same remark applies to the Short-toed Lark from Southern Europe and the Far East. It is rare in England. It is a seed-eater, so it would not be welcome to the farmers. Its name marks a peculiarity of its feet. Why it should be the one member of the Lark Family with very short toes is a mystery as yet unsolved. There must be some advantage in it, or these birds would never have spread across Europe and into India and Turkestan, and even beyond.

This hale and hearty family has its empire in many lands, and not even the grim terrors of the Arabian and African desert repel the Desert Larks. Meagre as the fare is, the larks are there, not in flocks, but as single pairs, severely isolated from rivals, lest all should starve in the general misery and want.

Larks which so closely resemble finches as to be called Finch Larks inhabit arid wastes in Africa and India. Asia has larks which find their dwellings in low shrubberies and are called Bush Larks. Then there are Calandra Larks in Southern Europe, Africa and Asia; an almost entirely black lark in the wilds of the Central Asian steppes; a White-winged Lark ranging from Europe into Asia, once a visitor to England; Shore Larks which teem from Northern Europe westward to the coasts of North America, where they are usually called Horned Larks.

THE LARK THAT SINGS ITS SONG OF HOPE AT HEAVEN'S GATE

Find them where we may, the larks all sing, and are the heralds of happiness. The world may be sad and worn and depressed, but ever a lark is singing, as if to tell us that woes are not eternal, that felicity is about us for the seeking. The larks are the optimists of bird life, and we have need of them. It was Goethe who wrote:

> Let your trouble be,
> Light will follow dark:
> Though the heaven falls,
> You may hear the lark.

The larks make life musical; their closest relatives, the European Wagtails, suggest active well-being and tireless industry in which whim and pretense have their share. A pied wagtail on the lawn comically recalls a man dashing for a train and missing it through excess of twists and turns for fussy, purposeless aims. They run, they dart, they flit and fly, and are ever moving.

Energy marks all the tribe—the White Wagtail, which is rarely seen in Britain; the Pied Wagtail, which frequents houses wherever there is a green lawn for hospitality; the lovely Yellow Wagtail, which keeps more to the plow and meadow, drawing nearer and nearer with the advance of summer to the lands that flank the streams; and the Gray Wagtail, which shares with the dipper the sweet scenery and fat fare of mountain, lake and stream.

WHY THE WAGTAIL STRUTS AROUND HORSES AND CATTLE

Nearly all the wagtails, including the handsome blue-headed and yellow-headed species, attach themselves to cattle and horses, darting about between the feet of the animals to snap up the insects disturbed in the grass by the hoofs of the browsing creatures.

MANY SINGERS, SHRILL AND SWEET

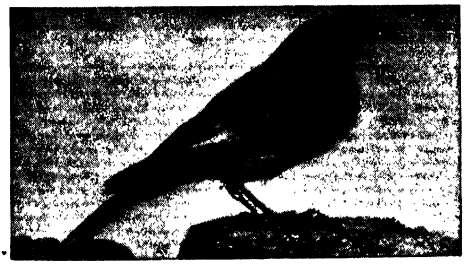
Black-backed Piping Crow.

Waxwing.

Mocking Bird.

Catbirds of Queensland.

Wagtail of Australia.

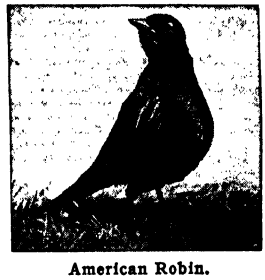


Black Redstart of Central Europe.

White-backed Piping Crow.

Parson Bird of New Zealand.

Shama—the Indian Nightingale.



American Robin.

Pictures by A. Brook, H. Mortimer Batten, W. S. Berridge, R. Chislett and others.

They are a widely distributed group, but not more so than the Pipits. These birds get their name from the sound they make. If some of us mistake them for a species of lark we deserve pardon, for the long hind toe and the general outline do suggest those birds, of which they are near relatives. But they never have their nostrils feathered as in the manner of larks. Except for their soberer plumage, they more nearly resemble wagtails, and certain authorities have it that the pipits are the ancestral type from which the wagtails developed.

THE PIPIT THAT SINGS IN THE DESERT AND THE PIPIT THAT SINGS BY THE SEA

There are many pipits in the Old World, but only two species in America. These are the American Pipit, and Sprague's Pipit. They look very much alike, but differ in their power of song. The second sings in the sky like the lark and is sometimes called the Missouri Skylark. Few birds have a sweeter song. The European Tree Pipit nests on the ground and feeds there; and though he sings a simple lay as he runs through the grass after an insect, it is the high branch of a tree which he prefers for his platform. There his lay begins, though it may end in the air, or be continued as he spirals with taut wings and tail to the ground. The Meadow Pipit seems everywhere.

Its cousin, the Rock Pipit, is the minstrel of the British seashore. Rocks and cliffs are its home, so long as sea be at the foot; and an island not too green will serve for many a pipit mansion. There is no mistaking this bird. Does he sing by the sea? Yes? Then he is a rock pipit, the only warbler by the salt sea. There is a rich banquet spread between tides for him—worms, tiny crustaceans and marine insects—and though the way is rough and stormy at times, he is safer in his privacy than cousin meadow pipit, whose nest is shamelessly invaded by the cuckoo for purposes which we all understand.

HOW THE PIPITS BAND TOGETHER TO WAR ON THE CUCKOO

Meadow Pipits loathe the adult cuckoos and combine fiercely to mob them, yet they take their eggs and rear their youngsters with a passion of devotion not to be excelled. Do they know that the adult birds are unscrupulous interlopers? Or are they, like other little birds which assail cuckoos, misled by the rascal's hawk-like appearance into mistaking it for a flesh-eater? These problems do not vex the pipit of the rocks; his nest and his babes are safe where the sea wind sings.

Where the pipit darts from the rocks to the shore for breakfast, another bird, small and plain of coat, but with a notably curved longish beak, may be seen foraging on the rocks themselves for spiders and flies and other things of the kind. It is a Creeper, a wee thing vowed to a restricted life, a life sustained by food found on cliffs, rocks, walls and trees, and to be gained, not by flight, but by diligent search on closely scrutinized surfaces. The Wall Creeper is common among the mountains of Central Europe, and ranging through Central Asia and India, where the stranger may reasonably mistake its flickering flight for that of a great butterfly.

The Tree Creeper is more common in Western Europe. It is a delicately built bird, but with long claws which enable it to run over the trunk of a tree with the agility of a monkey in the branches. Every wood and orchard should have its corps of these to rid the trunks and boughs of trees of wicked insects, their eggs and their larvæ. It should be a serious offense to kill one of these. North America has only the Brown Creeper, found in both Canada and the United States.

HOW THE NUTHATCH GETS THE KERNEL OUT OF THE NUT

The nuthatches are a large family, close to the creepers. We delight to see their antics—standing, clinging, right-side-up, wrong-side-up—and the perky confidence with which they pose like exquisite little carvings upon a bough or trunk. One feels affection for these birds because of their grace, their appetite for the parasites harmful to trees, and for the masterly art with which, when nuts and fruits arrive, they take the nuts, wedge them into cracks, and with little hammer blows from their bills smash the shells and so gain the kernels.

The European Nuthatch nests in a hole in a tree, and where the entrance is too large, plasters it up neatly with clay; but the Syrian example makes his nest of earth and stones and other matter, attaches it to the face of a rock, and gives it the neatest little funnel for portal. In

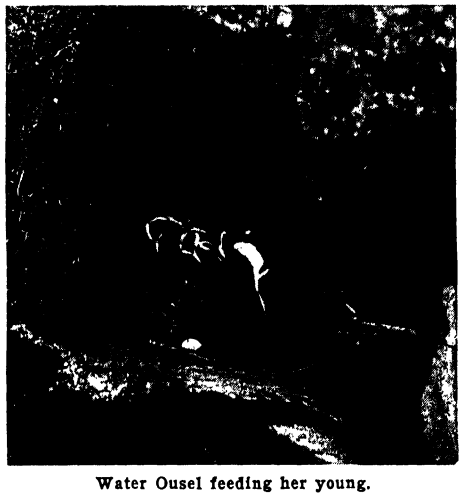
THE NIGHTINGALE, THE ROBIN AND THE LARK

English Robin.

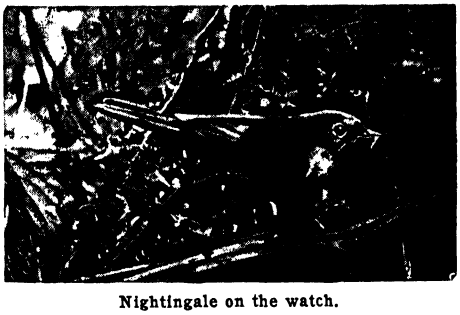
Nest of a Long-tailed Tit.

Male Whinchat.

Thrush Family.



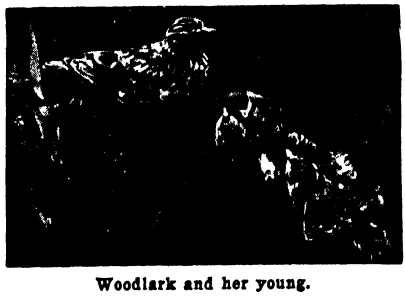
Water Ousel feeding her young.



Nightingale on the watch.

The Skylark finds its breakfast.

Nest of a Willow Wren.



Woodlark and her young.

Nest of English Robin.

North America the nuthatches have no such funnels, yet the Australian members of the group make the entire nest funnel-shaped. In India nest-building habits vary. We have several of the family—the White-breasted Nuthatch, the Red-breasted and the Brown-headed. All are much alike in their habits.

From nuts, back a step to honey, and here we find birds ready to live on this sweet provender—Honey-eaters by habits and by name. They are mainly Australasian, or natives of the South Pacific Islands. Whatever the species, they have this in common: they have heavy claws and curiously long tongues, which they protrude so that the feather-like edge may reach to the depths of the blossom. Notable in the group is the Tui, or Parson Bird. The second name is derived, a little foolishly, from its wonderful powers of mimicry. The Stitch Bird is named from its note, as the Four-o'clock Bird is from its curious cry.

THE GORGEOUS SUN BIRDS THAT LOVE THE SUNSHINE OF AFRICA

Other honey-eaters are the splendid Sun Birds, which take the place in the Old World held by the humming-birds of the New. But here the beak, and not the tongue, is long. The bill, curved and delicate, acts as a suction pump in the fountains of nectar into which it is thrust. The same implement serves for the collection of flies innumerable.

Australia and India have sun birds, but the true home of the family is Africa. There the gorgeous Malachite Sun Bird is richly enameled of feather—the sort of bird that a dreamy rajah of the old days would have sought to invent for his gold-decked palace. But equatorial Africa has a bird still more splendid in the Metallic Sun Bird, a creature of fire and fury, as we should suppose. It attacks its rival like a little cyclone; it rejoices in the raging heat of the noonday sun, which other birds avoid.

Indeed, a fondness for more sunshine than is healthful for other birds gives the group its name. They are all fighters, all as handsome as paint, given in the courting season to great length of lustrous tail, which, in the Indian species, gives the bird its name of Long-tailed Sun Bird.

THE OUNCE OF FLUFF AND FEATHER THAT COMES OVER THE SEA

Wherever we go the *tits* keep us company on the big land masses, throughout the Old World and in America, where there are a few specialized types; even in New Zealand the tits are present. They are great helps to man, for all of them are insect-eaters in the main. The one charge against them is that they levy toll on the green peas in the garden. But green peas are only their wages for the work they do in ridding the land of parasites.

The Great Titmouse is almost entirely insectivorous; the Marsh Titmouse is as innocent of offense. It is the Blue Tit, master titmouse proper, who brings the family credit into question. He is the little rascal who occasionally insists on seeing what is inside the pod of a pea. But he is the darling of the gardens, the little acrobat of the trees; the confident, perky little fellow who comes with fearless assurance up to windows, and turns himself upside down to feast on the halved coconuts and pieces of fat and suet which are hung up for him.

It is a stirring thought that these mites of life which abound in European gardens make the great overseas journeys like all the other migrants—high-engined living airplanes of less than one ounce! But, tiny as he is, the blue tit has a smaller cousin in the Long-tailed Tit, though, thanks to the long feathers of the tail and the general looseness of the plumage, this little fellow looks bigger than his size. None is more social in habit than this one. The Tufted Titmouse is rather common in southern United States, and occasionally goes to the north.

THE RED-BACKED SHRIKE IS CALLED THE BUTCHER BIRD

We must pass to the shrikes, at whose deeds the bird-lover must pucker his brows; for these birds are killers and eaters of other birds as well as of mice, frogs and insects. Most of them are Old World birds, but in North America are the Northern, the White-rumped and the Loggerhead Shrike. In Europe are the Great Gray Shrike, whose nests are made in Central Europe; the Lesser Gray, Pallas's Great Gray, and the Woodchat Shrike from Central and Southern Europe. The English shrike is the Red-backed Shrike.

The name Butcher Bird, often given, is well deserved. They pounce upon anything not too large for their powers—bird, mouse or grasshopper. They kill their victims with their heavy-toothed

beaks; then impale the dead body on a thorn, to devour it at once, or consume it at leisure when the day's hunt is done.

THE ORGAN BIRD, WHICH TALKS AND WHISTLES BUT CANNOT SING

Border-line relations in the bird world become a little complex at this stage of our journey through the order. We now speak of birds which seem to embody features of both magpie and lark, so as to be called by Australians, Magpie-larks. Next are the splendid Helmet Birds; then the Piping Crows and the Minivets and Cuckoo Shrikes. The piping crows are Australian, and are often called magpies, by virtue of their black and white plumage. They are a remarkable group of many patterns, and include that strange creature the Organ Bird.

That seems a pretty title, but organs can displease when they are out of tune, and the organ bird is one of the untuned. His notes are many and diverse, but woefully unmelodious. Still, Tasmanians love him, for, when caught, he ceases to be inharmonious: he picks up a tune and whistles right merrily, as well as talks with gravity and readiness.

Next come the Waxwings, pretty creatures with the ends of certain feathers of the wings and tail tipped with red, horny appendages resembling sealing-wax. The Bohemian Waxwing is common in Europe, but rather rare in America. The Cedar Waxwing is more common and is often called the Cedar Bird. The Japanese is an Eastern favorite, and the Caroline Cedar Bird is a waxwing too.

The American Greenlets, mainly green in color as in name, are wood-haunting birds. They are more properly called Vireos. There are many species. They lead us to the Wood Swallows of Australia and India, which, though swallow-like, as they fly and feed on winged insects, descend to the ground to eat grubs, which true swallows never do.

JENNIE WREN, SWEET SONGSTER AND DELIGHTFUL ARCHITECT

If in turning from the home of these birds we make a call on South America, we shall find there a great assembly of wrens. But the many species of these birds are scattered widely over the world. None is more familiar than the common variety which we call Jennie Wren, a garden treasure of sober hue but infinite charm. It is blithe of spirit and almost constantly in song; a delightful architect of nests, boldly confident, not so much that we shall not hurt it as that it has the right not to be hurt.

Jennie is not so ready to make advances as the tomtit and the robin. It takes its place in our midst with a certain minute dignity, if dignity may be possible with that fantastic little up-cocked tail and perky manner. It cares little for our bounty, but forages for itself. Wood-lice are its big game, spiders its tigers, caterpillars its snakes, and they and a host of other things harmful to us are its food. They, like other tiny birds, are marvelously prolific, but when spring comes and wren flocks are thinned, we sadly ask ourselves, Where are the baby wrens of yesteryear? The number of deaths must be enormous, or the land would swarm with these exquisite little creatures.

The Golden-crested Wren is the tiniest of European birds, as well as one of the sweetest. Its nest is one of the loveliest little homes ever devised by living thing. All the wrens are great nest-builders. Like the weavers, they sometimes build, for sport and practice, nests which they do not need and may never use.

The uptilted tail of the jolly little Water Ousel suggests at first sight a larger unknown wren. A general look at the outline seems to show it to be a strange little thrush. Probably it comes between the two, related to both. They cannot be so very far removed from the famous Mocking Birds, which are thought by some to be freakish thrushes established as a permanent type. These are wonderful mimics with a little repertoire of their own. They can imitate any sound from the cry of a sheep to that of an eagle.

THE LITTLE BIRD THAT MEWS LIKE A CAT AND CLUCKS LIKE A HEN

The Catbird screams and mews like a cat and clucks like a hen, as well as utters all sorts of whistling cries. The Brown Thrasher has a sweet song of its own. All these birds fly well and feed on the wing.

We pass on to the true Thrush Family, which includes many species. There are the Missel Thrush, the Song Thrush, the Redwing, the Fieldfare, the Ring Ousel, in addition to distinct genera of Rock Thrushes.

We have many thrushes, though we do not call them all by that name. The Wood Thrush is a wonderful singer, and

does not live entirely in the woods. The Hermit Thrush is shy, but its song is among the sweetest we hear. The American Robin is a thrush, and so is the joyous Bluebird, which used to be so common before the English sparrow drove him away. We tell more of them in Birds of the North. The Wheatear, sometimes called the Stonechat, is a thrush, but is more common in Europe than in America. It breeds freely in Labrador, and sometimes straggles southward into the United States.

THE TRAVELERS FROM THE ARCTIC SPEND CHRISTMAS IN ENGLAND

The English often speak of the Redwing and the Fieldfare. They come south in winter with a touch of mystery. They accept hospitality during inclement months, and settle down as cousins of the thrushes. But the same bird which eats a homely Christmas dinner in a rustic English hedgerow has seen great wonders and terrors in the Far North, where it was cradled.

Wheatears migrate every year the whole length and breadth of Europe—some to seize the moors, some the meadows, and some to enliven the beaches and sandbanks of the sea and estuaries. The European Redstart, which is Anglo-Saxon for Red-tail—the bird which country people call Fire-tail—spends the summer months in Northern Europe; the Bluethroat, which, leaving the Sunny South, is in its Arctic nesting grounds by the end of May—these all belong to the Thrush Family. The bird called the redstart in America is a warbler, not a thrush.

DIFFERENT BIRDS CALLED BY THE SAME NAME

The student of both birds and flowers must remember that the same name in Europe and America does not always mean the same bird or the same flower. In most cases they look something alike. When the first settlers came over they saw a bird or a flower which resembled one they remembered in Europe, and therefore they often called it by the name they knew. In fact, it often belongs to quite another family. On the other hand, many European plants have been brought over and have made themselves so much at home that we do not realize that they have not always been here. Many birds are equally at home on both continents. Occasionally an introduced bird, like the English sparrow, thrives.

THE ROBIN THAT MAY HAVE BEEN MAN'S FRIEND AGES AGO

Another genus consists solely of that charming redbreast, the English Robin, common to all Europe and represented by separate species in the Far East. Legend and fancy cluster thick about the beloved robin, but all arise from the fact that his plump little breast is a rich crimson.

The robin is the friendliest little creature of all the wilds. What wild bird but a robin will spring down and perch at the gardener's feet, or hop about the lawn as he mows? It is thought that the little robin began its association with men in the Cave days, when it could fly in at the open door and share their rough fare. The young ones share with their parents till they are able to fend and forage for themselves. Then either they or the old ones must move on, lest all perish of starvation. But they do not kill each other. The loser goes; the winner stays behind.

THE MAGIC OF THE NIGHTINGALE, THE SWEETEST SONG OF ALL

We began with a song at heaven's high gate from the throat of the lark; we end with a song which has thrilled poet, prince and peasant in all ages. It is the Nightingale's. Not unlike a soberly clad, slim robin, this matchless bird winters in Africa, but comes north for its cradle.

It makes a modest little nest in low shrubs and bushes, in copse and wood and hedgerow. When urged by the full ecstasy of song, it stands its ground on a green spray and sings in our face as we halt a yard from it. Night and day it chants while its mate is brooding her eggs. If the finest canary that ever trilled had been glorified immeasurably, such a bird might match a nightingale; no other bird can.

The canary note gives the clue to its melody, and once the note has been memorized it can never be forgotten. One can pause at a coppice where a hundred birds are singing in full sunlight, and pick out the nightingale's, sweetest of all the sweet voices. But at night, when all else is hushed, the world is the nightingale's. He thrills the silence with a song so lovely, so pure, so uplifting to heart and spirit as to make the saddest believe in the beauty and beneficence of the Providence which fashioned these birds to minister to our delight.

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 3277.

By Ewing Galloway, N. Y.

An old gate in Teheran, the capital. Tiles imbedded in cement form a beautiful mosaic pattern.

THE STORY of IRAN

LAND OF THE PERSIANS

PERSIA, or Iran, is one of the most dramatic of all lands. It is about as large as France, England and Germany put together (628,000 square miles). One is never out of sight of mountains; huge ranges sweep down from the northwest across the country, both in the south and the north, merging in the great mountain mass of central Asia. These mountain chains are often of imposing grandeur, with peaks running up to a height of nearly 19,000 feet, Mount Damavend, for example. In almost every part of the country there are peaks exceeding 10,000 feet. The ranges are very beautiful, cathedral-like structures or tumultuous masses, sometimes richly clothed in green but more often utterly bleak and forbidding like the lifeless mountains on the moon.

Central Persia is a plateau of 3,000 to 5,000 feet elevation, occupying half of the country. It is mostly a desert of the most ferocious and dangerous character, in many parts utterly devoid of life. Measured by its victims, it is probably the most dangerous desert in the world, and one of the most overwhelming expressions of natural force to be seen anywhere. Both mountain and desert are alleviated by lush valleys and widespreading meadows which, particularly in the springtime and early summer, are spangled with beautiful flowers. Many of the mountain slopes, too, for a few weeks are decorated with a sparse but entrancing tapestry of flowers, delighting the eye with color.

Cyrus restoring the sacred treasures to the Temple in Jerusalem. They had been stolen by Nebuchadnezzar.

In the deeper mountain ranges and around the southern rim of the Caspian Sea there are dense forests, fabled in classical times as the land of the Golden Fleece. These dark, impenetrable masses of hardwood and jungle, alternating with immensely fertile lowlands, are even today teeming with wild life, including leopards, tigers and bears.

Because of its meager rainfall Persia is dependent for its very existence on the mountains which condense the passing clouds, congealing their moisture into great snow and ice fields. These, melting, send cascades and streams fanning out from the slopes far into the plains below. Because of the summer heat and the dry air this precious water would be promptly evaporated unless it were specially conserved. The Persians learned how to do this several thousand years ago by building underground water channels, called Khanats. Sometimes these channels run thirty miles from the source. They are examples of man's courageous and intelligent conquest of adverse nature.

The heat on the southern shore and along the Persian Gulf is almost unsupportable; day after day in the summertime the thermometer reaches 130 or 135 in the shade; and this is made the more intolerable by sickening humidity. It was here that the Persian Gulf Command of the United States Army landed critically needed supplies to be forwarded to Russia during the war. With the help of Persian labor, these men performed miracles under excruciating circumstances.

DRY, SPARKLING AIR MAKES THE CLIMATE OF MOST OF PERSIA DELIGHTFUL

Nevertheless, on the whole, the climate of Persia is delightful. Its main cities enjoy a climate very much like that of Denver, Colorado. The heat in summer is even and dry, and the cold in winter is nothing like so severe as what we know in many parts of America. The air of Persia has been celebrated by visitors for centuries. The light is brilliant—sometimes almost to incandescence—the sky, a deep blue. The larger mountains can be seen from distances of ninety or even one hundred miles. The purity and dryness of the air and the elevation give it a stimulating, life-giving quality. The rivers are very few, only one, the Karun in the south, amounting to anything. The others straggle out and are absorbed in the desert, or end in dangerous salt swamps.

On the whole, it is a favorable environment. Luxury and indolence are impossible, except to a few. Effort is required to maintain life, but effort is rewarded, for, despite the deficiencies of water, the soil is very fertile and contains, in addition, precious minerals. With determination and intelligence, life of an excellent character can be maintained in Iran.

CIVILIZATION, OR MAN HIMSELF, MAY HAVE BEGUN IN THE IRANIAN HIGHLANDS

Persia, or Iran, if we use the ancient, correct and official title (for Persia is only a Western corruption of the name of one province), has played a vital role in history which we are only beginning to understand. Explorations and studies of the last few years make it increasingly evident that civilization itself probably emerged in the northwest Iranian highlands; and some authorities, like Sir Arthur Keith, Professor Ellsworth Huntington and Dr. Henry Field, think it is more than possible that man himself originated in this region.

The evidence is more conclusive that the domestication of animals and the development of agriculture and metallurgy originated in the region to the west of the Caspian Sea, in what is now Azerbaijan and Armenia. In his most primitive state, man lived by hunting, but this was a difficult, uncertain and meager way of living. Probably there was no place where more than

two or three people per square mile could be supported if they depended wholly upon hunting. Thus it was impossible for men to form towns or any substantial community life, except as various groups came together temporarily. But when wheat began to be cultivated, then one square mile could support thousands. With the domestication of animals and the making of more efficient implements through the use of tempered copper and then of bronze, it was possible for men to live together in communities. There they had protection and there the arts and crafts could be separately developed and leisure could be found for thinking and planning.

The mountain valleys of northern Persia favored the rapid development of this early civilization. These valleys were fertile, the streams could be very easily controlled for irrigation purposes. They furnished protection and yet they were near enough to one another to permit of contact, rivalry and the exchange of ideas which is an energizing force in human development.

Probably by 5000 B.C. town life had developed in Iran, and it overflowed into northern Mesopotamia and down into the Indus Valley. At Tepe Gawra and Tepe Hassuma in northern Iraq, as well as at various sites in Iran, we have very well preserved traces of this early civilization. Here are carefully made houses and temples and many implements of good living. In the oldest part of Tepe Gawra (about 4000 B.C.) there was found a child's clay flute which would still sound.

This early civilization carried the art of pottery to a high perfection, and some of the early painted pottery from these regions is equal in beauty and technical excellence to anything that we could do today. The objects were ornamented with beautiful patterns which were at first thought to be random artistic inventions, but which we now believe were prayers or supplications for protection and other favors. They depict mountains and rivers, and animals that represented the powers of heaven. The ibex with his long, sweeping horns recalled the curve of the crescent moon which was supposed to bring moisture and the cooling rains of winter. The eagle was a favorite device, the sky bird that disappears into the dazzling sun and must therefore be a representative of the sun—a bird that might bring back the springtime sun so that life might be renewed. They depict the bull with his concentrated energy, the life force which human beings so envied, for their life was dangerous and they must often have felt weary and weak. They felt the urgent neces-

From Ewing Galloway, N. Y.

The wedding of Alexander the Great and Statira, a Persian princess. He also urged his soldiers to marry Asiatic wives, so that the Greek army would dominate his empire in Asia. Alexander adopted Eastern dress and customs.

sity for controlling the powers of heaven to keep the seasons in rotation, so that sun and rain might follow each other in a life-sustaining orderliness. They had even figured out a theory of the universe based on the pole star around which everything revolved and from which came the source of life and power. They propitiated this power by ritual, and recorded their beliefs in these magical patterns which we are only beginning to interpret and to understand.

By 3000 B.C. the Iranian plateau was dotted with communities occupying mountain valleys, in way of life and in language more or less akin but politically separate and often warring. They produced superb examples of various arts, particularly bronzes. The horse was apparently first domesticated in this region, and horse-trainers, especially from the Lursitan district in western Iran, went all through the Near East teaching horse-training, horse-breeding, military and economic uses of the horse. A king or chieftain who wanted to make a regal gift to a neighbor king would send a horse.

The Metropolitan Museum of Art

A 13th-century recipe for cough medicine!

Iran, while developing a virile civilization of its own and building up city life, nonetheless could never compete in wealth with the tremendous civilizations of the Indus Valley, of the Tigris and Euphrates or the Nile. But other and more precious qualities compensated for the Iranians' lack of wealth and numbers. They were hardy, courageous, energetic people, with some very noble religious and ethical ideas. Their primitive systems of thought were gathered together by the great Zoroaster, who lived more than a century before Buddha and six hundred years before Christ. Zoroaster formulated one of the noblest of all religious systems. It was a system that dramatized out of the background of life in Persia the eternal conflict of good and evil; the contrasts between the desert and the sown, between the peaceful husbandry of the peasant and the marauding wild animals and the even more dreaded human marauders. From the oases and gardens that grew up where there was water came the vision of paradise which seemed the reward for life's labors. Hence came our word paradise, for "paradise" is a Persian word. These "paradises" were walled parks filled with all manner of trees and birds, fountains and flowing water, with soft air and delightful sounds. For the travelers who had to travel through miles of bitter desert with its painful glare, heat, sudden storms, its vast distances and bleak inhumanity, those paradises provided a contrast that the Western world can scarcely appreciate. Hence the luxurious garden became for them a supreme expression of life's highest ideals, the reward for courage and effort, the goal and justification of life; a feature that entered not only into the religion but into the language, poetry, art and daily living of all the people.

One of the ablest leaders of all time was the Persian, Cyrus the Great, who ruled from about 560 to 536 B.C. He was first of a line called the Achaemenid kings, after the family name. Cyrus conquered the Medes, fellow-Iranians to the north, and set up the first unified Persian kingdom which he soon expanded into the world's first great empire. He claimed the land from the Indus Valley to the Nile and from central Asia to the Aegan Sea. Cyrus it was who returned the Jews to Jerusalem after the Babylonian Captivity, and helped them to rebuild the city. He is called, in the Old Testament, "the Lord's annointed."

Cyrus was shortly after followed by Darius, one of the world's greatest administrators, and this huge kingdom was amalgamated into a peaceful, prosperous and relatively free whole. Each of the nations that composed it was left with cultural independence and generally in control of its own affairs; but all the provinces, called satrapies, were bound together by allegiance to the king. This allegiance was strictly enforced from a central government that was flexible in detail but firm on fundamentals. A magnificent system of roadways bound together the entire empire, so that

the king's officers could go in four days from the great capitals like Susa and Persepolis in south Persia, to the provincial capital of Sardis in Asia Minor. Even today, with modern roads, that would be a hard trip. The Greek traveler and writer Herodotus said of the Persian couriers "Neither snow, nor rain, nor heat, nor gloom of night stays these couriers from the swift completion of their appointed rounds."

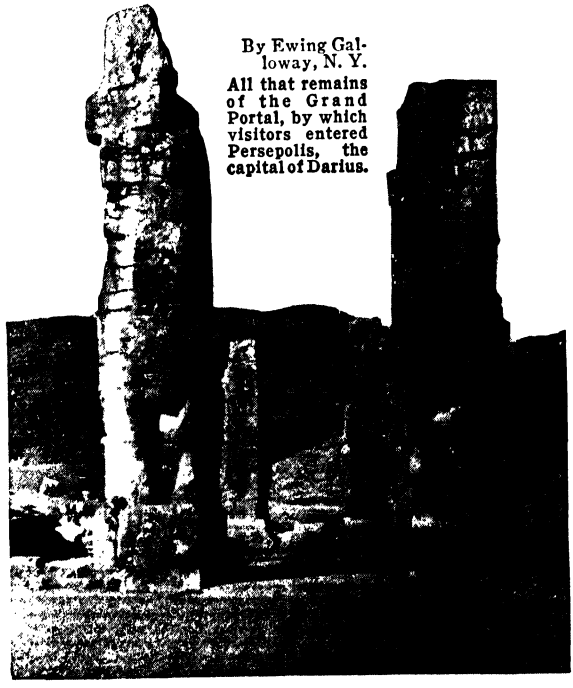
Even more important than the roads or the system of government was the political and ethical theory that underlay the Achaemenid Empire. For the first time in history there was racial and religious tolerance. The rights of the conquered people were recognized, their gods were respected and honored, their way of life and their worship were confirmed and protected. They received the benefits of the wealth and progress of the Empire. In Egypt, Darius dug the first Suez Canal, established schools, hospitals and medical schools; in Egypt he was hailed in inscriptions as a benefactor of the country. Some of the inscriptions are still in existence.

The Greco-Persian wars which loom so large in European history were, from the Persian point of view, a relatively unimportant colonial affair. Even if Persia had won at Marathon, Greek civilization would probably not have been extinguished. Persia was in certain respects more civilized than Greece and admired her talents; while Greece had the profoundest respect for certain elements of greatness in Persian civilization. In the opinion of Herodotus, Persia had much to teach Greece. Xenophon, another Greek writer, author of the ANABASIS, wanted to reform Greek education along Persian lines.

Art developed magnificently under the Achaemenid kings. Sculpture of great delicacy and beauty, of fine simplicity and power of expression, worthy to rank with the sculpture of the Parthenon yet preceding it by many decades, adorned the great palaces at Susa, Persepolis and Hamadan. Esther of the Bible was the queen of Ahasuerus, who was really Artaxerxes II, one of the later Achaemenid kings; and the account of certain features of Persian life in the Book of Esther is one of our important documents.

The palaces that these kings built, literally astounding in their size and magnificence, in some respects have never been surpassed. At Persepolis the terrace retaining wall contains single blocks that weigh as much as twenty-six tons. In the Apadanna of Xerxes beautiful slender fluted columns tower sixty-five feet high, crowned by double bull-head capitals weighing six tons. The Hall of a Hundred Columns could accomodate a congregation of 10,000. Gold and bronze work of the period set high standards of elegance and beauty.

But power and prosperity in turn bred indolence and arrogance. The lofty and vitalizing precepts of the early religion petered out into stale and lifeless routine. The country became enfeebled by its own prosperity, contentment and dangerous sense of superiority. So the Achaemenid Empire was swept away by the young conqueror from Macedonia, Alexander the Great. In revenge for the looting at Athens in 480 B.C., Alexander burned the glorious palaces of Persepolis. Probably he meant to signify thereby the end of the Persian state, for these great palaces were the visible expression of the divine as well as the human power of the king, the very embodiment of the life of the nation.



By Ewing Galloway, N. Y.
All that remains of the Grand Portal, by which visitors entered Persepolis, the capital of Darius.

Alexander had seen the constant quarreling between Greek city-states which cut short one of the world's supreme civilizations; and he was certainly aware of the over-organization and

dictatorial character of Persia's political and social life. Apparently he thought to build a new world culture—a Greco-Persian world—in which Greek individuality and talent and Persian discipline, tolerance and universality should complement each other. In other words, he may have hoped to build the first world civilization. In any case, Alexander's death cut short any such prospect. This most urgent task, the building of a world civilization uniting the values of the East and West, is something that still awaits accomplishment, though slow progress is being made.

The Iranian Institute and School for Asiatic Studies

Native boats at Khorramshahr. This port is at the head of the Persian Gulf, in a region of almost intolerable heat.

As the years went by Greece was displaced by Rome, and Roman wealth and power reaching out to the whole known world came in contact with Persia. From about 200 B.C. to 220 A.D. Persia was ruled by a virile dynasty called the Parthian, or Arsacid, dynasty. This was a related Iranian group that developed a formidable military power based on a fine cavalry using disconcerting and novel tactics (the Parthian shot), swift attack, swift retreat and dispersal. Another vital element in Parthian power was the control exercised over the trade routes that connected Asia and Europe. Roman grandees, growing rich from taxes and tribute, bought with utter extravagance all the fabulous luxuries of the East—silk from China, gold, incense, spices, rare woods from India. All these goods passed across Persia and contributed substantial profits to the Parthian overlords.

By 46 B.C. Rome was impoverished by misgovernment, civil wars and the decline of economic productivity. She sought to recover her fading fortunes by a conquest of Asia, hoping that the prodigious wealth of the vast continent would restore her wealth and glory. So Mark Antony, at the head of the greatest army Rome had ever gathered, marched into Asia, first intending to subdue the Iranians. This magnificent army was shattered by the resourceful Parthian cavalry and by the resistance of their great citadel of Phraaspa or Ganzaka (modern Takt-i-Suleiman)—a powerful fortress crowning the top of a mountain in northwest Persia. The walls of this citadel are still standing almost intact. They were fully explored by an expedition of the Iranian Institute in 1937. This battle was a triumph for Iran; it marked the final defeat of Europe's hopes for a military conquest of Iran.

During all the period from the death of Alexander (323 B.C.) until the beginning of the third century A.D., Greek ideals had dominated the Persian court; Greek drama and Greek coin-carvers were in high favor. But for the bulk of the people Greek art seemed superficial, naturalistic, failing to convey to the average man the symbolic power, the sense of the great controlling forces of the universe which his more austere decorative art proclaimed to him with deeply moving symbols. We must remember that through these centuries the genius of Greece was dying. Slowly its inspiration slackened; artists merely copied the old masters, and copied them without distinction. But a new era suddenly dawned in Persia that had immense consequences for the whole world.

At the beginning of the third century, the Sassanians (220-640 A.D.), a strictly Iranian dynasty from south Persia, opened a new epoch full of enthusiasm, self-confidence and creative energy. It repeated the Achaemenid conquests; and Persia was for a time once more master of all western Asia to the Aegean and the Nile. It brought together in Iran a new stream of influences from central Asia, from the Far East and particularly from India. A new art came to life, having something of all these Asiatic influences and breathing new irresistible spirit into the dying Greek forms. Tremendous monuments were built, palaces of the king which, as in Achaemenid days, were visible symbols of a divinely sanctioned state.

Impressive ruins have survived at Ctesi-

Top picture, The Iranian Institute; others, from Ewing Galloway, N. Y.

Chiseling stone in flowing Persian script.

phon, which lies south of Bagdad, where the throne hall of Khusrau still stands under a vaulted ceiling 126 feet high, 76 feet wide. It was a palace of unbelievable magnificence. Around the walls was a dado of mother-of-pearl, carved and decorated above in polychrome and gilded stucco. Above that were huge mural paintings of the Sassanian kings as divine guardians of their people, engaged in symbolic hunts proclaiming their power over the forces of nature. From the ceiling hung massive silver lamps.

Women wearing chadars, or long veils.

The floor was covered with the world's most astounding fabric—a carpet in gold and silver, the design studded with hundreds of thousands of jewels, representing the eternal spring, the paradise gardens of Persian religion and poetry. The wide outer border representing the green fields surrounding the garden contained probably not less than two million emeralds. The whole fabric, as we know from dependable and detailed ancient documents, when cut up and sold in pieces to a great combination of jewelers, brought more than $250,000,000.

War with Rome continued; and Rome, mighty as she was, was frequently disastrously defeated by the Iranians. A huge sculpture-relief cut in the solid rock in southern Iran today shows the Roman Emperor Valerian on his knees before Shahur, his Persian conqueror.

The Sassanians revived the ancient religion in some of its noblest forms. Painting, sculpture, poetry, music—all the arts of civilization flourished. Unfortunately, this proud regime came into conflict with the equally proud regime of Byzantium; each felt itself the representative of the Almighty, the one legitimate and sovereign power in the world which could brook no rival. So a long series of wars exhausted both and deprived the world of the full value that each might have contributed to the march of civilization.

But a new force was soon breaking on the world. Out of Arabia there burst like a hurricane, fired by a burning faith, by confidence in themselves and lust for plunder, a rude and simple people, but warlike and full of fighting fury. This was Islam, the following of Mohammed. In sublime self-confidence it summoned the known world to surrender and started out to conquer those peoples who did not promptly submit. The great Sassanian Empire fell before the warriors of Islam like a storm, and so did a whole belt of the world extending from Spain in the west to China in the far east.

Modern compressed-air drills are used in road-building.

Islam had much to offer the Persians, a more simple religion in which the fatherhood of a merciful and compassionate God and the brotherhood of all men were devoutly preached and easily understood, and which could be turned into a sustaining and comforting force.

Under Islam, after a century of uncertainty and re-adjustments, Iran made one more of her remarkable recoveries. Other nations can boast a renaissance, or perhaps two or three revivals. From prehistoric times to the present, Persia has achieved out of disaster, defeat and depression, a succession of new eras. Each has been infused with new life, new hope, attaining new values though always utilizing her immortal traditions. Historians have regarded this as a mystery. How could this small country, so frequently crushed and overwhelmed, so often rise from its ashes and create ever more magnificently?

The ninth and tenth centuries saw in Iran the birth of poetry. The Persians are perhaps the most poetic people who have ever lived, and in proportion to their numbers have probably produced more and better poetry than any other land. Firdausi, whose millennium (1,000 years) was celebrated in 1935 all over the world, is only one of hundreds of great poets of Persia. Everyone knows of Omar Khayyam in the eleventh century; but in the eyes of the Persians,

Philip Gendreau, N. Y.
The pointed arch and mosaics on a modern building.

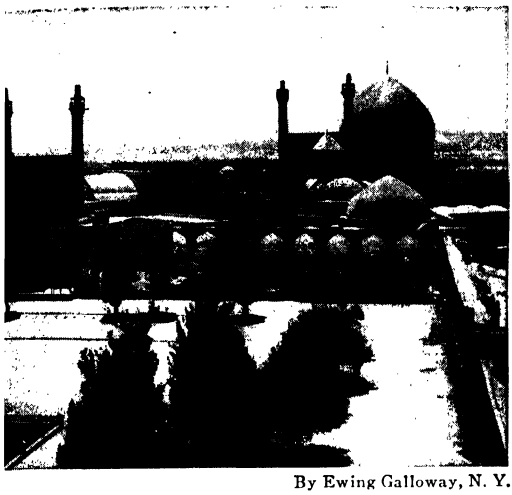
By Ewing Galloway, N. Y.
Pahlevi, near the Caspian Sea, is a caviar center.

Omar was only a delightful versifier and gatherer of verses. He was really an astronomer and algebraist and a mighty good one, too. Hafiz and Sadi and a group of other mystic poets have written some of the most exalted religious verses ever composed.

Science had its heroes, also. Ibn Avicenna (980-1037), one of the great minds of all time, laid the foundations of medicine so deeply that his textbook still had prior authority at Oxford 700 years later. Al-Biruni, the historian, had few rivals. In the Sasanian period, Persian builders had solved fundamental structural problems of the dome and the vault—discoveries that made possible the development of domed and vaulted architecture in Europe. Now to those architectural inventions Iran was adding the pointed arch, the ribbed vault and even buttresses which made their contribution to the development of Romanesque and Gothic architecture in Europe.

The art of Islam forbade representing human figures. It was hardly an injunction of the Prophet and is not recorded in the Koran. It appeared in books of religious law written later. It was meant as a protest and protection against the danger of idolatry; but it retarded the development of painting and sculpture. Yet it helped to divert Persian artistic talent to its more natural theme of rich and symbolic ornament in which it was supreme.

Nonetheless, Persia's aesthetic instinct, its vivid and sensitive appreciation of the world and of beauty could not long overlook human themes. Profiting by suggestions



By Ewing Galloway, N. Y.
Isfahan, a domed city out of the ARABIAN NIGHTS.

from China and also from Mesopotamia with its old Hellenistic (Greek) traditions, Persia developed a miniature style of painting in which scenes are crowded with human figures done with an exquisite grace, a jewel-like perfection of color, that brings, in Binyon's phrase, "The glory and freshness of a dream." This was a unique achievement in the field of the visual arts.

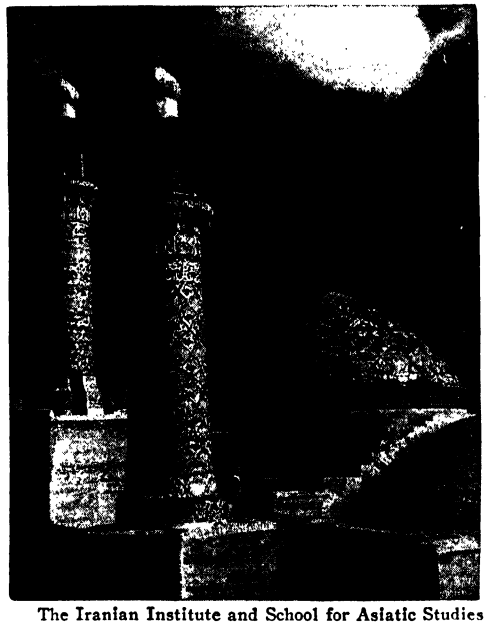
To this period we owe some of the world's greatest architecture, of which the famous cathedral, or Friday mosque, of Isfahan is the most famous. The smaller Dome Chamber here has been ranked by architects who have seen it as the world's finest small dome (diameter, 30 feet).

All the arts were developing with new power, technique and fine feeling. A Persian living in Isfahan in the tenth century wrote a ten-volume history of music. Persian music influenced Arabian music and, by way of Spain, European music. Silver and bronze, wood-carving, ornamental stucco, pottery and woven fabrics were carried to a lofty degree of imagination, taste and skill. In their own field they are not rivaled by the arts of any other time or place.

There was a great dynasty called Seljuqs (Seljuks), (1037-1194)—a dynasty of Turkic origin that became thoroughly Persian. The Seljuqs were converted to Islam, and set up a rule of such power, good sense, sincerity and energetic zeal that Persia again became immensely prosperous and, for the third time, conquered all of western Asia. Its achievements were more than military. It achieved a political organization of exceptional character, thanks to Nizam ul Morek, a very great statesman who was prime minister to two of the greatest kings in Persian history—Alp Arslan and Malek Shah.

Just as this superb civilization reached its highest peak, a hurricane of horror and devastation broke over the doomed and panic-stricken land. In the first quarter of the thirteenth century, Jenghiz Khan and his Mongols bent on loot, massacre and destruction, left the country a wilderness of ashes and death. The great libraries, fabulous gardens and populous cities were obliterated; poets, scientists, priests and scholars given to the sword. Whole provinces were depopulated. It seemed as if the end had come. But after years of appalling misery, and even some years of anarchy, Persia again revived. The first half of the fourteenth century saw a brilliant renaissance, in which good government that conferred peace and prosperity was combined with an outburst of creative energy in architecture, art and learning. The superiority of Iranian culture tamed and civilized even those Mongols who stayed in Persia.

At the end of the fourteenth century the invasion was repeated on a less dreadful scale by Tamerlane, and with similar consequences, for his successors likewise were captivated by the charm and brilliance of Persian civilization. They set forward a great renaissance (fifteenth century) which pro-



The Iranian Institute and School for Asiatic Studies
Intricate design, in tiles, on a mosque in Teheran.

duced more than its share of poets, painters, architects and learned men.

A final renaissance came a hundred years later by the Safavid, or Sufi, dynasty (1501-1734) to whom we owe the finest of Persian carpets, the most exquisite and luxurious of fabrics (often richly interwoven with gold and silver) and new achievements in architecture.

The eighteenth century was a period of decline. Persian arts could no longer compete with European industry, and Persian trade routes were passed by after the opening of sea routes to the Far East. Misgovernment and invasions from the rude Afghan tribes brought Iran to a lower state. Culture was still alive in the nineteenth century, but politically Iran was grievously handicapped and found the adjustment to the modern world too difficult.

The Iranian Institute and School for Asiatic Studies
The ruins of a castle mid the bare mountains of the plateau.

For nearly 150 years Persia has been embarrassed by British and Russian rivalry. Under the tsars' rule, Russia was expanding throughout Asia with limitless ambitions and harsh methods. The British saw in Persia a vital link in their communications with India. Each struggled for influence and supremacy in the country, and Persia suffered accordingly.

The discovery of oil in the beginning of our century complicated the problem. A British company received in perpetuity the rights for exploiting three-fifths of the territory of Iran and brought into production the most prolific oil-field in the world. Conflicting ambitions resulted in 1912 in an agreement to divide Iran into zones of influence, the north to the Russians, the south to Britain, an arrangement that threatened to strangle the country.

The battle for a liberal government, begun in 1908, resulted in the establishment of a constitution. Persia was encouraged to hope that she was on the way to becoming a modern, democratic country. Then came 1914. Persia, though wholly innocent, did not escape involvement in the first World War and suffered damage, loss of life, frustration and partial chaos.

However, at this crucial moment there appeared the strong man, Reza Khan (ruled 1925-1941), founder of a new dynasty. He replaced the corrupted, inefficient Kajar regime; and with furious energy, intelligence and ruthless will he established law and order, initiated many reforms, emancipated women, established a real educational system, developed sanitary services, built a good road system, and carried through the building of the Trans-Iranian Railway. (This in World War II rendered crucial service to the Allied cause.) National revenues were multiplied; the standard of living rose; and the whole country was given new energy. However, Reza Khan's methods were those of a military dictator, and he failed to prepare his country for a more active and responsible share in government. His tolerance of Axis plans led to his abdication in 1941, and he was succeeded by his young son, Muhammed Reza (1919-), an energetic and high-minded man, devoted to his people's welfare and ruling conscientiously as a constitutional monarch.

During World War II, American, British and Russian forces were stationed in Iran, guarding the precious line of supplies. The presence of the foreigners seriously interfered with the exercise of sovereign power. It made almost impossible the transition to new, liberal and democratic policies which were long overdue.

At Teheran in December, 1943, the three great powers—the United States, Great Britain and Russia—assured Persia of future aid. This, if generously given, would go a long way toward restoring her prestige, prosperity and power. Iran has rendered vital service to civilization for more than two thousand years. Her course is not yet run. She seems to be one of the eternal nations, with a vital part still to play in the world.

By Arthur Upham Pope.

THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 3151.

PLANTS USEFUL IN INDUSTRY

WE have already told you of many useful plants—the food, beverage, sugar, spice and medicine plants. There are many others that serve man in various industries. Some provide tanning materials, enabling us to change skins into leather. Others give latex, which can be made into such valuable substances as rubber and gutta-percha. Some plants give valuable oils; others furnish useful resins and gums. Many, too, are the plants that modern chemistry transforms into yarns, explosives, plastics and so on.

The trees of the forest give us many precious materials. One of the most important of these is paper. The interesting story of how logs are transformed into pulp and how this pulp is made into paper is told in the chapter called Pulp and Paper, on page 2445.

Certain trees produce the substance called tannin. Tannin is used in medicine (to check the flow of blood, among other things) in the preparation of inks and in making various acids. It is particularly important in the leather-preparing process that we call tanning. You see, there is a good deal of gelatin in the raw skins of animals and this spoils when exposed to air and moisture. When tannin is applied to a raw hide, a chemical change takes place which prevents the hide from rotting and makes it moisture-proof.

One of the chief sources of tannin is the bark of the hemlock tree. This plant is common from Nova Scotia to the southern part of the Appalachian Mountains and as far west as Minnesota. The bark is stripped from the tree by means of a spudder, a large tool resembling a chisel; after this the tree is felled. Sometimes the wood of the fallen tree is used as timber; where this would not be profitable, it is left to rot. The bark of the chestnut tree also gives tannin.

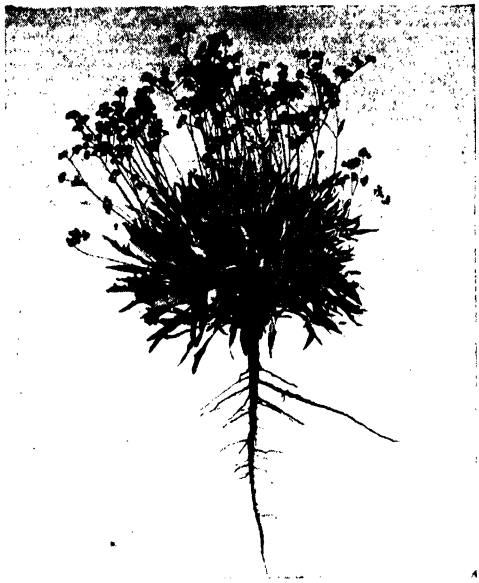
Tannin is contained in large amounts in the nutgalls that are to be found in many species of the oak tree. This is how nutgalls develop. The tree is attacked by small wasp-like insects that lay their eggs in the tissues of twigs or leaves. This irritates the delicate tissues and results in the formation of swellings, shaped like little nuts, in the leaves or twigs. These swellings are the nutgalls (sometimes called simply galls). The tannin supply obtained from nutgalls comes chiefly from the oaks of Asia Minor.

Extension Service, U. S. Department of Agriculture

Cloth, animal feed and fertilizer, paint, dynamite and gunpowder and other products come from cotton.

Tannin is also derived from various other plants—from the sumac, which occurs as either a tree or shrub; from the quebracho, a South American hardwood tree; from the mangrove, which is found in the tidal water areas in such widely separated places as South America, Africa, Madagascar and the East Indies. (Tidal water areas are those situated at or near streams affected by the tides.)

In the chapter beginning on page 1404 we tell you the story of latex—the milky fluid from certain trees and other plants that can be converted into rubber. There are various other latex products besides rubber. One of them is gutta-percha, which is used as insulation for submarine telegraph cables, as a mold for taking impressions of the teeth, as a temporary filling for teeth and so on. Another useful latex product is balata, which comes from the latex of a tree—the *Mimusops balata*—that grows in the jungles of British Guiana and elsewhere in South America. Balata is used chiefly for telephone cables running under water and



U. S. Department of Agriculture

The guayule shrub, from which rubber may be made. The whole plant is cut up and pounded and put into water. Little blobs of rubber float to the top.

as belting material in factories and shops.

The valuable substance known as cork comes from the outer part of the bark of the cork oak. This is an evergreen tree; it is found in Portugal and Spain and in other countries that border on the Mediterranean Sea. The cork oak has been introduced into North America and has become fairly widespread in California.

The cork is first removed when the tree is twenty years old. As this first layer is rough and has deep furrows, it is not very valuable. It is sometimes ground up and used for packing grapes. After the first stripping the cork is removed from the tree every ten years or so. First it is seasoned by being exposed to the open air. The rough outer part is then scraped off; the rest is flattened out and dried. After being trimmed and properly graded, the cork is ready for the market. Portugal, Spain, Tunis and Algeria are important centres of the cork industry.

Cork is a buoyant material, light in weight and very resilient (that is, springing back to its former shape or position after being pressed). It resists moisture and heat; it absorbs sound and vibration. Cork serves as a stopper for flasks and bottles. The small floats used on fishing lines and the larger ones used for seines are generally of cork. Baseballs have cork centres. Tiny cork balls no larger than peas provide the trill in whistles. Thin shavings of cork furnish cigarette tips. Split cork is used for cork helmets, which protect the wearer from the heat of the tropics.

Waste bits of cork, which were formerly disposed of as refuse, are now ground up and molded into many different shapes. This granulated cork, as it is called, is used for flooring tiles and other floor coverings. It is sometimes pressed into the form of bricks and is then used to make walls soundproof. Table mats and coasters (small trays set under glasses) are often made of granulated cork.

A useful substance is camphor, which is a product of the camphor laurel tree. This tree is an evergreen, found chiefly in Japan, Formosa and southern China. Camphor is produced by a process of distillation. (In distillation a substance is heated and gives off vapor, or steam; this vapor cools and then condenses—that is, becomes a liquid or a solid.)

First the camphor laurel tree is chopped down. Then the wood is cut up into small chips, and these, together with the leaves and bark, are put into a vat. They are heated. The vapor that arises from this mixture condenses in the form of crystals and oil. The crystals are heated again and become vapor. They condense this time in the form of the tough gumlike substance that we call camphor.

THE MAN-MADE PRODUCT THAT TAKES THE PLACE OF CAMPHOR

While camphor is a valuable ingredient of various liniments and medicines, it is used chiefly at the present time for industrial purposes—in the manufacture of explosives and of pyroxylin plastics (see page 4000). At one time Japan held the world trade in camphor. However, an artificial substance, having the properties of natural camphor, has been developed in the laboratory. This substance, which is called synthetic camphor and which is made from turpentine oil, is now manufactured in large quantities. It has replaced natural camphor in industry to such an extent that other countries do not have to depend upon Japan.

When the trunks of certain pine trees—particularly the longleaf pine, the slash pine and the maritime pine—are cut, a gummy substance called crude turpentine or oleoresin oozes from the cut. The cuts or streaks, as they are called, are made with a gouge and are in the shape of a V. The

crude turpentine flows from the tip of the V into a cup of metal or earthenware. After being collected in this way, it is then distilled. The spirits of turpentine (often called simply turpentine) and the water contained in the crude turpentine are turned into vapor. Then they cool and condense, dripping into a barrel. As the turpentine is lighter than water, it comes to the top of the barrel. The water in the barrel is drained off from time to time by means of a pipe set at the bottom of the barrel; the turpentine is removed from the top. Turpentine is used extensively in paints and varnishes. It is also used for shoe polishes, greases, sealing wax and so on.

Crude turpentine yields another valuable product. After the distillation process that we just described has taken place, a gummy substance called resin is left behind in the still (the vessel used in distilling). The resin is cleaned; chips, pine needles and so on are removed. Then it is allowed to harden. The hardened substance is called rosin on the market.

A good deal of rosin is used in the paper industry as sizing or filling material for paper—the rosin gives weight and gloss to the paper and prevents the ink from spreading on it too much. Rosin is also used in the manufacture of soap, sealing wax and linoleum. Of course we must not forget the use of rosin by players of instruments like the violin and the cello. They rub the hairs of their bows with rosin. The particles of rosin cling to the hair and enable the bow to "bite" firmly into the string.

Courtesy, Grace Line

Harvesting hemp in Chile. Many varieties of hemp are grown in Asia, Europe and North and South America. The fibre comes from the bark of the stalks.

Courtesy, National Farm Chemurgic Council

A field of castor beans in Texas. Oil from the beans is a medicine and is used also to oil engines.

Certain plants yield gums that are valuable in industry. Gum arabic, for example, is used for mucilage and for calico printing; it provides size (filler) for fabrics. It is derived from several species of acacia; the best-known of these is the gum arabic tree which is found in Arabia and India. The gum oozes out as a liquid from the bark of the tree but soon hardens in the sun and air. It is sold in the market in small round drops, called tears. Gum tragacanth is used for much the same purposes as gum arabic. It comes from the astragalus, a low bush growing in Asia Minor and Persia.

It is a long process, with many steps, by which the tall monarchs of the forests are converted into building materials. Another plant that provides building materials of many kinds is the bamboo, a member of the grass family. It sometimes grows as high as a tree (large species of the bamboo reach a height of over 100 feet). Its stem is hollow, with well marked joints. The bamboo grows very rapidly; one species in Ceylon

grows as much as sixteen inches in one day.

The bamboo serves almost numberless purposes. In certain parts of tropical Asia entire houses are made of the plant. The posts, or columns, are formed by complete sections of bamboo stem. Split bamboo is used for the floors, rafters and roof; interwoven in latticework, it serves for the sides of the house. The families living in these fine, airy houses often use water buckets made of large joints of the stem. In Europe and North America bamboo strips are woven into all sorts of articles—chairs, tables, baskets. Bamboo stems sometimes serve as canes or umbrella handles.

The palms, too, yield great quantities of building materials. Many of the larger species, like the coconut palm, provide all that is necessary for building houses in many an island of the South Seas. The plant known as the rattan palm, which climbs along the trunks of lofty trees, furnishes the tough and flexible substance known as rattan. This is used for the seats and backs of chairs, for floor mats, brooms, baskets and so on. In Eastern countries rattan is sometimes used for rope bridges.

THE NUTS FROM WHICH "VEGETABLE IVORY" BUTTONS ARE MADE

A variety of palm tree that grows in northern South America and the Isthmus of Panama gives us the corozo or tagua nuts that are used to make buttons. These buttons are called vegetable ivory buttons because they are derived from a plant and because they resemble ivory—that is, before they are dyed. They are used on men's suits and women's tailored clothing. To a certain extent they have been replaced by buttons made of galalith, a plastic material that is made from milk. Other plastic materials have also come into use.

A number of dyes, known as vegetable dyes, are made from plants. The blue dye, indigo, comes from the indigo plant; red, from the brazilwood and the madder; yellow, from the Venetian sumac and so on. Formerly these dyes were in general use. They are giving place nowadays to synthetic dyes such as those obtained from aniline, a coal-tar product.

The oils derived from plants play a large part in industry. Some of them are called volatile oils. The name is applied to substances that can readily escape into the air and that can move about or "fly about" in it (volatile really means flying). Volatile oils derived from various flowers and other plants are used to make floral perfumes.

The simplest perfumes are those given off by dried flowers—rose petals, violets, lavendar flowers and so on. Roses, rosemary, thyme, patchouli, lavendar, cedarwood and sandalwood are often treated by the process of distillation. For example, to produce the delicately lovely perfume known as attar, or otto, of roses, petals of roses are placed in large vats containing water. The water is boiled and gradually the oils contained in the roses are distilled with the water itself. The rose water that results is then distilled again, yielding the extract that we call attar of roses. It is said that thirty roses produce but one drop of the precious liquid.

There are other ways of getting perfume from flowers. An interesting process is that known as *enfleurage*. Lard or beef fat is smeared on the underside of a piece of glass; flowers are placed upon netting right under the glass. The fat draws into itself the odor of the flowers or rather, the tiny particles of oil causing the odor. The fat is now washed with alcohol. As the alcohol is a solvent (dissolving substance), it draws with it most of the particles of odor-producing oil.

Distillation is now applied to the liquid mixture of alcohol and perfume. As the alcohol has a low boiling point, it turns into vapor long before the rest of the mixture would. When this has happened, the heat is turned off. The alcohol condenses in another part of the distilling apparatus; the extract that contains the pure perfume is left behind. *Enfleurage* is applied to delicate flowers like jasmine and tuberose.

THE FLORAL PERFUMES THAT ARE NOT MADE FROM FLOWERS

Nowadays many perfumes which are called floral perfumes (perfumes obtained from flowers) are not made from flowers at all but from various artificial substances. Often these synthetic perfumes ("synthetic" means "put together in the laboratory") are finely blended mixtures of chemicals derived from coal tar.

Certain oils, when exposed to the air, dry in the form of a tough and resistant film. These are known as drying oils and are used chiefly in paints and varnishes in order to provide a durable finish. The chief drying oils are linseed oil and tung oil. Linseed oil comes from the seed of the useful flax plant that gives us linen. Generally the seed is crushed to produce the oil, though there are several other methods. While most

Courtesy, National Farm Chemurgic Council

From nuts of the tung tree come quick-drying oils for the paint and varnish industry.

linseed oil is used for paints and varnishes, a considerable amount is used in linoleum and other floor coverings, in oilcloth, in putty and in soaps.

Tung oil is obtained from the nut of the tung tree, which grows chiefly in China, though it has been grown successfully in Florida and other states bordering on the Gulf of Mexico. Tung oil has valuable drying properties and has replaced linseed oil to a certain extent in waterproof varnishes.

The oils known as non-drying oils do not dry when exposed to the air; they merely become greasy and sour. These non-drying oils include cottonseed oil, coconut oil, palm oil, olive oil and castor oil. They are widely used for food—as substitutes for lard and butter and as salad dressings. However, some of these oils are used in industry too.

Non-drying oils are used extensively in making soap. Castile soap and certain other fine soaps are made from olive oil, pressed from olives. Both coconut oil and palm oil lather freely and are therefore often used in making shaving soaps and shampoos in North America. Coconut oil is derived from copra, the dried kernel of the coconut; palm oil, from the fruit of the oil-palm tree.

Castor oil comes from the castor oil plant, a tropical herb, which originated in Africa and Asia but which is now to be found in many other parts of the world. The oil is obtained from the plant by pressing; other methods may also be employed. Castor oil is a valuable medicine. It serves to lubricate or oil airplane and marine engines; it is often combined with mineral oil for this purpose. From castor oil is made turkey red oil, which is important in the dyeing and finishing of textiles.

Modern chemists have succeeded in changing castor oil from a non-drying oil to a drying oil by means of a complicated process, called dehydration (loss of water). It is possible that some day castor oil will replace tung oil as a drying oil for paints and varnishes.

In other articles in THE BOOK OF KNOWLEDGE we tell you about the fiber-producing plants—cotton, flax, hemp, sisal and so on—that are used to make fabrics for clothing, towels, draperies and thousands of other articles. Vegetable fibers that are converted into rope, cord, twine are also discussed elsewhere.

A plant that has affected the habits of millions, the world over, is tobacco. The smoking of tobacco is a practice that originated in the New World. When the Spaniards first came to this hemisphere, they were astonished to find the natives smoking the dried tobacco leaves. The Spaniards imitated the practice and smoking soon spread all over the world. One of the first tobacco smokers in England was Sir Walter Raleigh. The story goes that when Raleigh's servant first saw his master puffing away at his pipe and producing clouds of smoke, he tossed a pitcherful of water on Sir Walter in order to put out the blaze!

There are various species of tobacco plants but the one known as *Nicotiana tabacum* provides most of the tobacco used for commercial purposes. This is a rapidly growing annual (a plant that lives but a single year); it reaches a height of from three to six feet.

Courtesy, Robert F. Nelson, Virginia State Chamber of Commerce

A Virginia tobacco farmer surveys his crop. The United States grows one-third of the world's tobacco.

Tobacco is produced from the large leaves of the plant.

These must first be dried. Some tobacco leaves are air-dried; they are stored in barns or sheds, which are provided with many openings to allow the air to circulate freely. Other leaves are exposed to the sun. Still others are dried over open fires, or in sheds into which heat is brought from outside fires by means of flues.

After they are dried, tobacco leaves are very brittle. They are left hanging on racks until rainy weather; they then absorb moisture and may be handled without breaking. The leaves are now stripped from the stems and stacked in piles. Fermentation takes place; when this is completed, the tobacco is graded and packed for the market. It is often left in warehouses for several years so that it may become more mellow.

The United States grows more tobacco than any other country—almost a third of the world supply. Much tobacco is also grown in India, China, Russia, the Dutch East Indies, Turkey, France, Greece, Italy, Cuba, Puerto Rico, the Philippines, Mexico, Brazil and Canada.

Different regions produce different kinds of tobacco. For example, the Cuban tobacco leaf called Havana tobacco makes the best filler for cigars; the leaf grown in Sumatra makes a choice outer wrapper. The finest cigarette tobacco in the world grows in Macedonia and Turkey. This tobacco is blended with other kinds to produce the famous Turkish cigarettes. Cigarettes made from Burley tobacco, grown in the United States, are much milder; Burley also makes an excellent pipe tobacco.

We tell you elsewhere how modern chemistry transforms many plant substances into new industrial materials. (See The Importance of By-products, page 633; The Wonder of Cellulose, page 2747; Plastics, page 3999.) A recent development called farm chemurgy has added greatly to the number of industrial materials obtained from plants.

THE SCIENCE OF FARM CHEMURGY AND HOW IT HELPS THE FARMER

Chemurgy is a new word, combining "chemistry" with the Greek word "ergon," meaning "work," to give us "chemistry at work." Farm chemurgy applies chemistry and other sciences to farm crops in order to obtain new materials for industry. This useful science was firmly established in 1935, when the National Farm Chemurgic Council held its first meeting at Dearborn, Michigan.

For one thing, farm chemurgy proposes to create new uses for familiar farm crops. Steady improvement in the methods of crop production makes it possible to raise far more crops than can be sold at profitable prices either as food for humans or as feed for animals. Farm chemurgy makes it possible to put surplus crops to use. Industrial alcohol is now made in large quantities from corn. The soybean, which has been grown in North America for a hundred years or so, is now finding a ready market in the plastic, paint and varnish industries for its casein and oil. The great Negro scientist George Washington Carver has developed hundreds of new uses for peanuts. (See page 2614.)

Farm chemurgy also makes it possible to use much plant material formerly considered as waste. Sawdust is ground into wood flour and used in the manufacture of dynamite, cartridges and linoleum. Sugar-cane bagasse (the fibrous mass left after the juice has been pressed out) is now used to produce wall board and other materials. Even the seeds of citrus fruits, like oranges and lemons, are not thrown away. They are ground up with the skins of the fruit and are used in manufacturing cattle feed.

THE NEXT STORY OF PLANT LIFE IS ON PAGE 3261.

This Greek vase-painting by Polygnotus shows how people dressed in the fifth century B.C. The soldiers wore short uniforms, perhaps made of leather, and protective leggings (greaves) from ankle to knee. The women's dress was loose, comfortable-looking and elegant.

HISTORY'S PATCHWORK QUILT

A CHAT ABOUT COSTUME

PERHAPS your grandmother has a treasured patchwork quilt of little snippets and squares fitted into a lovely pattern that you admire. Your grandmother, however, sees more than the beautiful pattern. Each little snippet and square has a story to tell her. Here is a piece from the bright blue dress she wore to her first party. There is a bit of red from the dress of her favorite doll. Over in the corner is a flower-sprigged memento of her sister who went off to Australia as a bride; and right in the centre is a patch of pink and white that tells of beautiful Aunt Caroline who used to bring gay presents from the city for all the family.

Your grandmother, dreaming over her quilt of memory, can call to mind how her dear ones looked, the styles in which their dresses and cloaks were made and the events of dear bygone days. From the scraps of cloth she can call back the past, and make it live again.

We can not gain a true idea of the past, or enjoy to the full the wonderful stories that history has to tell, unless we know something of how people looked. Queen Elizabeth's clothes were not like Cleopatra's. Oliver Cromwell did not wear a dainty curled wig like King Charles II, nor did Lincoln wear the silk knee breeches that were elegant in Washington's time.

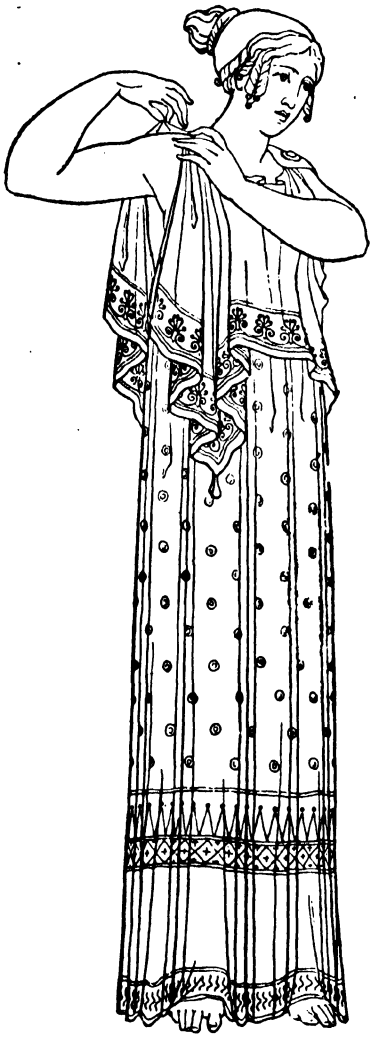
Let us imagine that some industrious history class has made for your school a wonderful patchwork quilt. The pieces for it were gathered from museums and attics and curiosity shops in many parts of the world, and they represent many periods of history. Each piece of material is a memory-token from the long and ever changing story of costume, or dress.

If we look carefully at history's patchwork quilt, each little snippet and square will bring to life great days from some bygone era. Here is a patch of faded rosy-red, hand-woven woolen cloth. Twenty-five hundred years ago it was part of a Greek garment, a himation, worn by the noble Athenian statesman, Pericles, when he went to the Acropolis to take part in a public ceremony. His himation was an oblong of deep, rich, red cloth woven and dyed at home by the women of his household. It measured about a foot longer than Pericles himself, and in width was twice the span of his outstretched arms, from wrist to wrist. And with what an air he wore it! It must be folded just so, and wrapped carefully around his body, below the armpits, then the lengths drawn up over one shoulder and fastened with handsome brooches. The right arm was free, the left was covered. A linen garment, called a chiton, was sometimes, but not always, worn underneath the himation.

Pericles had both sandals and boots of leather. His hair and beard were short and curly. In time of war Pericles had

a suit of armor, consisting of shield, helmet, greaves (leggings) and front and back armor plates laced on with leather thongs.

Pericles' wife dressed in a linen chiton similar to his, but long and graceful and girdled at the waist, and a himation which could be drawn up over the head. Her sandals and shoes were like her husband's, but more gaily decorated.



Greek lady in chiton.

On page 1201 is a picture of the goddess Athena, whom the Romans called Minerva, dressed in flowing girdled chiton. Her cloak (himation) is draped over the left shoulder. She has a helmet, breastplate and spear to show her divine rank, otherwise she looks like Pericles' wife or sister or any other well-born Athenian lady of his time.

HOW JULIUS CAESAR DRESSED AT HIS TRIUMPHS

From Pericles to Julius Caesar is but a short space on History's patchwork quilt, although almost five hundred years lie between them. Here is a patch of white wool lavishly embroidered with gold threads in a design of palm branches, a piece from a tunica, or shirt made much like an old Greek chiton, which Caesar wore the day he celebrated his triumph over the Gallic tribes. Above the tunica he arranged a purple toga heavy with embroidery. This was an enormous robe, almost four yards wide and more than five yards long, draped, like the Greek himation, over one shoulder, but so long that great folds hung down in front, forming a pocket. The back was drawn up over the head like a hood.

Rules concerning the wearing of the toga were very strict. Ordinary citizens wore a plain white wool toga. Boys under sixteen and certain priests and magistrates wore white togas edged with purple. Generals celebrating a triumph and magistrates presiding at games wore a toga of purple, beautifully embroidered. This was supposed to symbolize majesty and great honor. During the final months of Caesar's dictatorship in Rome he wore the purple toga, not just for state occasions, but every day, as though he considered himself a king.

A smaller toga was used for certain ceremonial occasions, trimmed with bands of bright wool. Purple was the usual color of distinction, however. The Roman senator had two broad bands of purple on his tunica, as a mark of his honorable estate. (In the days of the Byzantine empire, only the emperor was permitted to wear purple shoes, so that the expression "he has put on the purple shoes" meant "He has been crowned.")

CAESAR'S WIFE LOVED SILKS AND JEWELS

Caesar's wife, Calpurnia, wore a fine silken under-tunic, with short sleeves, and a sash, or broad belt of soft leather. Beautiful gold and jewelled buttons or clasps fastened the tunica at the shoulders. Over this Calpurnia put on a stola, which was a dress much like the tunica, but wide and long. It was trimmed with purple edging, and embroidered with pearls and gold spangles. The girdle was of rich braid, studded with pearls and precious stones.

When she went out of doors, Calpurnia wore a loose mantle which she called a palla. It billowed about her in generous folds and gave her an appearance of great dignity. Her hair was confined in a net of gold or silver, and for street wear she had a lovely, delicate veil that hung down softly over her shoulders. Calpurnia and her women friends loved rich attire. Even their shoes and sandals were of bright leather or silk, trimmed with gold and embroidered with pearls.

But we must not suppose that ostentation was always the rule. There is many a patch on History's quilt that recalls clothes more useful than elaborate. A scrap of leather tells of the rude garments of men and women who lived in Northern Europe in the Bronze Age; there is a piece of coarse linen from the South American Indians who lived before the Incas; wool dyed in different colors and woven in a simple pattern is from a comfortable warm gown that once belonged to the tall daughter of a Viking. After the fall of the Roman Empire, European costume suffered a decline.

FRENCH FASHIONS CROSS THE ENGLISH CHANNEL

The later Middle Ages saw increasing luxury in dress. In 1100 Henry I, youngest son of William the Conqueror, was crowned king of England. This is what Henry wore ordinarily. Over a white linen shirt he drew on a loose wool tunic that reached to the ground. It had long tight sleeves and broad edgings of gay material hand-worked by needle, or woven in patterns. A second tunic, reaching to the knees, and with wide elbow-sleeves, came next. This was also trimmed with embroidered edging, and a precious gold brooch was clasped at the open neck. His belt was of leather or silk or cloth. Henry wore tight, fitted trousers, boots of soft leather and short socks. Garters criss-crossed around the calf of his legs, to keep the trousers neat and to serve as ornament. A cape cut like a half-circle, lined with fur and caught with a golden clasp, was both warm and elegant.

THE LADIES BRING THEIR HAIR OUT OF HIDING

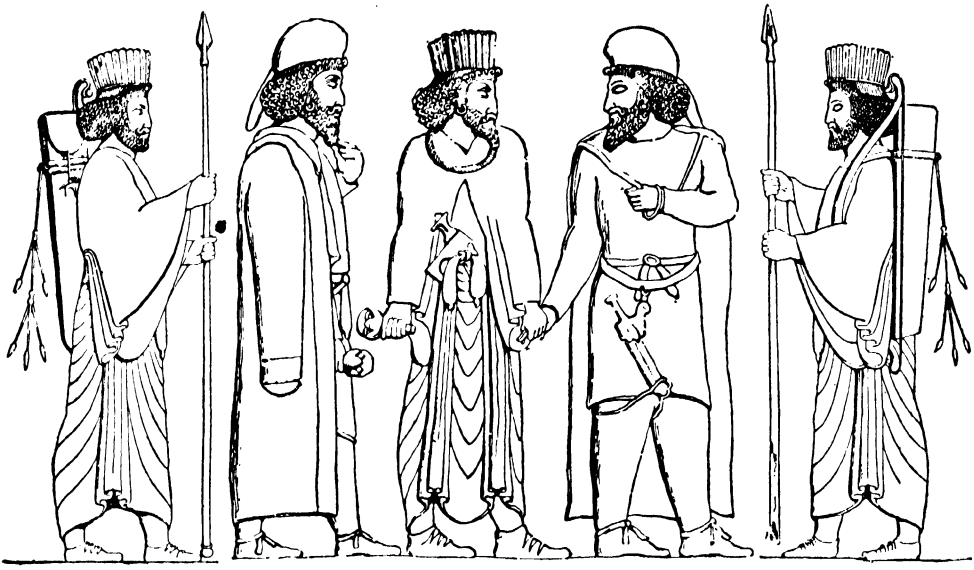
The ladies of the court felt themselves quite daring. For more than a hundred years ladies had modestly concealed their hair with scarves called wimples. There is a good example of a wimple in the second figure, last row, page 3162. It came up under the chin in front, and served as a frame to the face. Some orders of nuns nowadays wear a sort of wimple, having continued the costume from the Middle Ages. In fact, most religious dress comes down to us from Medieval times.

About 1100, as we have said, the women began to show the beauty of their hair, by

Roman gentleman in toga.

letting it hang in two long braids over the shoulders. If a lady's locks happened to be sparse, she bought extra hair to add to her plaits. The court lady wore a linen or wool chemise with long tight sleeves, and a gown, open at the neck so that the white edge of the chemise showed above it. The gown trailed upon the ground. Sleeves were tight

ORIENTAL COSTUMES OF THE PAST



This is a copy of a sculpture found at Persepolis, capital of ancient Persia. It was made by an artist of the time of Cyrus the Great and shows several costumes of his day. The two outside figures are soldiers from the king's bodyguard, wearing their uniform, which looks quite unsuited to fighting. The central figure is dressed in the royal robe of the Medes, whom Cyrus conquered. The two other men are wearing Persian dress, and earrings. All, as you see, have mustaches and curly hair and beards.

The Tang dynasty in China, which lasted from 618 to 907, was a period of splendor. The arts flourished, and painters, sculptors and jewelers made many beautiful things, some of which still exist. Dress was also elegant, as we can see from this picture of an emperor and his wife. An important servant stands between them in embroidered robe almost as magnificent as his master's. The empress and the servant wear long sleeves covering the hands. It was for many centuries considered vulgar for a Chinese lady to show her hands.

to the elbow and then hung loose, and so long that sometimes knots were tied in them to keep them from dragging on the floor. The bodice of the gown was laced to give it a neat outline. A jewelled belt of woven gold threads or other rich fabric was passed twice around the waist and the ends hung almost to the hem. Her cloak, cut in a half-circle, was fastened at the neck with a cord and jewelled clasps. Elegance, dignity and modesty were found in this lady's appearance. It is one of the most charming costumes ever worn.

THE MAGNIFICENT COSTUMES OF LEONARDO'S TIME

As the Middle Ages passed, and the Renaissance years brought to Europe gold and silver and gems from Asia and America, heavy brocades from China, silk interwoven with gold, and even cloth of gold, the tendency was towards greater splendor. In Germany in the fifteenth century the desire for decoration went so far that numbers of little bells were sewn on gowns as trimming!

At the beginning of the sixteenth century Leonardo da Vinci, the Italian genius, painted the portrait of a Florentine lady, Mona Lisa, wife of Francesco del Giocondo. The picture is shown on page 829. It is called the most celebrated portrait in the world.

Doubtless Mona Lisa wore her best dress to have her picture made. We can see that it was of rich material, draped generously. The low neckline is finished with delicate braid. A veil over the hair and a mantle across the shoulders are faintly outlined. The painter said that the picture was unfinished, and we cannot doubt that he had intended to add the jewels and adornments common to the day. On page 825 is a portrait in the manner of da Vinci. A silken hair-net bordered with large pearls is held in place by a ribbon heavy with gems. Pearls and precious stones encircle the dress.

We must remember that women did not discard their clothing in a season or two. A beautiful gown was worn for years. Fashions changed slowly. Many a good wife of the middle class had but one Sunday dress from the time she was married until she grew old.

The story is told that when Beatrice d'Este, an Italian girl of noble family, was preparing to become the second wife of the Duke of Milan, he wrote an urgent note to Beatrice's mother imploring her to furnish plenty of dresses for the bride. He knew that women's clothing was very costly, and he hoped that he might not have to provide any frocks for his new wife, for many years. Beatrice was step-mother of the girl you see on page 825.

Let us glance again at History's patchwork quilt, and see what lies next to the velvet square from Mona Lisa's gown. Another velvet square? Yes, this pale yellow one is from the fur-bordered cloak of a gentleman of her time. He was a soldier quick with his sword, ready to endure hardships on march with the rough fighters he

Chief of a clan in ancient Japan.

captained. Yet at home he went gallantly dressed in silks and satins. His shirt was frilled at the neck. His scarlet doublet was closely fitted with tight padded sleeves. Long tight hose and short puffed breeches with trimmed slits that showed another color beneath added to the dandified effect. The coat was loose, trimmed and lined with silk or fur. The craft guilds were still powerful at this time, and the furriers' guilds had many interesting rules and regulations; for instance it was a crime punishable by death in some places for a furrier to use on a new

COSTUMES OF THE MIDDLE AGES

Aligyfe, Canute's queen.

Druids of ancient Briton in long white robes and mantles. The chief Druid is crowned with oak leaves and carries a sceptre. His companion holds the priestly symbol of the crescent. Druids of somewhat lower rank wore gowns of bright green, the color of nature, whose secrets they were said to explore.

Saxon King Canute.

A king and a court lady of the fourteenth century. In the centre is a knight donning chain armor.

These ladies concealed their hair under headdresses of strange shape. They must have been very uncomfortable.

garment a piece of fur that had ever been worn.

Italian men of this period liked beards and mustaches, and they also liked jewelry. Turn to page 1109. The portrait by Titian shows an elaborate ring on the first finger, common in those days, a jewelled necklace and pendant and the hilt of a fine jewelled sword.

Side by side on our memory quilt are two pieces of satin, bits from the gowns of two queens, proud Elizabeth of England and Marie Antoinette of France.

QUEEN ELIZABETH'S LADIES-IN-WAITING HELP HER TO DRESS

Elizabeth died in 1603, and to the very end she kept a lively interest in clothes. During her reign dress was not only fanciful, it was ridiculous. Even with the help of maids and ladies-in-waiting Elizabeth could not have dressed in less than an hour. Her face was heavily powdered and rouged. Her own hair was hidden by a wig decorated with jewels and sequins and glass beads. Then she drew on a pair of the newly invented silk knitted stockings, beautifully embroidered, and velvet slippers, trimmed with gold and silk stitching. Her chemise was of fine linen; over it went a linen petticoat, then a bodice of bones and stiff fabric, and, laced around her waist, a stiff frame that stood out over her hips. It was called a farthingale. (The little girl in the picture on page 1503 is wearing a farthingale to hold her skirts out.) Several linen petticoats and an underdress of heavily embroidered silk followed. Two maids-in-waiting helped the queen into her overgown of bright satin. It was open down the front, to show the pretty undergown. The sleeves were separate, and were tied to the shoulders with ribbons.

SHOES WITH SOLES OF CORK SEVERAL INCHES HIGH

Strings and strings of pearls were slipped around the queen's throat, then a ruff supporter and a ruff upon it were tied high under her chin. Her girdle of twisted gold was knotted in front, with a looking glass, fan and vanity case tied to it. If the queen were going out on the streets, she put on shoes with soles of cork many inches high. History does not tell us, but we may be sure that Elizabeth was not wearing these shoes, the day Sir Walter Raleigh spread his beautiful cape in the street that she might walk dryshod across the mud, for the high cork soles were made for muddy roads. Many ladies of Elizabeth's reign covered their faces with masks when they attended the theatre, and even sometimes when they went shopping or calling.

A GOWN THAT WAS CHANGED FOR PRISON GARB

Almost two hundred years later Marie Antoinette in the great palace of Versailles, outside Paris, dressed for a court reception, and this is what she wore. Over her linen chemise a farthingale was tied, not round like Elizabeth's, but flat in front and back and very, very wide at the sides. The iron side-pieces were hinged so that ladies could fold them up and so be able to pass through narrow doors. Over the farthingale Marie Antoinette had a petticoat of silk or brocade, festooned with flowers or lace or braid or flutings. The overdress had a close-fitting, laced and boned bodice very low at the neck, and a skirt open in front. The sleeves were tight and came only to the elbows, but ruffles of lace sometimes hung gracefully to the wrist. The skirt was long; it was caught back and showed the pretty petticoat in front. Necklaces, earrings, bracelets and rings were rich and fanciful. Little shoes with buckles and silk stockings completed the court attire.

Marie Antoinette's hairdresser was an artist. He powdered the hair thickly, then with false hair and frame-works built it up high on the head. Ostrich feathers and ribbons, pearls, flowers, aigrettes and other ornaments were festooned giddily over the massive hairdress. Sometimes the queen or one of her ladies appeared carrying on her head a fanciful creation like a basket of flowers or a ship in full sail! These must have been difficult days for women of fashion.

The French society painter François Boucher showed in a number of his pictures the sumptuous style of dress worn in Marie Antoinette's early years as queen, before the toplofty head-dresses became fashionable. Marie Antoinette herself wore costly silken gowns that were a triumph of dressmaking skill.

MEN WHO DRESSED ACCORDING TO THEIR POLITICS

It may seem strange to you to learn that people have many times worn special clothing to proclaim to the world their political beliefs. This happened in the French Revolution. The aristocrats had worn fancy knee breeches of satin or velvet, tied at the knees with ribbon bows. This garment was called *culotte*. The revolutionists wore long pantaloons, the rough short coats of the laborer, and the red caps of the galley slaves (known

Courtier with starched ruff.

Plate armor and plumes.

James I, hawking.

Queen Elizabeth's jeweled hairdress.

The somber Puritan.

The Puritan's wife.

A Stuart lady with ridiculous patches, a dandy in hair ribbons and ruffles and Charles I in his nightcap.

to us now as Liberty caps). The revolutionaries came to be called, in slang, *sans-culottes* (without fancy knee-breeches) and as the Revolution proceeded, the aristocrats were afraid to go out on the streets in their grand clothes, so the humble pantaloons became part of the general costume.

THE CLOTHES OF CHARLES I AND OF CROMWELL

Something of the same sort happened in England, in the reign of Charles I. A remarkable contrast existed between the dress of the King's party and that of the Puritans. Charles Stuart was painted in velvet and lace, his long hair curling prettily about his face. Beneath his saddles was a richly embroidered blanket.

The painter shows Cromwell in different guise. He sits upon his horse carelessly. His rough leather boots are made for country wear. His suit is plain, the collar a simple linen band. His hair is cut short, and is not curled. His hat is without ornament and instead of an outer cloak he wears a thick woolen plaid, or shawl. He is trying by his sensible, plain dress, to tell the world what he thinks of the foolish elegance of the courtier. After Charles I had paid with his head for his extravagant and dictatorial ways, Cromwell and the Puritan party came into power, and throughout the land everyone wore plain, somber, serviceable clothes.

Later, however, when Charles II came to the throne, he brought from the gay capitals of the continent, where he had been living in exile since the death of Charles I, his father, beautiful but ridiculous fashions. Men became once more effeminate in dress. Rich over-ornamented apparel brightened the lives of thousands of naturally gay people who had hated the sober garb of the Commonwealth, but the swing away from solemnity went too far. Men wore ruffled breeches, lacy blouses and picture hats!

It is two hundred and fifty years since Charles II strutted through the streets of London in his ruffled breeches and beriboned garters, one hundred and fifty years since Marie Antoinette put aside court raiment for her sober black prison gown. History has lately sewn into her patchwork quilt a square of white silk from a dress worn by a young girl at her first grown-up party. Silk? No, this is a material made out of the trunks of trees. How surprised the kings and queens we have been speaking of would have been, to know that many of the girls dancing in their slim frocks, at to-day's parties, are dressed in trunks of trees! The

Enormous picture hats of 1786.

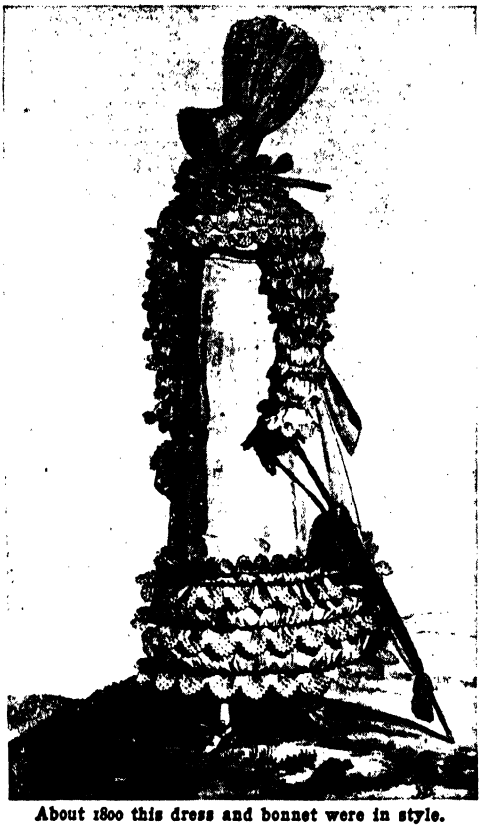
French evening hairdress of the time of Marie Antoinette.

Demure bonnets of 1867.

A PAGEANT OF FASHION

Cavalier of 1700 in coat and waistcoat to the knees.

Gentlemen of 1843. The tall hats have wide brims.



About 1800 this dress and bonnet were in style.

The tiny waistline of 1900 was considered beautiful.
Photographs, The Bettmann Collection.

Children's fashions in America in 1867. Girls were dressed much like their mothers. Boys' suits were gaily trimmed.

chapter on Cellulose, page 2747, will tell you more about this wonderful invention.

AMERICAN STYLES FOLLOW THOSE OF EUROPE

From the Middle Ages, Paris has been the leader in fashions, especially women's fashions. Before the days of cables, radio, fast mail and photography, women in countries distant from Paris followed French dress, a year or more behind. This was true in the American colonies. It is true that plain living and simple clothes characterized New England and the smaller towns of all the colonies. But ladies of means in New York, Philadelphia and Charleston bought dresses and dress materials in Europe, and when they went to parties they were very fine ladies indeed, in their rich brocades and satins and laces.

Perhaps the most outstanding woman in the social life of the new Union was Nancy Willing, wife of William Bingham of Philadelphia. She was just sixteen when, in 1780, she married the wealthy young merchant and banker. Three years later she and her husband and baby went to Europe, where they lived, traveling about as they pleased, for another three years. They were received into the highest social circles of France and met many important people in England and on the continent. The beautiful Mrs. Bingham, as she came to be called, loved parties, gaiety and splendid clothes. She brought home from Paris many trunks full of fine array, when the family returned to Philadelphia in 1786. Here is a description of one of the costumes. She "blazed upon a large party in a dress which eclipsed any that has yet been seen. A Robe a la Turke of black Velvet, rich White sattin Petticoat, body and sleeves, the whole trimmed with Ermine. A large Bouquet of natural flowers supported by a knot of Diamonds, Large Buckles, Necklace and Earrings of Diamonds, Her Head ornamented with Diamond Sprigs interspers'd with artificial flowers, above all waved a towering plume of snow white feathers."

John Adams' wife wrote to a friend, at about this time, "Mrs. Bingham has certainly given the laws to the ladies here, in fashion and elegance." During the rest of her life Mrs. Bingham sent to Europe for clothing, furniture and delicacies for the ta-

ble. In 1800 her daughter, a girl of fifteen, was criticized for her scanty attire. The Bingham ladies were, it seems, following the styles of the Napoleonic court.

SOME ODD FACTS ABOUT COSTUMES OF THE PAST

The kings and courtiers of former years would be surprised, too, to see all the young men garbed alike, in dark suits and white shirts, black, uninteresting shoes, short hair and no beards. Our costumes have lost something of glamour and of originality, but changes in styles come faster now, and it may be that before long men will again be wearing embroidered coats of yellow and crimson and green, and women will be finding some surprising new fashion to delight them.

As we study History's patchwork quilt, we find many an odd and amusing fact. Roman ladies went to bed with a kerchief tied around their heads, to keep their hair in place, just as women do to-day. Walking sticks began to be carried when swords, as part of masculine costume, were discarded, because the men felt "lonesome" without something to handle. The kimono, a street costume in Japan, became a dressing gown in other countries. We find that in the reign of Henry II of England, the tailors needed a measure of length. The length of the king's arm, 36 inches, was accepted, and called a yard.

MEN WHO WORE EARRINGS AND LACE ON THEIR BOOTS

At several periods in history, men have worn earrings—sometimes only one—and were not considered the less manly. But the London dandies who wore ruffles of lace on the tops of their boots, in the time of Charles II, were laughed to scorn. So were the ladies in Queen Anne's time who wore nightgowns on the street, until a famous woman criminal was hanged in her nightgown. The unlovely fashion then disappeared in a single day.

Comfort in dress has seldom been a consideration. From the painful tattooing and scarring of some primitive peoples, to the uncomfortable woolen suits men wear nowadays in the hottest summer, both men and women have followed fashion rather than usefulness in dress. The Chinese girl of good family used to have her feet bound so tightly that they became deformed. Women's hats have often been difficult to keep on the head, and frequently have been very heavy. Both men and women have laced their waists so tightly as to endanger health. The face veils of Mohammedan women furnish another example of discomfort in dress, though these were worn, not for reasons of fashion, but of religion.

Ways of wearing hair have varied much. Among the ancient Greek men short curly hair was much admired and almost all the Greek statues of heroes and gods were carved with tightly curled locks. At one time in ancient Egypt, when every man shaved his face, artificial beards were tied on, for certain important ceremonies.

Men at the French court wore wigs in the reign of Louis XIII, but Louis XIV had beautiful long lustrous hair, so he discouraged wigs. Years later, when he began to grow bald, he and all his court once more wore wigs. Queen Elizabeth had many wigs of different colors. When hair was powdered, in the eighteenth century, white, yellow and red powders were used.

The pigtail of the Chinaman, the shaved spot on the heads of monks in some religious orders, the "love-lock" of the English dandy of Charles II's time are a few eccentricities in men's hairdress.

Many mothers preserve locks of their children's hair from babyhood. A hundred years ago, lovers saved strands of the loved one's hair, in lockets or braided into rings or bracelets, or brooches, or tucked into tiny jewelled compartments in rings.

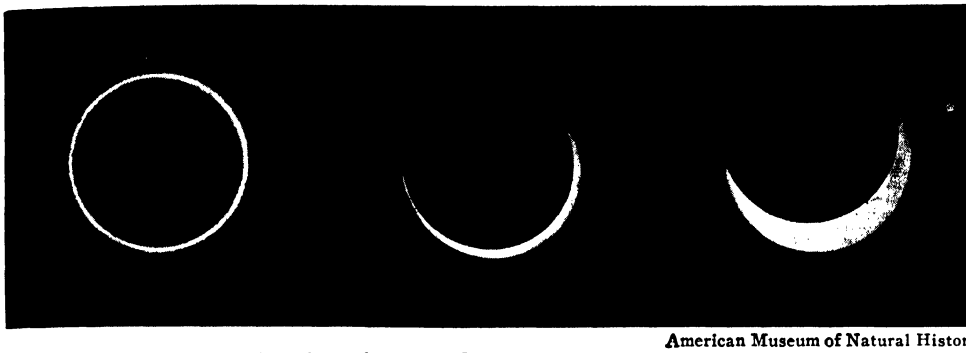
THE SPECIAL MEANINGS OF COLOR IN DRESS

Color in dress has long had symbolic meaning. Purple was, as we have seen, the imperial color in Byzantium, and the color of honor in ancient Rome. It is worn by bishops in the Catholic church, and is the color of tragedy in art and religion. Yellow was reserved for the Emperor in old China, and no one else was permitted to wear it. White is, over much of the world, the color of brides, and black, of mourning. Among the Highland Scottish clans, the combinations of colors in designs called tartans had the same significance as heraldic devices and of totem poles, that is, they were distinguishing marks of families.

Survivals of costume are also interesting, such as the bridal veil, which comes to us from the Middle Ages.

The primary material needs of man are three—food, shelter and clothing. It is perhaps a proof of man's restless nature that our imaginations are always at work, devising new foods, new houses and new clothes.

THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 3181.



American Museum of Natural History

Three phases of an annular eclipse of the sun. These photographs were taken at Jacksonville, Florida.

THE SUN *and* ITS POWER

IN the earlier chapters of this department—The Earth—you have read about the universe, in which our solar system has its place. We have told you what astronomers believe about the forming of the earth. We have explained its place in the solar system, and its motions, why we have day and night, and seasons. We have told you many things about the earth's rocky crust and top soil and water as they are now and as they were in the long, long ages of the past. We have described volcanoes and earthquakes.

Now let us take a closer look at some of the other bodies in the heavens—the stars and planets, meteors and comets and other pieces of matter.

We must, of course, begin our study of the heavenly bodies with the sun. It is by far the most important of them all for us, as it is the source of the earth's life and beauty. This great glowing ball sends forth, day and night, in every direction, enormous streams of light and heat, and it has been doing this for countless ages. We know how powerful the sun's heat and light are in so far as the earth catches them; but it is right to remember that all the light and heat that fall on the earth are a mere nothing compared with the total amount the sun is always giving out in all directions.

As we know the size of the earth and its distance from the sun, we can calculate that the amount of the sun's light and heat which fall on the earth is less than one 2,000-millionth of the whole. Yet this trivial fraction of the sun's light and heat makes all the difference between an earth without life and the earth we know. As has been well said, "for the power to live and move, for the plenty with which we are surrounded, for the beauty with which nature is adorned, we are immediately indebted to one body in the countless hosts of space, and that body is the sun."

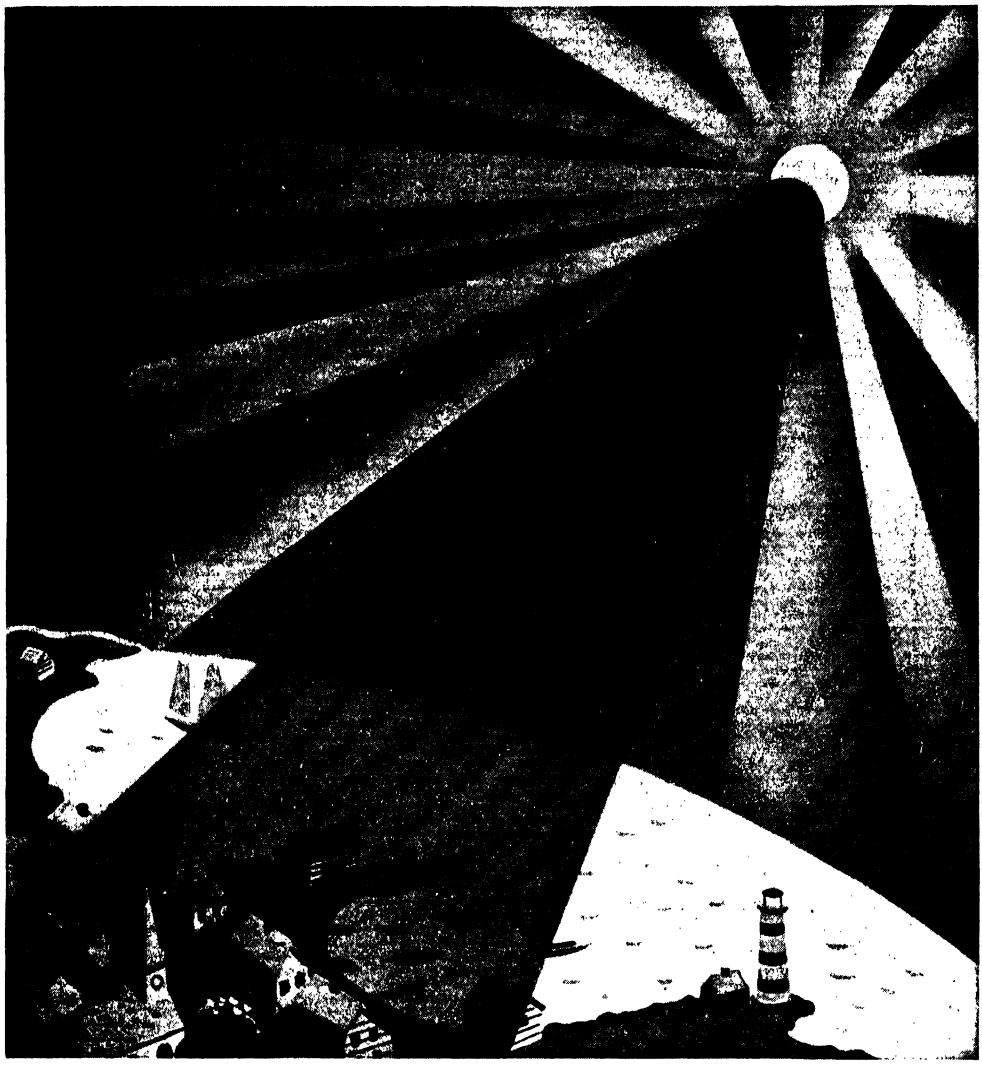
We can get some idea of the sun's power by remembering that if there were 2,000 million earths dependent for all these benefits on the sun, it would be able to satisfy them all.

We know that the earth, compared with our own small bodies, is large. The length of a line drawn right through it from one side to the other, passing through its center, would be almost 8,000 miles. Such a measurement is called the diameter, which really means the "measure across." But the diameter of the sun is nearly 865,000 miles.

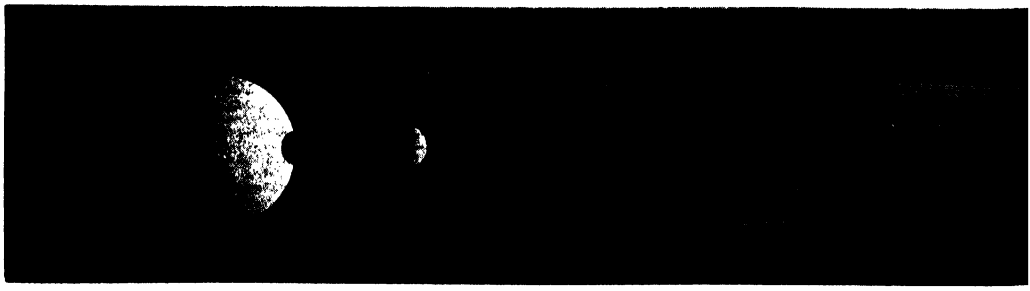
The earth's circumference measures about 25,000 miles, but that is hardly any distance at all compared with the circumference of the sun. It has been calculated that a train traveling sixty miles an hour would have to travel without stopping for more than five years before it went around the sun.

We can get some further idea of the size of the sun when we learn that if it were cut up into a million parts of equal size, each part would be bigger than the earth. They would not, however, be as heavy as the earth, for the sun is much less dense than the earth. The mass of the sun, compared with the mass of the earth, is about three hundred thousand times as great. The earth has shrunk much more than the sun, and the matter in it is more tightly packed. The earth is denser because a great part of its matter has condensed into liquids and solids, while the sun is a mass of gas, probably all

THE SHADOW OF THE MOON

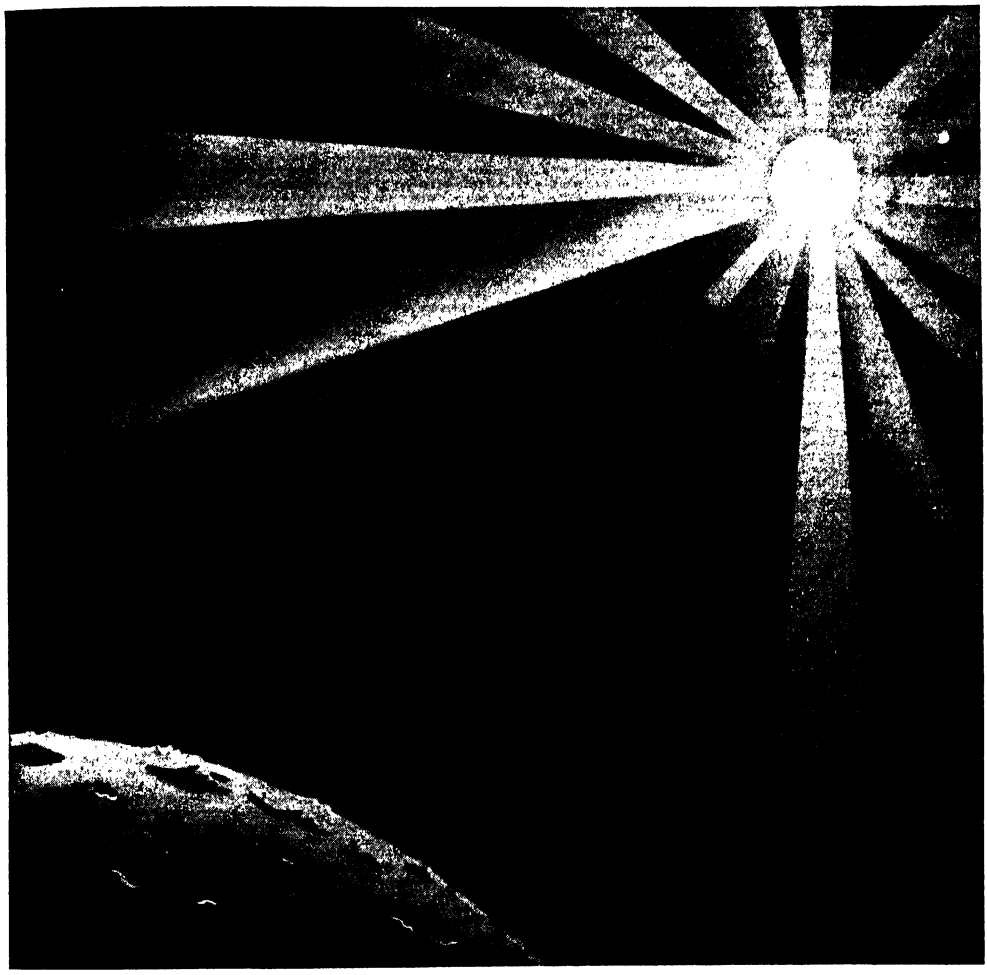


When the moon casts its cone-shaped shadow upon the earth, shutting off the light of the sun, we say the sun is eclipsed. The sun's total eclipse at any spot on earth never lasts longer than seven or eight minutes.

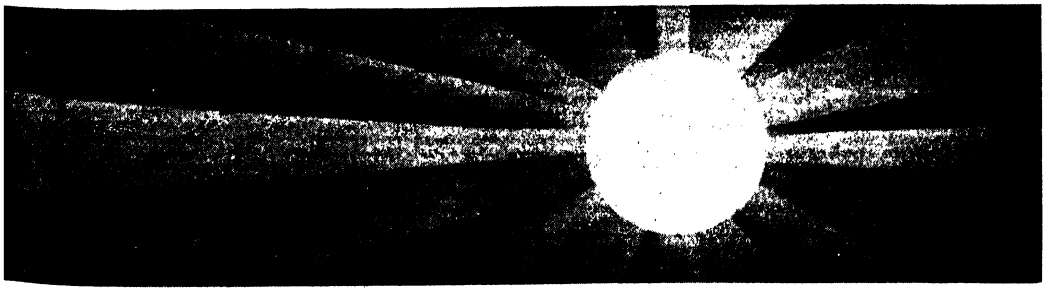


Here are earth, moon and sun in line, as they would be viewed from space during an eclipse of the sun. Only a small

THE SHADOW OF THE EARTH



We have all seen our shadows on the ground, but there is one great shadow that not all of us have seen. That is the shadow of the whole world. This shadow is thrown upon the moon when the earth is directly between the sun and the moon. It is called an eclipse of the moon, or a lunar eclipse. A lunar eclipse can take place only at full moon. Usually we can still see the moon dimly, during a lunar eclipse. It shines with a strange copper-colored glow, or its face may be mottled (spotty). If you stood on the moon during a total lunar eclipse, you would see the sun blotted out as the earth moved across it. Around the ball of the earth you would see an airy band of light. That would be the earth's atmosphere shining with reflected sunlight. This reflected light from the atmosphere, falling upon the moon during eclipse, is what gives it the dim light. The word eclipse comes from the Greek word for fainting.



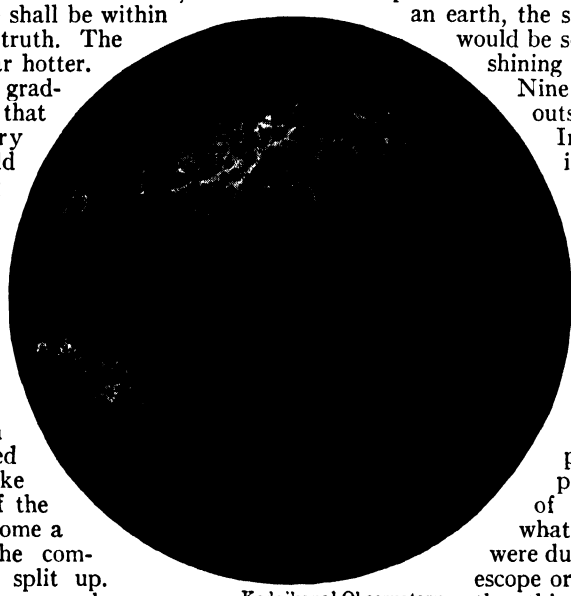
area on earth is thrown into darkness by total eclipse at any moment. Stars come out and birds go to roost.

the way to the center of the glowing body.

The heat of the sun is something almost unthinkable. We know that the degree of heat of most things can be measured by a thermometer. Using an ordinary thermometer, we say that the heat of the human body is between 98 and 99 degrees Fahrenheit, which we mark like this: 98° and 99°. If the heat of the air in the shade is as high as that, we become intensely uncomfortable, so hot is it. Boiling water is hotter still, and the flame of a match or a fire is much hotter than boiling water. For some purposes—as, for instance, in order to melt metals—we have to produce as high temperatures as we possibly can. By means of electricity, in what is called the electric furnace, we can, with great difficulty and at great cost, produce for a short time a temperature of nearly 10,000 degrees.

This is less than the temperature of the sun. It is by no means easy to find out what that temperature really is, and many calculations have been made. But if we think of the temperature of the surface of the sun as somewhere between 10,000 and 15,000 degrees, we shall be within the limits of the truth. The interior must be far hotter. If the earth were gradually raised to that temperature, every living creature would be burned up long before the earth had reached any such temperature. Also in a very short time the whole earth would be turned into a ball of gas.

If the temperature of the earth were gradually raised to something like the temperature of the sun, there would come a time when all the compounds would be split up. Very few chemical compounds exist at a very high temperature. All of the water of the earth, after having been made into a gas by the heat, would be broken up into the oxygen and hydrogen of which it is made. Sand, and the rocks that are made of burned, or oxidized, silicon, would be split up into their oxygen and silicon. These elements and all the others, including all the metals, would exist in the form of intensely hot and intensely bright gases. Such a picture gives us some idea of what the composition of the sun probably is.



Kodaikanal Observatory

A spectroheliogram of the face of the sun, showing its ultra-bright regions and its heights. A spectroheliogram is a photograph of the sun made by a special camera and light which consists of only one color.

The distance of the sun from the earth changes slightly from day to day, as the earth does not move around the sun in a circle but is a trifle nearer in winter than in summer. The difference is very slight, however, and 93,000,000 miles is the average distance.

Compared with the size of the earth, this distance is very great. But, compared with the distance of the other stars, it is very small. As Sir Robert Ball said, "the fact is that we are nestled up comparatively close to the sun for the benefit of his warmth and light, while we are separated even from the nearest stars by a mighty abyss."

If the sun were to move away from us until at last it was as far off as even the nearest star, the earth would be in perpetual night, and no creature could live on it. If it were possible for a man to live on such an earth, the sun at that distance would be seen as a bright star shining in the night sky. Nine other stars would outshine it.

In the year 1610 Galileo discovered that there were dark spots on the sun, and that these spots moved across the surface from day to day. There was nothing said about them in the writings of Aristotle, and so the people who were powerful in the time of Galileo said that what he called sun-spots were due to faults in his telescope or in his eyes. Worse than this, the discovery was regarded as an insult, implying that the sun was not perfect.

Since the time of Galileo we have learned to regard sun-spots as among the most interesting things in the sun. When large ones are present, anyone can see them for himself by looking through a smoked glass.

If we watch them from day to day, we find, as Galileo himself found over three hundred years ago, that the spots often travel right across the face of the sun, disappear, and then appear again on the other side.

American Museum of Natural History

Drawing of a sun-spot by S. P. Langley, director of the Allegheny Observatory. He was a famous pioneer of aviation.

We note that as they reach the side of the sun they seem to get narrower, as if we were looking at them sideways. This can only mean that the sun spins round. Now here is an interesting fact. The sun is a body made up of gases, so it does not have to spin around all in one piece, as our solid earth does. Various portions rotate in different periods. At the sun's equator, the period of rotation is a trifle less than twenty-five of our days. In a latitude halfway between the sun's equator and either pole, the period of rotation is about twenty-eight of our days. In the regions of the sun's poles, the rotation period is about thirty-four days.

Lately, in careful study of the giant planet Jupiter, it has become almost certain that various parts of its surface move round, as it spins, more or less independently of one another, and this doubtless means, as it does in the case of the sun, that the surface of Jupiter is not solid, but either wholly gaseous or partly gaseous and partly liquid.

The study of the sun-spots, as they travel across and as they change their apparent shape, helps us to prove how the sun spins. We find a spot traveling across the sun in twelve or thirteen days, and then we may find the same spot appear again on the other side after twelve or thirteen days more. We find that sun-spots always travel in the same direction, which is, of course, the direction in which the sun spins. We find also that the sun spins round in the same direction as the earth and all the other planets. The same is true of the direction in which the moon travels round the earth, and the direction in which the moon spins on its axis.

Spots are noticed at various parts on the surface of the sun, and there are other parts where they are not noticed. We do not often see them close to the equator, or middle line, of the sun, and we never find spots near the poles of the sun. There are certain zones of the sun, corresponding to what we call the temperate zones of our earth, where the spots are found.

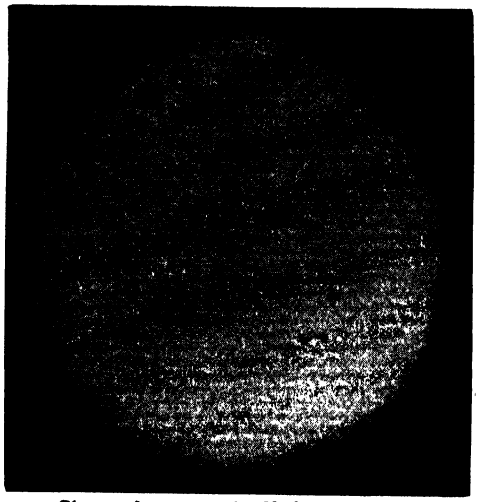
Of course this fact means something as to the way in which the different parts of the sun are made, but we have not yet been able to understand it.

What we usually call spots are darker than the rest of the sun. There are many spots also, perhaps more than the dark spots, which are brighter than the rest of the sun. We must think of the surface of the sun as consisting of hot gases reaching to a tremendous depth. These gases are in a state of great commotion, and the spots we see on the sun may depend on the collection of particular kinds of gases at particular places. The dark spots are believed to be whirling uprushes of gas from deeper parts of the sun. We call them spots, but we require a better idea of their size than that word gives us. It is not uncommon to notice a spot into which several earths could be put.

THE CONNECTION BETWEEN SUN-SPOTS AND THINGS THAT HAPPEN ON EARTH

It is very interesting to know that there is some connection between sun-spots and various things that happen on earth. Changes in the earth's magnetism, and in the movements of magnetic needles on the earth, correspond with changes in the number and size of the dark spots on the sun. When we come to think of it, this is an amazing thing —that these changes in the surface of the sun should be registered by magnetic needles on the earth. Yet this seems to be the case. Scientists have carefully noted how often magnetic storms occur and how severe they are. They have found that these storms happen most often and are most severe when the sun-spots are largest and most numerous. Under such conditions, short-wave radio reception is generally poor.

There is something even more remarkable about sun-spots, which is that the number and size of them change from year to year in a regular way. There can be no doubt



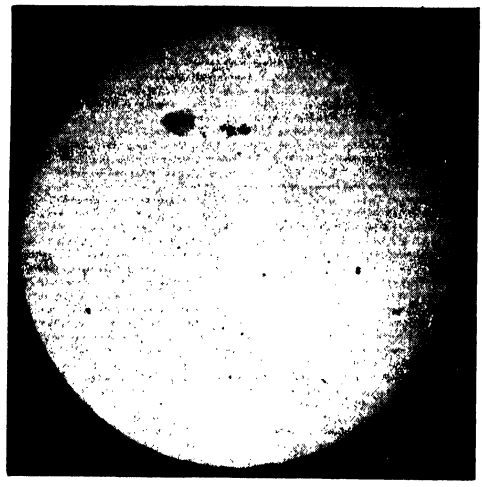
Photos of sun-spots by U. S. Naval Observatory
The striking photographs on these two pages show how sun-spots travel across the face of the sun.

about this, for sun-spots have been carefully watched for three hundred years. Through all this time there has been a regular increase and decrease in the number and size of sun-spots. At the end of eleven years they are just about as numerous and as large as they were at the beginning. Then they repeat their changes for another eleven years, and so on. When a change in anything goes round and round like this in a regular way, we call one round a cycle, and so we say that the sun-spots show an eleven-year cycle. Whatever causes them is something which waxes and wanes at this rate. What it is and why it should do this, we do not know, but it is one of the facts which will some day help us to understand something about what goes on inside the sun.

It happens that now and then the moon passes between us and the sun. For a few seconds or minutes it sometimes fits almost exactly over the body of the sun, as it were. When this happens, anything projecting from the body of the sun on any side can be seen. Such projections do exist. They are very beautiful in themselves, and they tell us a great deal about the surface of the sun. They are not bright enough, however, compared with the blaze of sunlight, to be seen as a rule, any more than the stars can be seen in the daytime. Only during a total eclipse of the sun, when the body of the sun is hidden by the moon, can we see these things clearly.

Astronomers, however, have instruments by which they can see and photograph these prominences of the sun even when there is no eclipse. The prominences are great masses of hot gas. They give out light of a different kind from that given out by the body of the sun. The astronomer, with his instrument, the spectroheliograph, is able to cut off the ordinary sunlight from his eye so that he can see the prominences by themselves. They are notable for their enormous size and their splendid red color.

We may think of these prominences as gigantic flames, and, like other flames, they flicker, though of course they are so enormous and so far from us that they require to be watched for some hours before we notice their movements. We can sometimes see one of these great red flames starting forth from the surface of the sun and darting outward.



Note the difference in the position of the spots.

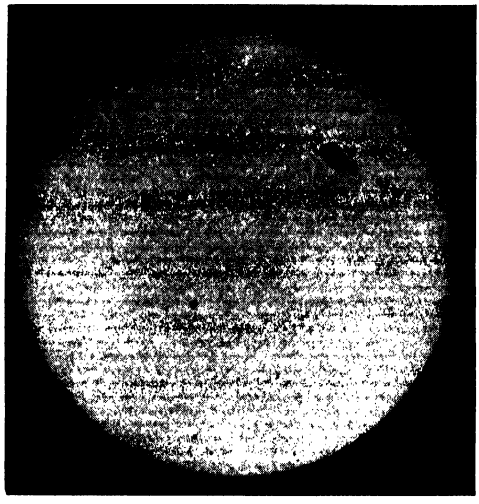
We thus come to see that the surface of the sun is far from being a steady, quiet thing, but is endlessly disturbed by mighty tempests. No storm that travelers ever experienced on earth can compare with the storms on the sun. We can measure the length of these flames. Many have been measured that were ten or more times as long as the diameter of the earth, and a good many years ago one was watched which was estimated at more than one-third of a million miles. Some idea of its force as well as its size is given us when we learn that this flame must have dashed out from the sun at 250 miles a second.

During a total eclipse of the sun there can be seen a soft halo of light around the sun;

this halo is called the corona, from the Latin word for crown. The corona is much too faint to be seen in ordinary daylight, but when the sun's bright face is hidden from view by the moon, during an eclipse, it can be seen. It is a beautiful and surprising thing; those who travel to distant places to see total eclipses call the corona one of the loveliest sights of nature.

Sir Norman Lockyer believed that the corona consisted mainly of a special element unknown to earth—coronium. But today we know that the corona of the sun consists of iron, nickel, calcium and other familiar materials, all in the form of vapors because of the high temperature in the neighborhood of the sun. Nearer the body of the sun also we find proof of the existence of gases or vapors of many elements which can be found in our own bodies—hydrogen, calcium, magnesium, sodium, iron and a large number of other materials known to us.

It is important to compare the sun with



The spots now approach the other side of the sun.

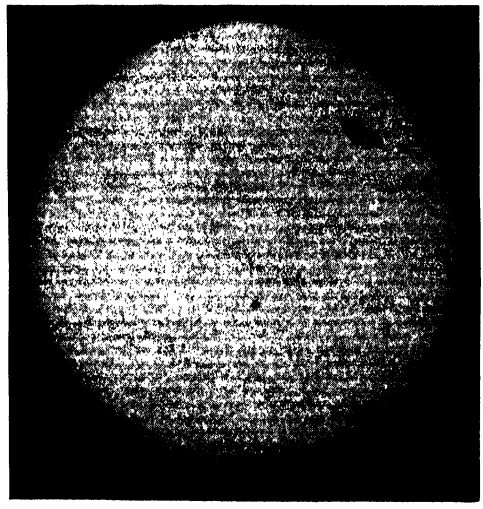
other stars. We can be sure that, whatever the source of the light and heat of the stars, it can not go on forever; the stars must some day be exhausted. It is only with the increase of our knowledge of the nature of atoms that we have been able to discover why the stars shine.

Atoms are the tiniest particles of an element; they are far too small to see, even with the most powerful microscopes. But the atoms are made up of still smaller particles called electrons, protons and neutrons. An atom of hydrogen, for example, consists of one proton with one electron revolving around it, as the earth revolves around the sun. An atom of helium consists of two protons and two neutrons put together in a nucleus, with two electrons revolving around this nucleus. All atoms are made up of these particles, with the heavy parts, the protons and neutrons, packed together into a nucleus, and the light-weight electrons revolving around the nucleus.

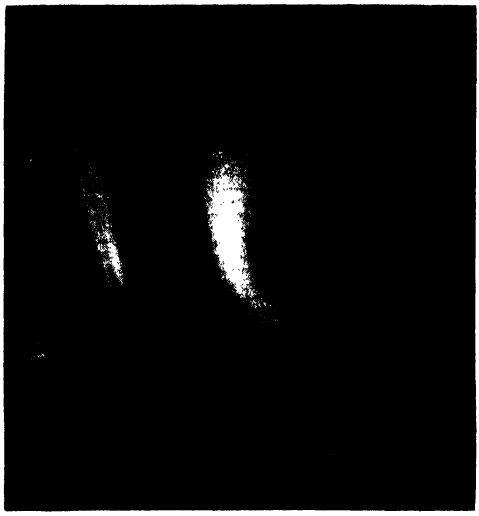
In the great machines called cyclotrons, man is learning how to take atoms apart and put them back together again, sometimes in new and strange ways. Sometimes, when the parts of a new atom have been assembled, it will pour out some energy and lose weight. We never get something for nothing! If we want energy from an atom, it must give up some of its mass.

Deep in the heart of the sun (and in the other stars), atoms are rushing along, colliding with each other, knocking off fragments now and then, putting themselves back together again. All the while, the mass of the sun is getting less, for it must be sacrificed to provide the energy. To give us our daily quota of sunlight, day in and day out, our sun must lose 4,200,000 tons of its mass every second! This need not worry us, however, for the sun's total mass is very, very great.

The sun will continue to have nearly the same temperature and color throughout most of its life; it does, however, grow slightly hotter as time goes on and after about ten



In just a few days the spots will be lost to view.



Charles H. Coles
The Aurora Borealis, caused by spots on the sun.

billion years the average temperature of the earth will be nearly 700 degrees—hot enough to melt many metals—and all life will have vanished. For a few billion years, however, the change will be so slight that those who live here will not notice it.

There must come a time when the sun is no longer massive enough to shine as a star. Then it will fade rapidly and go through space for the rest of eternity as a cool, dark object, no longer giving light and life to our earth.

How did the sun start spinning? Some men have supposed that in its journey through space it encountered some other starry traveler, and that the two, by their partial collision, set one another spinning. Or again, perhaps the mere falling inward of the particles of gas, under the same law of gravity that makes a stone fall to the ground, set the whole irregular mass spinning.

Now, if this is what happened, the rest of the history of the sun and its family is not hard to follow. The particles falling inward fed the sun if they fell far enough; but many clashed against one another and clung. As they swept round the sun they collected into themselves other particles, till they became larger and larger. Anyone who has ever rolled a hoop knows that if the hoop is rolling along fast and straight enough, it seems as if it could go on forever.

So with the particles that flew round the sun. Some went round it at such a pace and in such a way that there was no reason why they should not go on continually. They did that, and have done it ever since, collecting and adding to themselves any stray objects in their path. These were the clots or knots of particles that grew into planets, and their orbits or paths are those that are said to be stable—that is to say, they are not altered or badly upset by the pull of the great sun, or by the pull of other heavenly bodies.

Such are the planets. Here are some facts about them:

Planets	*Miles from Sun*	*Length of One Trip Around the Sun*
Mercury	37,000,000	88 days
Venus	67,000,000	224¾ days
Earth	93,000,000	365¼ days
Mars	142,000,000	687 days
Jupiter	483,000,000	12 years
Saturn	886,000,000	29½ years
Uranus 1,782,000,000		84 years
Neptune 2,793,000,000		164¾ years
Pluto 3,670,000,000		247¾ years

Long ago an English astronomer, Sir John Herschel, told how to make a model that would give an idea of the great mass out of which the sun and its family formed themselves, and of the distances from one another at which the planets gathered themselves together.

In a great field we may put in the middle an electric light globe 2 feet across, to represent the sun. At 82 feet from it we put a mustard seed for Mercury. Venus, 142 feet away, will be as large as a pea, and that also will be the size of the earth, 215 feet away from the arc light. Mars will be smaller, a peppercorn, 327 feet away. Jupiter will be a small orange, nearly a quarter of a mile off. A tangerine for Saturn is two-fifths of a mile away, and Neptune, still more distant, will be a mile and a quarter off, and the size of a plum. Pluto would be a mile and two-thirds away and the size of a pea. (Neptune and Pluto were discovered long after Sir John Herschel's death. We have added these planets to complete the model.)

That list does not include the little pieces of territory that are called planetoids, of which almost two thousand are known. They seem to circle in a fixed orbit between Mars and Jupiter. In the model we have made they would be no larger than grains of finest sand.

Article prepared with the assistance of Roy K. Marshall, Director, The Morehead Planetarium, and Professor of Astronomy, The University of North Carolina, Chapel Hill, North Carolina.

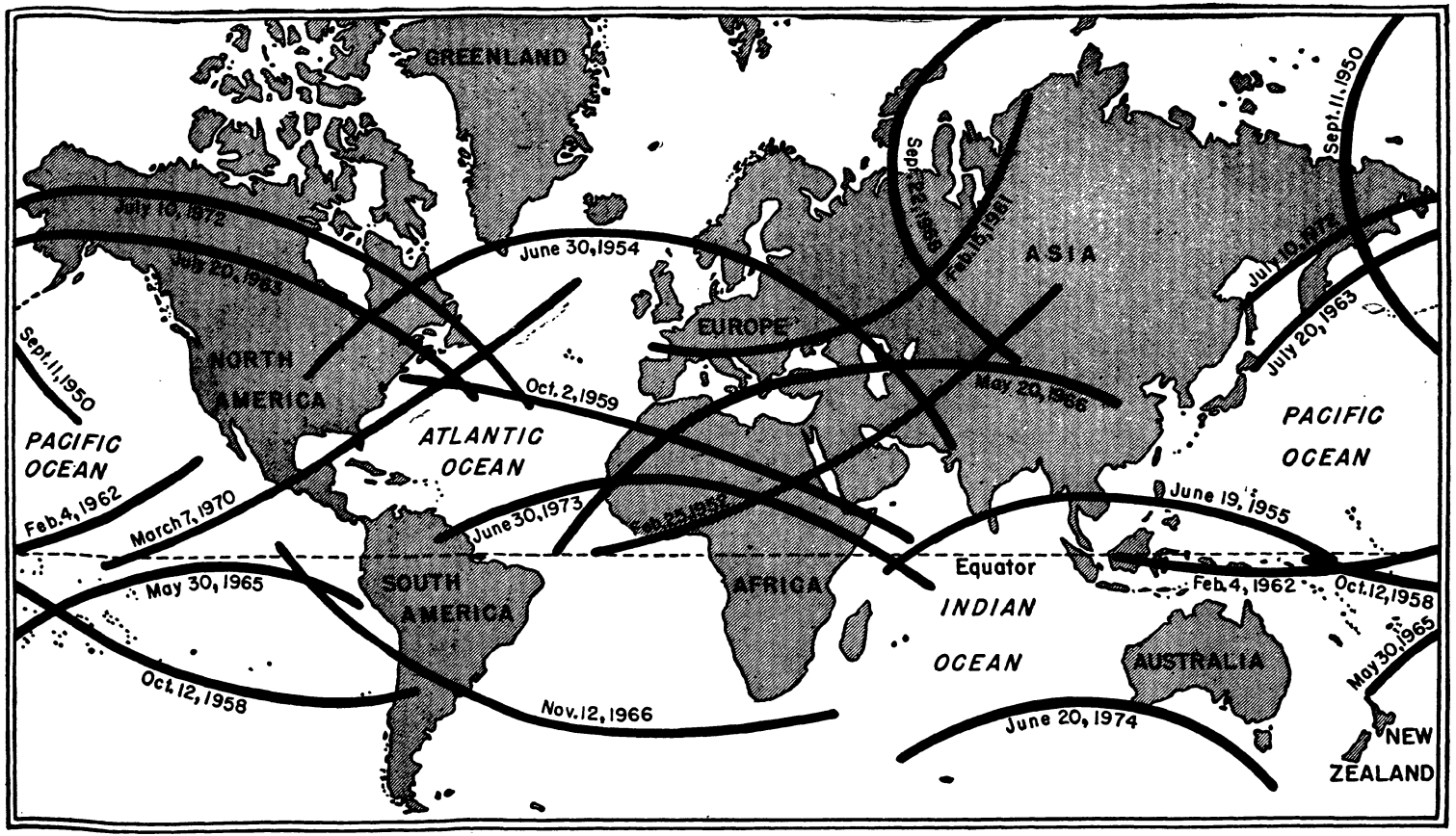
THE NEXT STORY OF THE EARTH IS ON PAGE 3289.

Why Does the Sun Fade Carpets and Not Flowers?

A COLORED object is simply an object which reflects to the eye certain waves of light. Its power of reflecting light depends mainly on the way in which its molecules are built up. Now, the sun has power to alter the chemical state of bodies, as we see when it turns silver nitrate black; and some of these alterations so affect the structure of the material that its surface reflects less light than formerly—that is to say, it fades.

Many artificial colors used in dyeing carpets pass through chemical and molecular changes when exposed to sunlight, and so fade; whereas the colors of living plants are more strongly built and so are not readily faded by the sun. When plants are dead, however, they usually fade quickly when exposed to sunlight.

PATHS OF TOTAL ECLIPSES OF THE SUN FROM 1950 THROUGH 1974



The curved black lines on this map show the paths of the shadow cast on the earth during toial eclipses of the sun. The shadow is cast by the moon when it comes exactly between the sun and the earth. Only observers in those areas over which the dark lines pass will see the sun blotted out completely. People at some distance on either side of the lines will see the eclipses as partial, with part of the sun still visible—not entirely covered by the moon.

HOW CAN WE FORETELL AN ECLIPSE OF THE SUN?

We can predict many movements of the heavenly bodies because they follow a pattern. We can time the progress of the planets quite exactly. While the earth goes round the sun, the moon goes round the earth. At certain times the moon comes between the earth and the sun in the daytime, cutting off the sunlight from certain places on the earth as it passes along.

Twelve or thirteen times a year, at new moon, the moon comes between the sun and the earth, but not usually in such a position as to cause an eclipse. The earth goes around the sun in one plane and the moon around the earth in another plane, and unless the planes intersect, or nearly intersect, the shadow of the moon does not fall on the earth. We must have earth, sun and moon in a straight line, with the moon in the center, before we can have an eclipse of the sun. The periods at which sun, moon and earth are so placed can be found out by astronomical calculations.

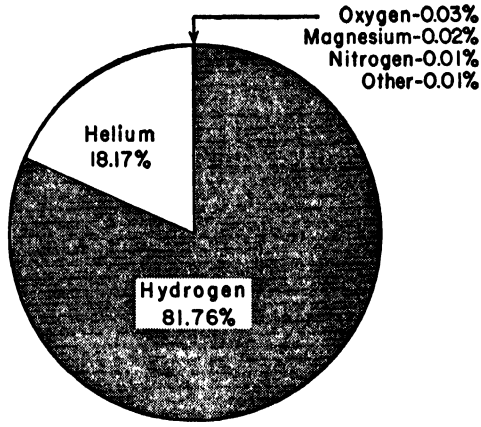
Thousands of years ago the Chaldean astronomers discovered that eclipses recur at intervals of 18 years and 10 or 11 days. This period of time was called by the Greeks the "saros," and this name is still used. This does not mean, however, that there is only one eclipse in a little over 18 years. There are at least two eclipses of the sun every year, and there may be as many as five in one year. Eclipses occur in series, and all the eclipses in one series, which lasts for over 1,200 years, have definite similarities. There are many series going on at the same time. Those eclipses which belong to a particular series occur when the centers of the sun and the moon are in almost exactly the same position in the sky which they held at the beginning of the series. The second eclipse in a series, however, which comes after the period of a little more than 18 years, is not visible from exactly the same place on the earth as the first eclipse.

IS THERE ANY WATER IN THE SUN?

We know that the sun contains oxygen and hydrogen, the two elements that combine on the earth to form water. But we know, also, that the sun is so hot—many millions of degrees at its center—that no matter can exist there except in the form of gas. Even iron, nickel and copper, which we know to be present in the sun, exist there only in a gaseous state. Any object approaching the sun closely, whether another heavenly body or a super-airplane, would immediately be reduced to a gaseous form. There is, then, no water on the sun, since it is too hot for the combination of oxygen and hydrogen to take place.

WHAT IS THE SUN MADE OF?

The sun is made of gases—incandescent gases—which glow but do not burn. (The little wire filament in an electric light bulb is incandescent, too, but you could not say that it burns.) More than sixty of the elements known on earth are found in the sun.



The proportion of the chief elements in the sun.

Among these—naming only a few—are hydrogen, in very great quantities, helium, carbon, nitrogen, oxygen, sodium, magnesium, aluminum, silicon, sulfur, potassium, calcium, iron, cobalt, nickel, copper, zinc and even silver and platinum. But you must not think of these elements as in the form which we know here on the earth. Even those which we know as solids are, in the sun, in the form of gases. However, as the graph shows, there is a far greater proportion of hydrogen and helium than of any of these other gases.

WILL THE SUN EVER BE AS COLD AS THE EARTH?

Yes, provided no celestial accident happens to the sun first, and it is allowed to live out its full span of existence. Every second, without ceasing, the sun is giving out enormous amounts of energy which we receive in the form of light and heat. To produce this energy the sun is using up over

4,000,000 tons a second of the stuff of which it is made. The sun's power comes from the breaking down and building up of its own atoms. The atoms are destroyed, or broken down, and then recombined into new forms. The sun is very much like a huge atomic furnace. You might be fearful, since the sun is constantly using up so much of the material of which it is made, that the sun will cool off in the near future and leave man without heat and light. There is no danger of this, however. It is estimated that there is enough material left in the sun to keep it shining for more than 30,000,000,000 years. In time, however, the sun will cease to shine so brightly and give out so much heat. It will become like the countless thousands of dark stars or suns which already exist in the sky and which we can not see. In time it will probably cease to give out any heat or light whatever.

DOES THE SUN MOVE OR DOES IT STAND STILL?

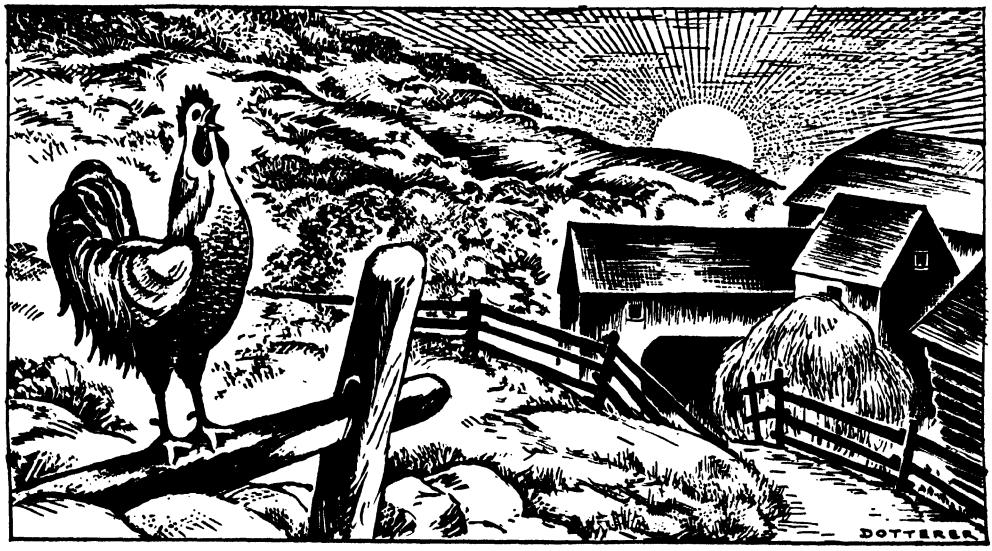
The sun has several movements. Like the earth, the sun spins, or rotates, upon itself, and in the same direction as the earth. Thus, we can notice a sunspot appear at one side of the sun, travel across its face, disappear for several days, and then reappear where we saw it first.

Besides this movement of rotation, the sun has a movement of translation, as it is called —that is, an actual bodily movement from place to place. We do not doubt that all other stars are in motion, too. Our own star, the sun, is moving through space at the rate of about twelve miles a second toward the constellation Cygnus, in the general direction of the brilliant star Vega. This point toward which the sun is traveling, carrying with it the whole solar system, is known as the apex of the sun's way. In addition, the sun, since it is one of the billions of stars in the Milky Way Galaxy, moves with the galaxy as it rotates. Further than this, the galaxy is undoubtedly moving through space, and the sun and solar system travel along with it. No astronomer can tell us, however, exactly where the sun is carrying us. We do know that one second from now we shall be twelve miles from where we are now, and that in all probability we shall never visit this spot in the universe again.

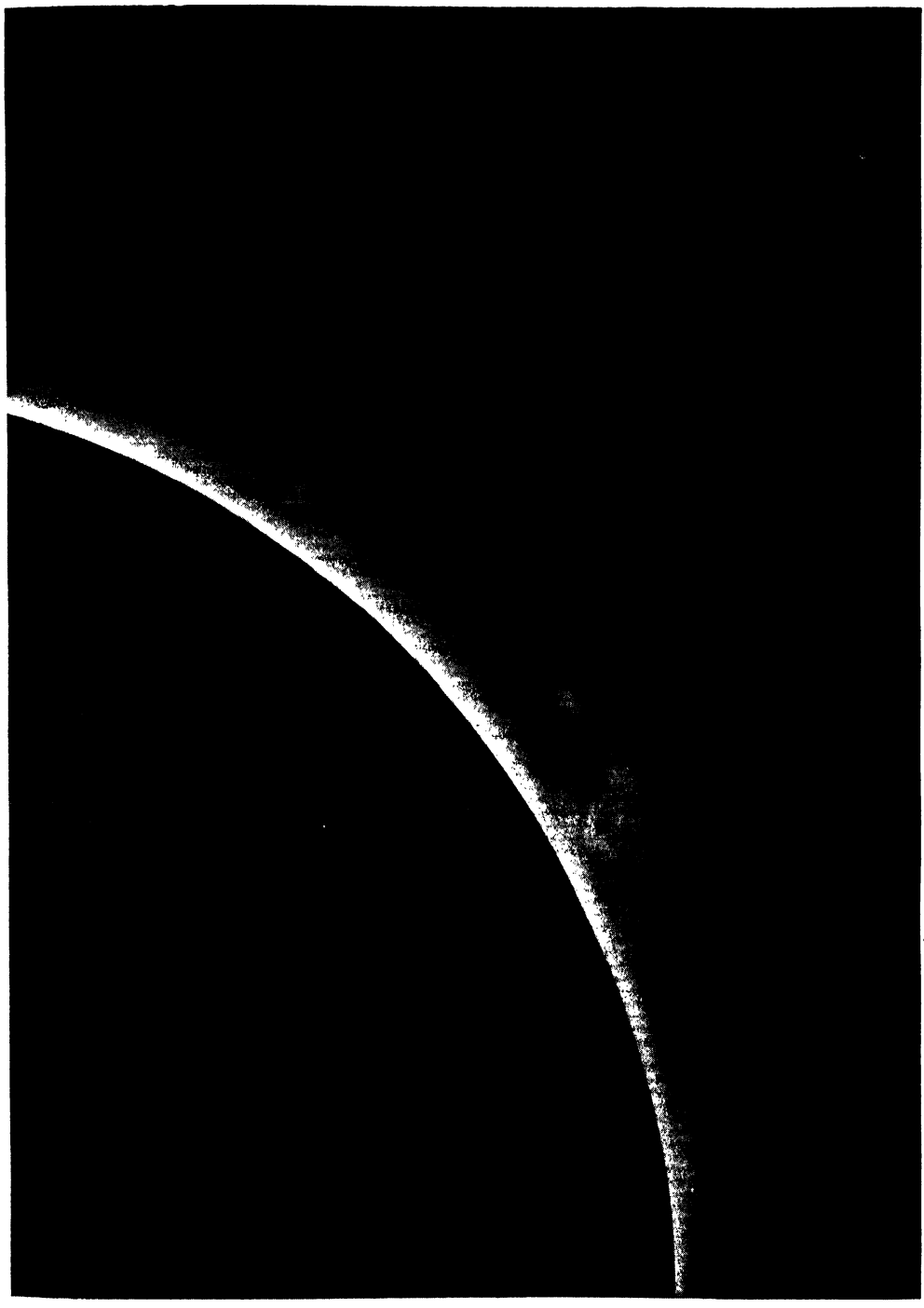
DOES THE SUN EVER CROSS THE NORTHERN SKY?

Whatever part of the world we are in, the sun rises in the east and sets in the west, because the whole earth is spinning in the same direction, and it is that spin which makes the sun appear to rise and set. If we are looking at the sun from the northern half of the planet, it appears to travel across the sky in the south; while if we look at it from the southern part of our planet, it seems to travel across the sky in the north. From places near the equator, however, the sun is sometimes seen to the north and sometimes to the south, although always very high in the sky at noontime.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3225.

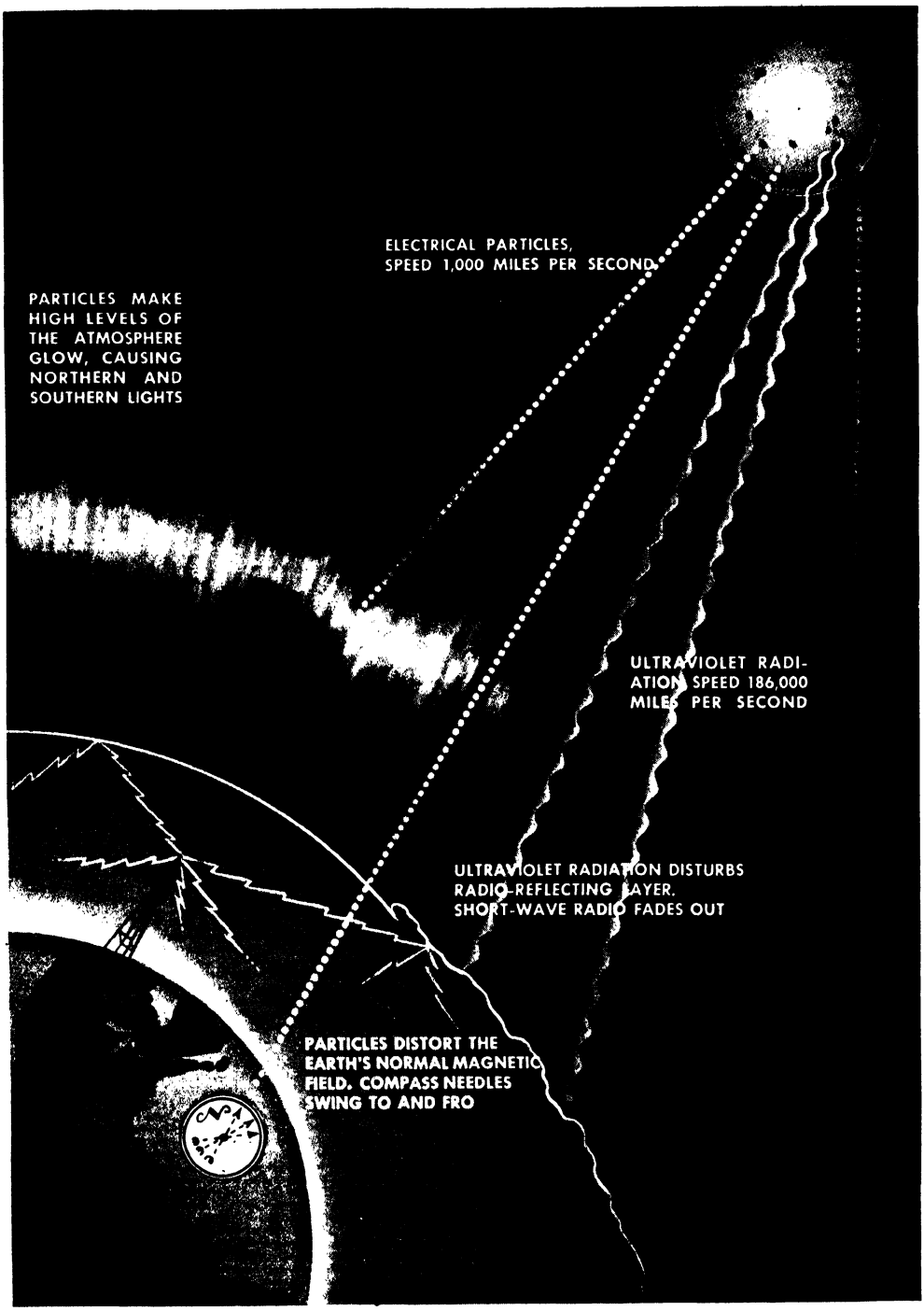


A "CLOSE-UP" OF THE SUN



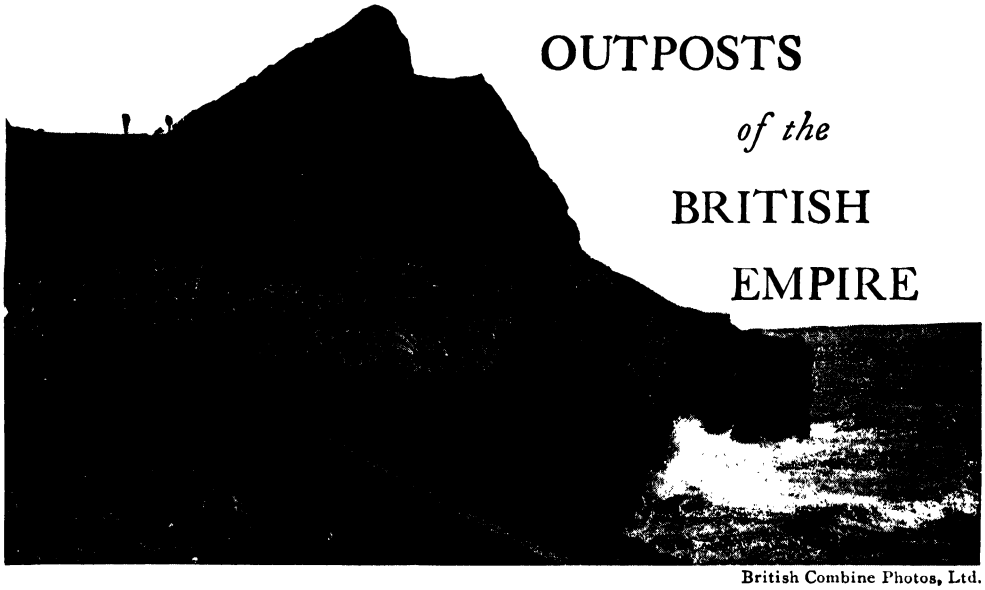
The visible surface of the sun, the photosphere, has a mottled appearance, with dark spots which are cooler storm areas in the gaseous matter. Above the photosphere lies the chromosphere, consisting of lighter materials. From the chromosphere spring flame-like prominences. These consist chiefly of hydrogen and calcium vapors.

SOME EFFECTS OF SUN-SPOTS ON EARTH



Electrical particles streaming from sun-spots may distort the earth's normal magnetic field; and they may cause the high levels of the earth's atmosphere to glow, making the auroras, or northern and southern lights. Ultraviolet radiation from the spots disturbs the radio-reflecting layer of the earth's atmosphere, and short-wave radio fades out.

OUTPOSTS *of the* BRITISH EMPIRE



British Combine Photos, Ltd.

The fortress of Gibraltar, towering to a height of 1,400 feet, guards the entrance to the Mediterranean Sea.

WE have glanced at the various parts of the British Isles, the great commonwealths and dominions beyond the seas and the many lands that fly the British flag in the vast continent of Africa. There still remain a great many British possessions that we have not mentioned. Distributed among all the continents, they form the outposts of the British Empire. In this article we are going to take an imaginary trip around the world, stopping at every one of these outposts. We shall set sail from a port in the English homeland.

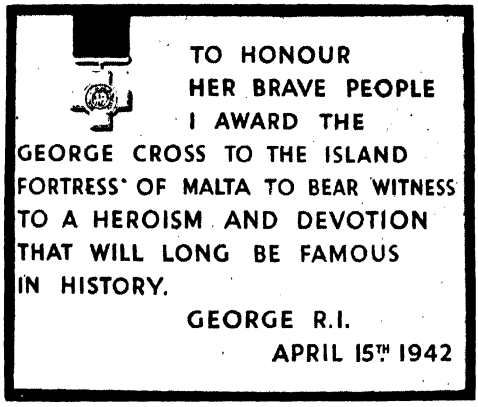
First, traveling toward the east by way of the Mediterranean, we arrive at the naval base of Gibraltar. Gibraltar consists of a mighty rock and a town nestling at its foot. Rock and town occupy a small peninsula, two square miles in area, on the European side of the Strait of Gibraltar. The peninsula commands the entrance to the Mediterranean at a point where the distance across to Africa is only fourteen miles. To the north it is connected with the Spanish mainland by a low, sandy isthmus, which is neutral ground.

The famous Rock of Gibraltar sprawls over the greater part of the peninsula. Towering to a height of 1,400 feet and bristling with big guns, it is one of the most formidable fortresses in the world. Numerous galleries have been cut in the solid rock; some of them extend for miles. They offer safe communication from one part of the rock to the other in case of attack. The fortress is manned in peacetime by a garrison of about 5,000 men.

The northern, eastern and southern sides of the rock are very steep. To the west it slopes toward the sea; at the foot of the slope, facing the broad Bay of Gibraltar, lies the town. It contains naval and civilian hospitals and the barracks of the garrison. The civilian population, numbering about 20,000, is made up chiefly of people of Spanish and Italian descent.

The harbor of Gibraltar is formed by three moles extending from the town. (A mole is a massive work of masonry laid in the sea; it serves to protect shipping by breaking the force of the waves.) The harbor is deep enough to give anchorage to the largest ships afloat. The big guns of the fortress above defend it from attack.

Gibraltar was captured from Spain in 1704 by Admiral Rooke and was ceded to England in 1713. Since then it has successfully resisted a number of attacks. The most famous siege of all, by the French and Spanish, lasted for almost four years (from 1779 to 1783). Besides being a naval base Gibraltar is a British crown colony. The commander of the garrison is also the governor of the colony.



This plaque, which hangs on the wall of a club for Maltese seamen in Cardiff, Wales, tells its own story.

Sailing east in the Mediterranean for 1,200 miles, we reach Malta, an island about 60 miles south of Sicily and 180 miles from the African coast. With the neighboring islands of Gozo and Comino it forms a British colony with an area of 122 square miles and a population of about 295,000.

Malta has had a fascinating history. The ancient trading nations, including the Phoenicians and the Greeks, often landed here; they have left their images, pottery and tombs to mark their presence. Malta was a Turkish possession in the Middle Ages. From 1530 to 1798 it was held by the Knights of St. John, a religious military order of the Catholic Church. The French seized Malta in 1798. Two years later it was captured by the English; it was annexed to the British Empire in 1814.

Malta is now an important base of the British Mediterranean fleet. It played a prominent part in World War II. After Italy entered the war in June, 1940, Malta was bombed from the air almost daily, but the people bravely stood up against all attacks. Later the island served as a base in the Allies' successful campaign to win control of the Mediterranean. In April, 1942, King George VI awarded the George Cross to the island, in order to do honor to its brave people.

Malta is fertile; farming is the chief occupation of the inhabitants. The principal crops are wheat, barley, potatoes, onions, beans and grapes. The people, who are called Maltese, claim descent from the ancient Phoenicians. Their language is a Semitic dialect, with a strong mixture of Italian. The capital and most important port is Valetta; it has a peacetime population of about 25,000.

Continuing toward the east, we come to another British Mediterranean colony, the island of Cyprus. It is forty miles from the coast of Asia Minor and sixty miles west of Syria. Cyprus is the third largest island of the Mediterranean; it has an area of 3,572 square miles and an estimated population of 450,000. Agriculture is the most important occupation; among the chief crops are wheat, barley, oats and olives. The capital is Nicosia, with a population of about 34,000.

The history of Cyprus goes back thousands of years. The island has had many masters. The Egyptians conquered it about fifteen centuries before the birth of Christ. Later, the Greeks and the Phoenicians set up colonies there. The Persians occupied Cyprus in the sixth century B.C.; the Romans in the first century B.C. The Turks held the island from the sixteenth century to the nineteenth. In 1878 they had to give it up to Great Britain, though the Turkish sultan was still its ruler in name. The British formally annexed Cyprus in 1914.

Our boat now makes its way through the Suez Canal and then sails down the Red Sea. Passing through the narrow Strait of Bab el Mandeb, we come to the Gulf of Aden and the British colony of Aden, on the stony

Both photos, courtesy, British Information Services

Milking goats for a housewife consumer in Valetta, Malta.

Worker in a textile factory of Cyprus. Most of the people in this Mediterranean island are from Greece or Turkey.

coast of southern Arabia. The colony includes little Perim Island, off the coast. Aden and Perim have a combined area of eighty square miles and a population estimated at something like 50,000.

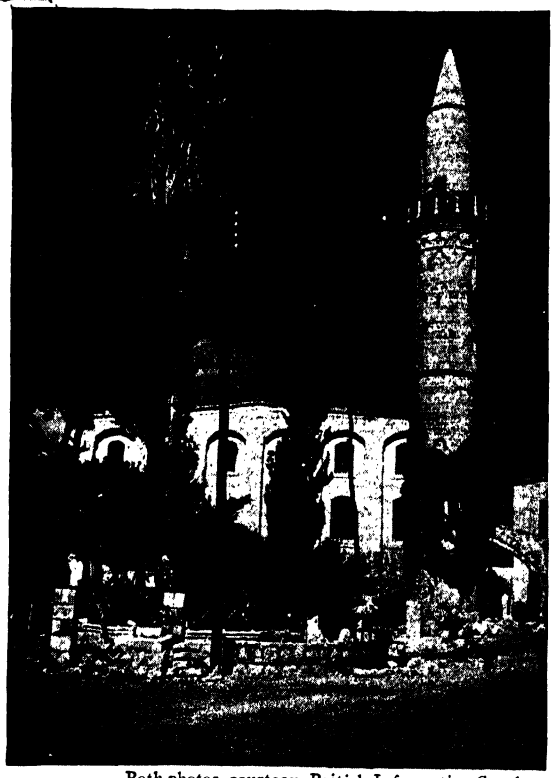
Aden is a hot and almost waterless place. It is important, however, because of its strategic position near the entrance of the Red Sea, and also because it is a center of trade for the lands round about. It exports salt, coffee, hides and skins, tobacco, grain and sugar.

To the east, north and west of the colony of Aden lies the Aden Protectorate. It is made up for the most part of a number of native states, called sultanates; they give special privileges to the English in exchange for protection. The Aden Protectorate has an area of 112,000 square miles and a population of about 600,000. The island of Socotra, with an area of 1,400 square miles and a population of 12,000, forms a part of the Aden Protectorate.

To the south, in the Indian Ocean, lies a group of ninety-two islands known as the Seychelles. These islands were captured by the English from the Dutch in 1794. They became a dependency of British-held Mauritius; in 1888 they became a separate colony of the British Empire. They have an area of 160 square miles and a population of 32,000. The chief island is Mahé; on this is the capital, Victoria.

The white sandy beaches of the Seychelles are enclosed by coral reefs. The climate is temperate; the soil is fertile. The coconut flourishes here; coconut products—fiber, nuts and oil—are the chief source of wealth. Vanilla, coffee, spices, tobacco and tropical fruits are other products of the Seychelles.

As we sail on to the south in the Indian Ocean, we come to the island of Mauritius, about 500 miles due east from Madagascar. The island was discovered by the Portuguese in the early sixteenth century. It was first settled in 1598 by the Dutch, who gave it the name of Mauritius, in honor of a Prince Maurice. Abandoned by the Dutch, the island was taken over by the French, who called it Ile de France (Isle of France). The



Both photos, courtesy, British Information Services

A relic of Turkish rule in Cyprus—a mosque at Larnaca.

British captured it in 1810. Four years later it became a colony of the Empire, under the old name of Mauritius.

Mauritius has an area of about 720 square miles, mostly rugged mountains with fertile valleys between, and cultivated plains along the coasts. The principal crop is sugar-cane; rice is also grown in considerable quantities. The climate is pleasant during the cool season, but very hot and sultry in summer. The population is about 428,000. About two-thirds are Hindus; most of the rest are of French descent. The capital and principal city is Port Louis (population, 67,000).

THE LOVELY SIGHT OF THE "UTMOST INDIAN ISLE"

From Mauritius we sail northeast. At last, near the southern tip of India, about sixty miles to the southeast—we sight Ceylon, the "utmost Indian isle," as the old geographers called it. Viewed from the sea the island is beautiful. The low coastline is almost lost to sight under green groves of palms. Toward the south, the great cone of Adam's Peak towers like a mighty monarch amid the encircling range of hills.

In 1505 the Portuguese made settlements in the west and south of Ceylon. The Dutch took possession of the island in the middle of the next century. It fell to the English in 1796. At first Ceylon formed part of the British India state called the Madras Presidency. In the year 1802 it became a separate colony. It won more and more self-rule in the years that followed. Finally, on February 4, 1948, it became a dominion in the Commonwealth of Nations.

Ceylon has an area of 25,332 square miles and a population of almost 7,000,000, of whom only 5,000 are Europeans. The population is made up chiefly of Sinhalese (Ceylonese) and Tamils. Both of these groups immigrated to Ceylon from India many centuries ago.

Colombo, the capital of Ceylon, is a thriving seaport with a population of about 361,000. Breakwaters extending out from the shore provide shelter for shipping. As a result the city has become a port of call for large steamers bound for Madras, Calcutta and points farther east. Colombo was first settled by the Portuguese in 1516. It was named after Christopher Columbus.

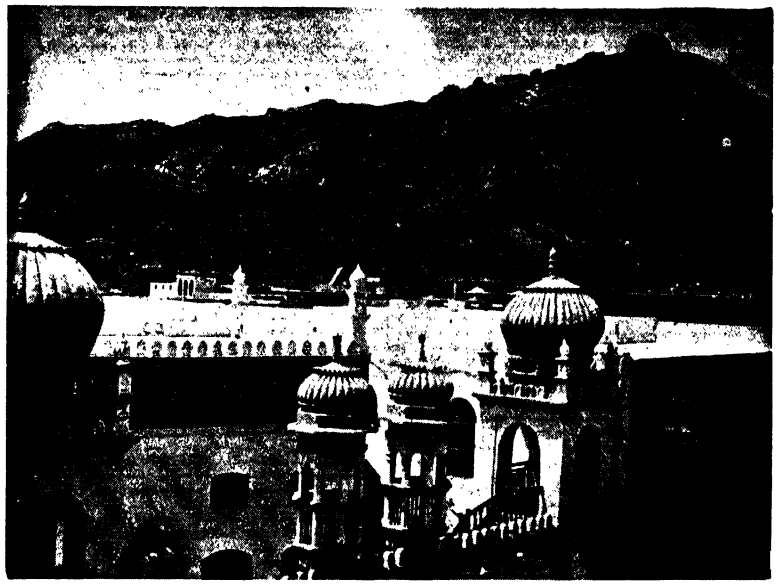
Ceylon is chiefly an agricultural country; the coconut-palm, rice, tea and rubber-producing plants are cultivated. Cinnamon is an important export. The chief mineral product of Ceylon is plumbago, or graphite, which provides the lead for pencils. Sapphires, rubies, moonstones and other gems are quarried. The pearl fisheries of Ceylon have long been famous.

Malaria has always been a serious threat in the island. In the past it was difficult to provide the inhabitants with enough quinine, the drug used in preventing and treating malaria. The government has set aside a large tract of land for the growing of cinchona, the plant from which quinine is produced.

From Ceylon we sail to the east. After rounding the northwestern top of Sumatra, we make our way down the Strait of Malacca, which separates Sumatra from the Malay Peninsula. We come now to the Federation of Malaya, which includes most of the territories formerly known as British Malaya. In the federation we find nine native states of the Malay Peninsula—Perak, Selangor, Negri Sembilan, Pahang, Johore, Kedah, Perlis, Kelantan and Trengganu. Though they have their own native rulers, they are really British protectorates. The federation also includes the two British settlements of Malacca and Penang. The Japanese conquered all these lands in World War II and held them until the end of the war. Then the British regained possession.

Black Star

Mauritius—a pig will go to market in this basket, which the boys are carefully bending into shape.



Courtesy, British Information Services

In Aden, the "Gibraltar of the Red Sea." The influence of India may be seen in the architecture of this mosque, with its picturesque domes, painted blue.

The ruler of each of the native states of the Federation of Malaya is assisted by a state executive council and a council of state. Each of the two settlements has a settlement council. The chief executive officer of the federation as a whole is the high commissioner, named by the British Crown. The central government consists of a federal executive council and a federal legislative council. This legislative council passes laws concerning the federation as a whole; both the native states and the British settlements are represented on it. The high commissioner has control over questions of defense and foreign affairs. The native rulers accept his advice in all matters of government except those which have to do with religion and native customs. Kuala Lumpur is the capital.

The Federation of Malaya has an area of 50,650 square miles and a population of about 4,780,000. By far the greater part of the territory is occupied by the native states, which have a combined area of 49,610 square miles and a population of about 4,125,000. Agriculture and mining are the chief industries of these states. Rubber is exported in considerable quantities; the cultivation of rice is also important. There is a great variety of forestry products—timber, gutta-percha, gums, oils, resins and canes. Minerals include tin, gold, tungsten and coal.

The two British settlements included in the Federation of Malaya—Malacca and Penang—have a combined area of 1,040 square miles and a population of about 655,000. Malacca is on the western coast of the Malay Peninsula, about a hundred miles from the southern tip. The settlement is chiefly agricultural; it has great rubber plantations. Penang is an island off the west coast of the peninsula. Rice is cultivated in the interior; coconut palms flourish along the coast. The capital, Georgetown, has a fine harbor.

The island of Singapore was formerly a part of British Malaya; it is now a separate colony. It is ruled by a governor, selected by the Crown; he is assisted by a legislative council. Singapore has an area of 220 square miles and an estimated population of 940,000. The seat of government is the city of Singapore, which is in the southeastern part of the island. The city is built around a splendid harbor. It was originally a trading post of the British East India Company; it became a world trade center. Ships from many lands brought merchandise to the port; they took away cargoes of rubber and tin from the Malayan area for world markets.

To protect this flourishing city, the British built a great naval base on the northeastern part of the island. Britain was confident that this base could hold off any invader. It was heavily fortified, it had ship-repair shops and a floating dock; it contained vast stores of munitions, food and other supplies. Yet the Japanese captured it after a short siege in February 1942.

For the next three years, the island of Singapore was a Japanese possession; the great port was closed to the shipping of the Western world. Now that the British flag is once more flying over the colony, the city of Singapore has again become an important center of world trade.

To the east of Singapore lies the huge island of Borneo, with an area of 287,745

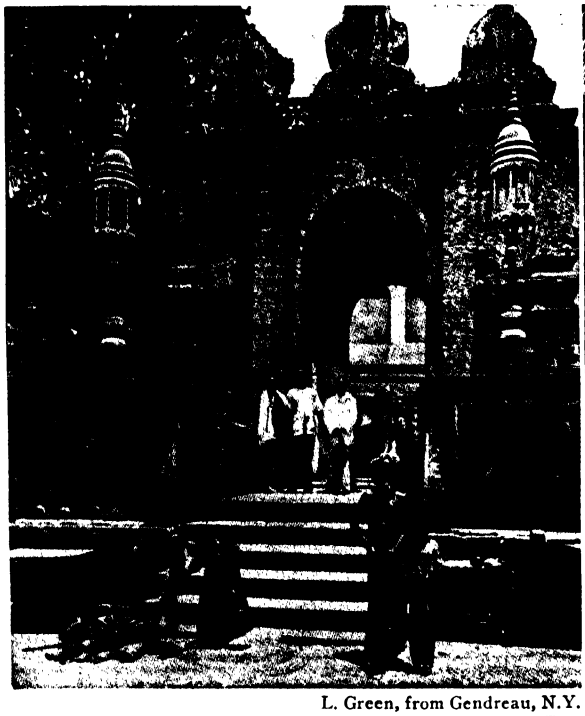
Courtesy, British Information Services

L. Green, from Gendreau, N. Y.

Left: native woman picking tea leaves in Ceylon. Right: two of Ceylon's "devil dancers" in a striking pose.

square miles. For the most part the island consists of jungle country. Rivers abound. In the interior there are several massive mountain chains extending roughly from north to south. The native population is made up of Dyaks and Malays; there are also large numbers of Chinese.

Up to the time when Japan entered World War II, most of Borneo was held by the Dutch. The British held a protectorate over three territories along the northern coast of the island—North Borneo, Brunei and Sarawak. The Japanese invaded Borneo in December 1941. Before the end of the month all three British protectorates were in Japanese hands. (Japan completed the conquest



L. Green, from Gendreau, N.Y.

Courtesy, British Information Services

Two religious monuments of Ceylon. Left: Temple of the Tooth, at Kandy. Right: Buddhist temple at Colombo.

of the Dutch portion of the island in February 1942). The Japanese were not dislodged until their surrender in 1945. Today the British and Dutch again divide Borneo between them.

The British North Borneo Company administered North Borneo from 1881 until the Japanese overran the island in World War II. In 1946 the company turned over its sovereign rights and all its assets to the British Crown. North Borneo is now a British colony, ruled by a governor who is named by the king. It has an area of about 29,400 square miles, with a coastline of over 900 miles; the population numbers about 312,000. There are only a few hundred Europeans. Chinese are numerous; they make up about one-sixth of the population. The chief products of North Borneo are timber, dried fish, rice, coconuts, rubber, tobacco and sago (starch prepared from the pith of a certain palm tree). The capital and chief city is Sandakan, with a population of 14,000. The island of Labuan, lying six miles off the coast, is a dependency of North Borneo.

The tiny protectorate of Brunei lies to the southwest of North Borneo. In 1906 the sultan of Brunei signed a treaty with Great Britain, providing that the land was to be administered by a British resident. Brunei has an area of 2,226 square miles and an estimated population of 48,034. The capital is Brunei (population, 12,000). Native industries include boat-building, weaving and the manufacture of brass and silverware. Rubber and sago are exported; there are large petroleum deposits.

Sir James Brooke, a retired British officer, became the rajah of Sarawak in 1841. From that time until the Japanese occupied the land, the government remained in the hands of the Brooke family, under British protection. In 1946 Sarawak became a British colony. It has an area of about 50,000 square miles and a population of about 500,000. The capital is Kuching. There are large coal and petroleum deposits in Sarawak; rubber and pepper flourish.

From Borneo we make our way northward to the island of Hong Kong, at the mouth of the Canton River in southeastern China. The island, which has an area of thirty-two square miles, was ceded to Great Britain by China in 1841.

The peninsula of Kowloon, on the Chinese mainland, facing the colony, was annexed by Great Britain in 1860 and it became a part of Hong Kong. In 1898 Great Britain leased for ninety-nine years another area on the mainland, together with the near-by island of Lan-tao and the waters of Deep Bay and Mirs Bay. The total area under British control in the Hong Kong colony is 391 square miles. The population is 1,750,000.

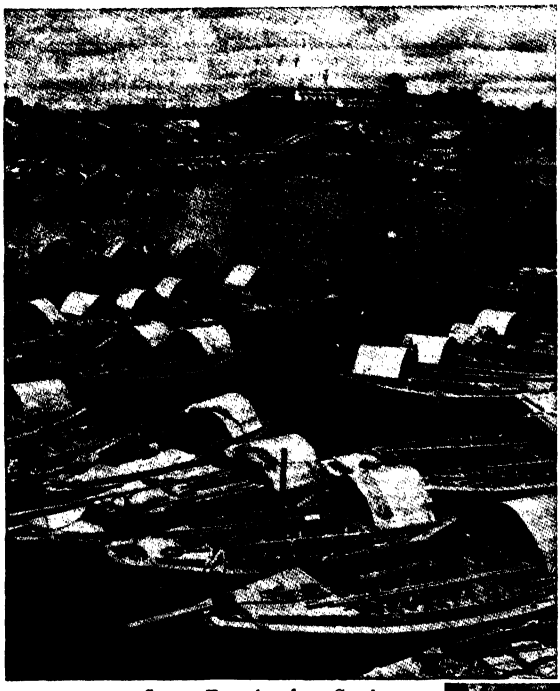
Up to December 1941, the colony was one of the most profitable in the British Empire. Victoria, on the northern coast of Hong Kong Island, was a flourishing trade center. Large quantities of British manufactures, including cottons, woolen goods, iron, steel, machinery and electrical goods, were distributed to the Far East through Victoria. Chinese tea and silk passed through Victoria on their way to the markets of the world. The Japanese conquered Hong Kong in December 1941 and held it until the end of World War II. The British flag waves once more over Hong Kong, but, because of troubled conditions in China, the colony has not yet regained the prosperity of former days.

From Hong Kong we set our course to the south. Sailing through the South China Sea, we pass to the south of the Philippine Islands and finally come to the island of New Guinea, which contains two other outposts of the British Empire. New Guinea is almost

Tilton, from Sawders

Natives of Perak, British Malaya, cooking rice in a bamboo container.

THE BUSTLING CITY OF SINGAPORE



Screen Traveler, from Gendreau

Scene in the harbor of Singapore. The native boats shown in the picture have brought goods produced in the Malay Peninsula.

De Cou, from Sawders

A traffic policeman of Singapore. He gives traffic signals by means of the semaphore (signal arm) which is strapped to his back.

James Sawders

A magnificent temple pylon at Singapore. A temple pylon is a monumental pyramid-like structure serving as a gateway to a temple.

Screen Traveler, from Gendreau

Street scene in Singapore's native quarter. Here we find representatives of many Asiatic peoples. Chinese are in the majority; there are also many Malays and East Indians.

as large as Borneo; it has an area of 234,768 square miles. The island is made up of a broad central portion, from which extend two comparatively narrow peninsulas, one in the northwest and the other in the southeast. On the map these peninsulas give the island somewhat the shape of a bird. It just might be a guinea hen, and so the island would seem to be well named.

Much of the island is heavily forested; the soil is very fertile. There are lofty mountain ranges in the northwest and southeast. New Guinea is notable for the number and beauty of its birds, particularly the beautiful birds of paradise. Most of the natives of the island belong to the Papuan branch of the Negro race.

NEW GUINEA IS A BATTLEGROUND IN WORLD WAR II

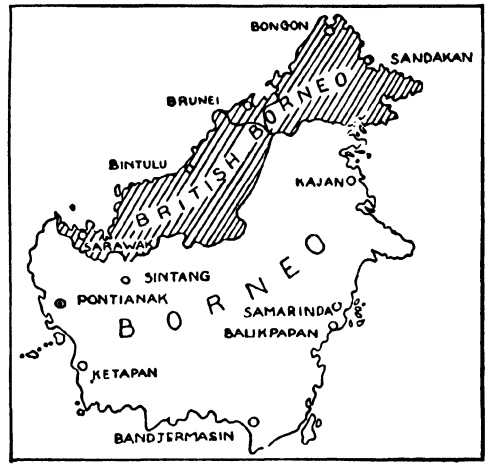
Before the outbreak of World War II the Netherlands held the western half of the island, Australia the eastern half. The Japanese invaded New Guinea in the early part of 1942; by the end of the year they had occupied most of it. But then they were stopped. Thereafter they were pushed back steadily by the Allied troops. After the war came to an end, both the Australian and Dutch areas of New Guinea were cleared of the Japanese.

Australian New Guinea is divided into two areas—Northeastern New Guinea and Papua. Northeastern New Guinea, to the north, forms a part of the Territory of New Guinea, which Australia administers under a United Nations trusteeship agreement. (The Territory of New Guinea includes the Bismarck Archipelago and several islands of the Solomons group.) Northeastern New Guinea has an area of 69,700 square miles; the natives in the explored areas number about 451,000. The chief towns are Salamaua, Lae, Madang and Wewak—all scenes of fierce fighting in World War II. The agricultural products of Northeastern New Guinea include coffee and a variety of tropical fruits. There is great mineral wealth, largely undeveloped.

THE TERRITORY OF PAPUA, ADMINISTERED BY AUSTRALIA

To the south lies Papua. (See the map of New Guinea on the following page.) Australia administers Papua together with the Territory of New Guinea. Papua has an area of 90,540 square miles and a population of about 302,000. The chief settlements are along the coast; among them are Port Moresby, Samarai, Kalumadau and Daru. Sago palms and coconut palms are plentiful. The mineral resources of Papua, as in the case of Northeastern Guinea, have hardly been tapped as yet.

As we sail eastward across the broad Pacific from the shores of New Guinea to Easter Island, about 3,000 miles across the South Pacific from Australia, we come upon thousands of islands, large and small. They make up the group known as the South Sea Islands,



Borneo, one of the largest islands in the world.

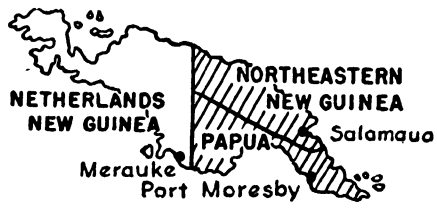
or Oceania. Many nations have some interest in these islands, and some are United Nations trusteeships.

The British Empire has various outposts here. Some are ruled directly by Great Britain; others, by Australia; still others, by New Zealand. The principal groups are the Tonga, or Friendly, Islands; the Gilbert and Ellice Islands Colony, the Territory of Western Samoa, the Fiji Islands, the Solomon Islands, the Bismarck Archipelago and the New Hebrides Islands. We tell you about them in the chapter called Islands of the South Seas.

We round Cape Horn, at the southern tip of South America. Directing our course to the northeast, we come to the Falkland Islands, some 400 miles away. This British crown colony consists of two large islands —East Falkland and West Falkland—and about a hundred smaller ones. The total area is about 4,600 square miles; the population numbers about 2,500. The capital and largest town is Stanley (with a population of 1,250), on East Falkland. Sheep-raising is the principal industry; whaling and sealing are carried on in the vicinity of the

islands. The Falklands are claimed by Argentina, which calls them the Maluinas.

The Falklands have a number of dependencies. One of these is Graham Land, on the Antarctic continent. The others consist of islands which extend in a long sweeping curve from the south to the east of the Falklands. They include the South Shetlands, South Orkneys, Sandwich group and the whaling settlement of South Georgia.



New Guinea is almost as large as Borneo.

From the Falklands we sail northeast in the South Atlantic, and at last we arrive at the island of Saint Helena, another British colony. Saint Helena lies nearer to Africa than to South America. It has an area of forty-seven square miles and a population of about 4,500. Jamestown is the chief port and capital. Flax thrives on this small island. The exports consist chiefly of flax products, such as fiber, tow rope and twine.

Saint Helena was formerly one of the chief stops on the route from England to India; but it lost its importance after the completion of the Suez Canal in 1869. Today it is renowned chiefly as the place where Napoleon Bonaparte was exiled. He was held prisoner here from October, 1815, until his death in May, 1821.

Saint Helena has two dependencies in the South Atlantic—Ascension Island and the Tristan da Cunha group. Ascension Island, thirty-four square miles in area, lies 700 miles to the northwest of St. Helena. It is a bare and gloomy rock. It is a favorite breeding place of sea turtles; thousands of gull-like birds, called terns, cluster on the rocks. Its position, midway between South America and Africa, gave it great importance in World War II as a stop on the air route from Brazil to the West African coast.

The Tristan da Cunha group, south of Saint Helena, is made up of four small islands. Tristan, the largest and the only one that is inhabited, consists of an extinct volcano, 8,000 feet high, and a small plateau. The smaller islands are all peaks of sunken mountains. Tristan was discovered in 1506 by the Portuguese navigator Tristan da Cunha; it was taken over by Great Britain in 1817.

The inhabitants, who number only about 200, are descendants of sailors and soldiers who were shipwrecked in that vicinity after setting sail from Saint Helena. Tristan has been described as one of the loneliest spots in the world; but its inhabitants seem quite contented. They cultivate peach and apple trees and potatoes, and raise cattle, sheep and geese.

We next make our way to the northeastern shoulder of the great South American continent. Here we find British Guiana, a British colony with an area of 83,000 square miles. The territory was first settled by the Dutch in 1620; it was annexed to Great Britain in 1814. East Indians form almost half of the total population of 381,000. The capital is Georgetown, with 78,000 inhabitants.

The principal crops include sugar-cane, rice, coconuts, coffee and cacao (from which chocolate and cocoa are made). The country

Keystone View, from Sawders

These Papuans dwell in one of New Guinea's coastal areas.

is rich in gold and diamonds; there are also large deposits of bauxite, manganese ore and mica. Forests cover almost nine-tenths of British Guiana; much of this forest area is still unexplored.

Making our way up the coast, we pass the Panama Canal and at last reach the colony of British Honduras in Central America. It was settled by woodcutters from British-held Jamaica in the middle of the seventeenth century. In 1862 it became a British colony, administered from Jamaica; it became an independent crown colony in 1884. It has an area of 8,598 square miles and a population of about 60,000. Belize (population, 17,000) is the capital.

British Honduras is heavily forested; it is particularly famous for its mahogany and logwood, which are exported on a large scale. Another important export is chicle, a product of the sapodilla tree. (Chicle is used in making chewing gum.) Among the important crops of British Honduras are sugar-cane, rice, corn, beans and bananas.

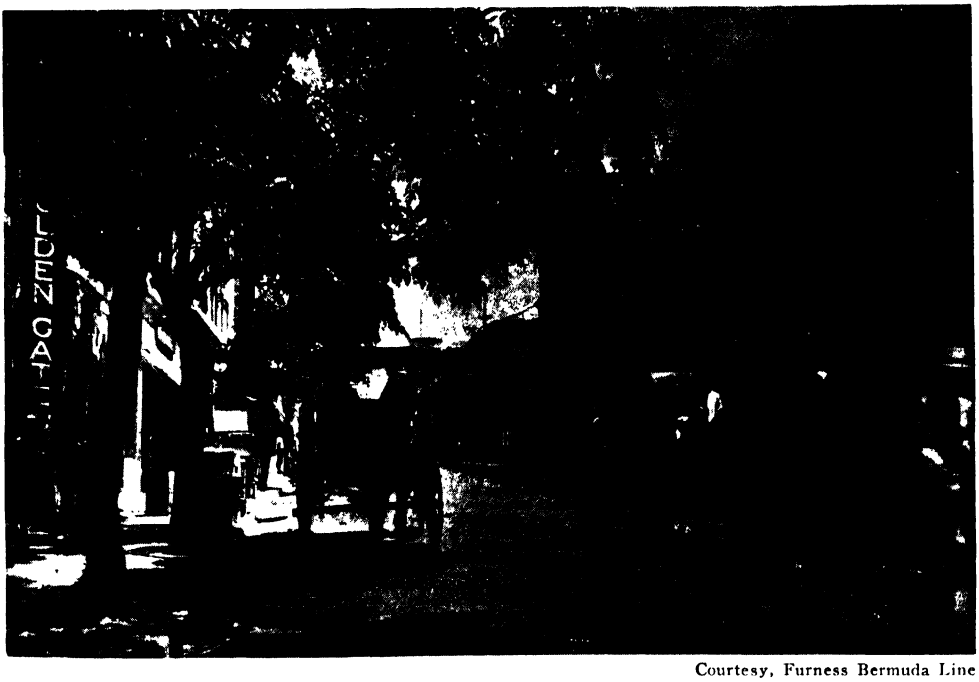
We now come to the great semicircle of islands that stretch from the southern tip of Florida almost to the mouth of the Orinoco River, in Venezuela. We call these islands the West Indies. Great Britain has a number of possessions in this group—the Bahamas, Barbados, Jamaica, the Leeward Islands, Trinidad and the Windward Islands. We tell you about them in our chapter on the Islands of the West Indies.

We make our last stop at Bermuda, an island group lying about 600 miles fror. the coast of the United States and 800 miles northeast of the Bahamas. Bermuda consists of about twenty inhabited islands and a large number of islets and rocks. The total area is nineteen square miles and the population is 35,000. The chief town, Hamilton, has 3,000 inhabitants.

The islands were first sighted by Juan de Bermúdez, a Spanish explorer, in the early years of the sixteenth century. They were not settled until 1609, when Sir George Somers, who was shipwrecked here on his way to Virginia, set up a colony. Bermuda became a crown colony in 1684.

Onions, potatoes and green vegetables, also lilies and other flowers, are grown on the islands and are shipped in large quantities to the United States and Canada. Because of its mild and healthful climate and its beautiful scenery, Bermuda is a favorite resort in peacetime. We could find no pleasanter place in which to rest after our long voyage.

THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 3294.



Courtesy, Furness Bermuda Line

Street scene in Hamilton, chief city of Bermuda. This island group is a favorite vacation resort.

THE WAVES THAT BEAT AGAINST OUR EARDRUMS

THE sense of hearing provides a most important link between the outside world and ourselves. It makes us aware of sound in all its variety: the joyous shouts of children, the chirping of birds, the twang of a guitar, the roar of a waterfall, the faint singing of telegraph wires.

What is sound? Let us first ask what all the sounds that we have just mentioned have in common. In a general way we might reply that all sounds originate by setting some body into sudden motion, or vibration, which causes disturbances to travel away in the surrounding medium—usually the air—just as little waves travel away from the spot where a stone hits the surface of a lake. These pulse-like disturbances that travel from the source of the sound to our ear cause the eardrum to vibrate; this vibration of the eardrum is finally translated into the sensation of hearing.

Scientists also classify as sound a large group of traveling disturbances which are not translated within our brain as *audible* (hearable) sound, though they, too, make our eardrums vibrate. These are ultrasonic sounds, which we shall discuss later.

Let us now go deeper into our original question, and try to describe the behavior of many different kinds of sound in order to find out what is common to all. We have said before that the air surrounding the source of sound must be set into wave-like vibration in order that sound may reach our ears. Now, exactly how is this accomplished?

Take a very simple example. You surely have seen a tuning fork. There is almost certainly one in the science room in your school. If we strike a prong of the fork with a padded hammer (the material of the tuning fork is so brittle that it would break if struck by a *bare* hammer), the ends of the fork will vibrate back and forth very rapidly. The exact number of vibrations in each second that the prongs make after being struck depends only on the *elasticity*, the *shape* and the *mass* of the material of which the fork is made. The number of vibrations per second depends very little, if at all, on the condition of the surrounding air, or the force or material with which the fork was struck. In other words, the *frequency* of vibration of the tuning fork is a characteristic of the fork itself (frequency = number of back-and-forth vibrations in each second, sometimes called the number of "cycles" per second).

Free Vibrations

Now this is true of all elastic bodies, not just the tuning fork: When you strike the table top, or a stretched piece of cloth, or pluck a string, in each case the material is set

into vibrations of frequencies depending only on the material itself. We call them the "natural" frequencies of the vibrating bodies. The kind of vibrations which a body makes by itself after having been given a short impulse is called "natural modes of vibration," or "free" vibrations.

Our vibrating tuning fork is immersed in a sea of air. As one of the prongs vibrates to one side, it pushes the nearest layer of air molecules away and right into the next layer. This is like giving a push to the last man of a long and crowded line of people waiting for a bus. The last man will have to push on the one before him, and so on down the line. The initial push then moves forward from the last man, "carried" by the people in front of him. The push travels along, but the line does not move along.

Compressions and Rarefactions of the Air

So also travels the push given by the tuning fork to the first layer of air, away from the prongs. The push is carried by successive layers of molecules; and we say that a *compression* of air is propagated away from the tuning fork.

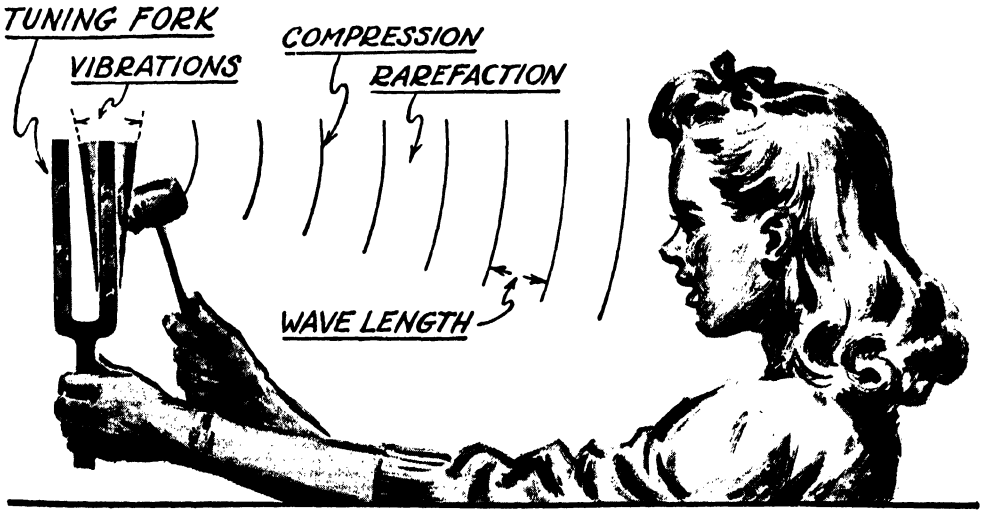
As the prong (we need not look at *both* prongs; one will do here) now swings back to the other side, it leaves an empty space behind itself, thereby pulling the layer of air back. This pull, too, is transmitted to the next layers, and we can say now that a *rarefaction* travels away from the fork.

This process of sending out pushes and pulls, compressions and rarefactions, takes place many times a second in the case of a little tuning fork that vibrates. The regular succession of pushes and pulls is transmitted through the air rapidly in all directions, making each successive layer vibrate back and forth like the source, until the disturbance reaches our ear and produces the sensation of hearing.

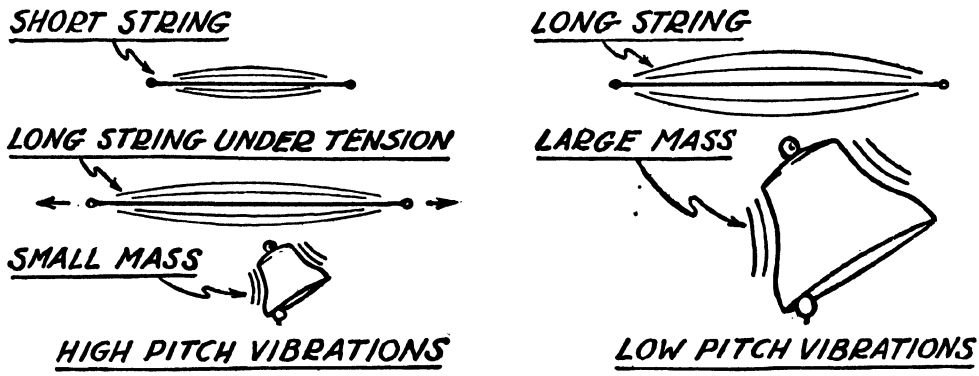
Pitch

If these vibrations falling on our eardrum are of low frequency, say only 20 or 30 vibrations per second, we hear a very low note. (A tuning fork would have to be very big and massive to produce such a tone!) But if the frequency is higher, the note heard is a higher one, and we say the *pitch* of the note is higher. Our ears, however, will usually not allow us to hear anything above about 20,000 vibrations per second. Some animals can hear higher frequencies. When the vibrations are above 20,000 per second, we call the sounds supersonic.

So far we have discussed only one of the many ways of producing sound, namely striking an object and letting it communicate to the surrounding air its free vibrations before they die out. Many instruments beside the tuning fork generate sound in this way: church bells; plucked strings on the guitar, harp, violin, and so on. (The case of the *bowed* string is, as we shall see, a different way of producing sounds.) The strings in a piano which are hit sharply by a padded hammer; the boards of the xylophone; and



When the prong of the tuning fork vibrates in one direction a pushed-together layer of air known as a compression moves away from the fork. As it vibrates in the opposite direction the fork pulls a layer of air to itself. This causes a hollow space, called a rarefaction, to move away from the tuning fork right after each compression.



We say that a deep-sounding tone has a low pitch, and a high, thin note has a high pitch. In the case of a violin string, the tighter the string, the higher the pitch will be. The bigger a bell is, the lower its pitch will be.

all percussion instruments, such as the drum and cymbals, are other instruments which generate sound in the way we have described.

Several interesting things about sound can be learned if we study the plucked strings of a violin. The stretched string, made of some elastic material, such as gut or steel, is tied down rigidly at both ends. If we now take hold of the string somewhere near the middle and let go suddenly, the elasticity of the string will tend to pull it back to the rest position; but like a pendulum which shoots past the middle, the string is carried to the other side, reaches a limiting position, and returns, again overshooting the middle, thus vibrating back and forth until the motion dies out. The frequency of vibration of the string (and therefore the pitch that we shall hear) will depend only on its mass, shape and tension. The frequency of the string goes up if the tension is increased, or if its length is effectively reduced by putting a finger on the string, thus preventing part of the string from vibrating. On the other hand, a long string means slow vibrations. You can test this for yourself by measuring the relative lengths of the strings of a piano on the low and the high side of the scale.

Now besides showing us how its sound is produced and what determines the pitch we hear, this example of the plucked violin string can teach us two other important truths about sound:

1. The pitch does not vary while the vibrations of the string slowly die out; that is, the *strength of the vibration does not influence the pitch.* That is desirable; for it would certainly be unpleasant if the piano played different notes on a given key, depending on how much force was used in playing.

2. *The wooden body of the violin has practically no influence on the frequency of the sound produced, but it serves to increase the amount of sound,* the intensity, that is radiated away from the instrument. You can readily see that a thin violin string is in contact with only a small layer of air, and therefore can not, by itself, send out much sound. But by communicating the vibrations of the string, by way of the bridge, to the body of the violin, the air around the large wood surfaces is made to vibrate like the string. Thus a lot of sound can be launched, whose frequency is controlled by the vibrating string. A similar action explains the purpose of the sounding box under a tuning fork and of the sounding board of a piano.

But now we run up against a very interesting question. Why is it that the sounding box of a violin (the belly) has to be made so carefully that it, not the strings, is the costly part of a good violin? To answer this we have to confess that the vibrations of a violin string are not just a simple back-and-forth motion of the whole string! And therefore a sounding box, to be able to reproduce all the complex motions of the strings, must be so carefully made that men such as Antonio Stradivari have become famous because of their ability to build fine-sounding instruments.

Now here a slight digression is necessary: you will, of course, easily distinguish between the sources of sound, even though the same note on the scale may be played. A middle C on a plucked violin sounds quite different from a middle C from a properly designed tuning fork. This difference in quality, it has been discovered, is due to the frequency and relative intensity of additional, weaker notes which some instruments produce be-

sides the note they are meant to play, and at the same time as the main note.

Fundamentals and Overtones

For instance, a tuning fork is calibrated to sound a middle C, which would correspond to a simple back-and-forth vibration of its prongs at the frequency of 256 cycles per second. But if we strike this tuning fork we shall get, not only 256 vibrations per second, but at the same time, though very faintly, some higher frequencies; these are called the *overtones*, whereas the actually desired vibration of 256 cycles per second is called the *fundamental* note. A violin string, too, if designed to vibrate back-and-forth 256 times a second, as one whole piece, will, while actually vibrating at this rate, also break up into smaller sections, each of which can vibrate at a higher frequency than the fundamental. These additional and fairly strong overtones are heard together with the fundamental of the string and account for the richer and fuller sound of a violin as compared to the tuning fork whose overtones are fewer and fainter.

The sounding box of an instrument such as the violin must therefore be able to respond to even the most delicate overtones quite as well as to the fundamental note itself; this means careful design and skillful workmanship.

Maintained Vibrations

The examples up till now were cases of sound being produced by the free vibration of a body; once vibration started by some impulse, the body was left to itself. This means, however, that eventually, often quite quickly, the vibration dies out, and the radiation of sound stops. In certain cases we can contrive to maintain these vibrations by starting them again before they die out—and that is what is done by the electric bell, where a little hammer is made to pound in-

The alarm clock is an example of maintained vibration. The hammer strikes the bell stroke after stroke, preventing the vibration from dying out.

A telephone diaphragm demonstrates the principle of forced vibration. It is made to vibrate at a frequency different from its own natural frequency.

cessantly against the bell itself. Some tuning forks are similarly operated electrically. The quick strumming of a banjo or guitar is another example of maintained vibrations. The wind instruments, as we shall see later, also rely on a continuation of the free vibrations of a column of air or a metallic reed, by means of a blast of air properly directed.

A fine example of maintained vibrations is the bowing of a violin string. The bow pulls the string against which it is pressed until the string slips back underneath the moving bow; the string is caught again for a while, slips back, and so on. This process repeats itself with the frequency of the particular string, as long as the bow is moved.

This process of producing sound is called "stick-and-slip." This same process causes the high-pitched noise from an unoiled bearing, or the screeching of a long piece of chalk against a rough blackboard.

Forced Vibrations

Some of the previous examples are sometimes regarded as members of the large third group of vibrations, namely the "forced" vibrations. In this case, the object is made to vibrate at a frequency different from its natural frequency. We have already talked about two such cases: one is the eardrum, which is set into vibration at the frequencies of the incoming sound; another is the sounding board, or box, made to vibrate at the rate of the string attached to it. Of course, eardrum and sounding board have their own frequencies of "free" vibration. Only, in the case of the eardrum, the natural frequency is outside the range of hearing. In the case of the violin box—well, something very interesting occurs if one tries to play the note on the violin that corresponds to the natural frequency of the belly: one can produce, at that frequency, only a kind of wailing noise

which is called the "wolf note" of the violin. Almost every string instrument has such a "wolf."

A good example of forced vibrations is the rapid motion of the wings of an insect in flight, such as a mosquito. So rapid are the vibrations of the wings that they produce a high-pitched noise which gets higher still if the mosquito tries to speed up to escape our angry swatting.

Or consider the sound coming from the siren of a firetruck racing down the street. Essentially a siren consists of a device which interrupts a stream of air briefly at a frequency that can be adjusted. If we cut off the blast of air only very few times each second, we do not hear a note but perceive the separate puffs of air. About twenty puffs per second link together into a very low note; as the frequency of the regular interruptions increases, the pitch of the note heard goes up, too.

The most important application of forced vibrations is that of the diaphragms in telephones and loud speakers, and in our ear.

Sounds from Air and Water

The noises the wind makes when whistling through the branches and leaves of trees may sound mysterious and frightening, but they are easy to explain. Each branch or leaf—or blade of grass, or telephone wire, for that matter—presents an obstacle to the wind, breaking up the smooth flow just as the post of a bridge breaks the passing water into eddies and little whirlpools. These eddies of air are pushed to and fro by the wind, with a fluttering vibration like that of a flag on a stormy day. That vibration causes the sound. The thinner the obstacle is, the faster is the vibration of the eddies—and that makes the high-pitched noise when wind goes through the thin needles of a pine tree, as compared to the lower-pitched noise made in thick branches.

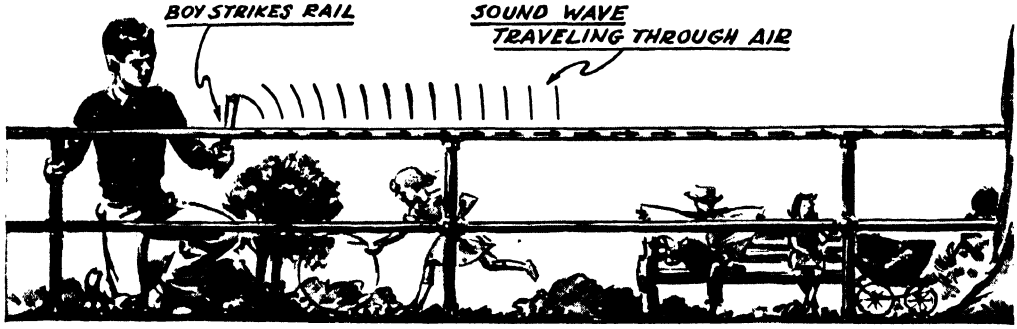
The roaring you can often hear in the fireplace or chimney, though no fire is going, is only the wind playing over the top of the chimney, like a boy blowing on his pan-pipe.

The noise made by waterfalls or sea surf is not completely understood; but it is probably similar to the singing of a tea kettle just before boiling. If you have a glass kettle, you can see that small bubbles rise toward the surface of the water in the kettle, but collapse suddenly on the way. The sudden collapse makes the walls of the bubble hit each other quite hard—and when there are many hundreds of such "hits" each second, the resulting noise has, of course, a high pitch. That noise stops when the water finally boils. Now the bubbles do not collapse any more under the surface, but explode on the water with a low-pitched "plop."

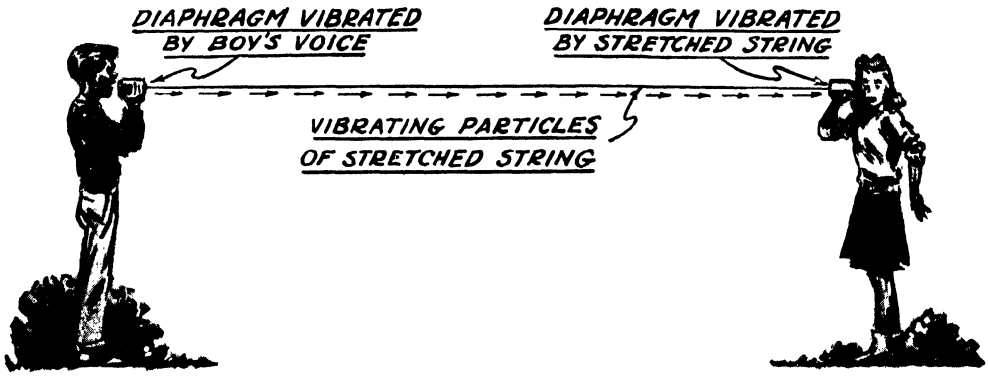
Sounds Caused by Explosions

When a firecracker or a bullet goes off, the chemical action of the powder produces very suddenly a lot of hot gas which pushes the air away very violently; in the case of thunder this is done by the suddenly heated air in the path of the bolt of lightning. But partly because of the quick cooling of the gases, and partly because of the elasticity of the surrounding air, it rushes back right away—and this to-and-fro motion of the air is transmitted to our ears, causing the cracking sound of the explosion.

A similar-sounding noise is the sudden and loud creaking you may have heard in your house at night. Such sounds are produced by some sudden motion which imparts to the surrounding air a ripple-like disturbance. Here it is the structure of the house itself, or the furniture in the room which sets up strains in itself because some parts shrink



When the boy taps the iron railing the girl at the other end will observe three things. First she will *see* the boy strike the railing; then she will *hear* the tapping as it comes *through the iron*, and third, she will *hear* the sound as it is transmitted *through the air*. If she is too close, the operations may overlap, but they are distinct never-



The string telephone is an interesting way of demonstrating how sound is transmitted through a solid. When the boy speaks into the paper cup the sound is sent along the stretched string to the listening-cup at the other end.

more than others when cooling at night; and these strains may "give" suddenly with a quick motion, thus making the short creaking noise. Similarly, the various expanding parts of a steam-heating system can set up quite a racket till the whole structure is heated uniformly.

Transmission of Sound We found that sound is a disturbance that travels in a medium, like air, between the source of sound and our ear. If we now put a ringing bell into a sealed glass jar and pump away all the air inside, the sound should stop, because there is no air around the source to carry it. This does happen. As the air inside the vessel gets thinner, the sound from the bell gets less and less intense.

Now it becomes clear that no sound can pass from one planet to the other, since there is no air nor any other material between them to carry the sound. No matter how large a loudspeaker we use on earth, its sound can not travel to other stars. This is, of course, quite different from light, for light, as you know, *can* pass through a vacuum.

theless. This is true because sound travels more slowly than light, and also because it moves at different speeds through different materials.

Sound travels very well through most solids and liquids as well as in gases. You know that the Indian used to detect the approach of horses, long before their airborne hoof-noise could be heard, by simply pressing an ear to the ground and picking up clearly the ground-conducted noise. Water, too, can be a useful conductor of sound: ships with under-sea listening devices can be guided in the dark or during a fog by submerged bells whose sound is heard louder than that of a bell in air at the same distance.

Since elasticity is the important property of a good conductor for sound, it is to be expected that steel and iron are also better conductors than air. Even a slight tapping at one end of a long and continuous piece of iron railing in the park can be heard clearly by an ear pressed to the other end.

This ability of solids to conduct so well is a great blessing for persons with defective eardrums. If the inner ear is not injured, sound sometimes can be conducted to it through the surrounding bone structure. Thomas Edison became quite deaf in his youth; but in his ingenious way he overcame this handicap. He once explained how he listened to the phonograph he invented: "I hear through my teeth and through my skull. Ordinarily I place my head against a phonograph, but if there is some faint sound that I don't quite catch this way, I bite into the wood and then I get it good and strong."

Longitudinal Vibrations and Transverse Vibrations The string telephone is another interesting example of conduction of sound in a solid (namely, in the long stretched string between two membranes). But you must clearly recognize that in this

In air, sound travels about one mile every five seconds. Light moves much faster. So, even though they start at almost the same time, the flash of lightning is seen before the sound accompanying the flash (thunder) is heard.

case, as always in the conduction of sound, the particles of the medium through which the sound travels vibrate back and forth *along the direction of propagation of the sound.* When the string *conducts* sound, each particle of the string moves to-and-fro along the string; this is called *"longitudinal" vibration.* It is true, the string can be made to move up and down so that its particles vibrate *crosswise* to the length of the string; that is called *"transverse" vibration,* and is the kind of motion which a violin string makes when *producing* a sound of its own.

To illustrate this important difference between the two kinds of vibrations, consider first the particles of water when it *conducts* sound. Each particle between the submerged bell and a fog-bound ship moves back and forth along the direction between bell and ship, the direction in which the sound from the bell travels. The water particles (and all other materials too) make therefore *longitudinal vibrations* when *conducting* sound. But on the other hand, we see if we watch waves traveling across the surface of water during a storm, these surface waves make each water particle rise and fall. While the disturbance, the wave, travels horizontally, the particles themselves move up and down, vertically, at right angles to the travel of the wave. Therefore water makes *transverse vibrations* when moved by ripples or surface waves.

You may have wondered whether transmission of sound through, say, a solid rod, changes the sound at all. The explanation of a famous trick will answer this: Professor Tyndall, a British scientist who made many important contributions to the study of sound, once demonstrated an empty tray of wood, supported only by a wooden rod from the floor, which mysteriously sent out the sounds of a playing music-box. Actually the supporting rod reached through the floor into the basement of the building, where its end stood on a music-box; the tray at the other end served merely as a sounding board. The sound itself had not been changed on the long path up through the wooden rod.

The Speed of Sound

A little while ago we talked about a simple experiment you can make in a park: hold your ear to one end of a long, continuous iron railing and ask a friend to tap lightly at the other end. If he is about 100 feet or more away, you will observe the following: first you *see* him strike the railing; then, a small fraction of a second later, you hear the sound coming through the rail; and a little after that you hear the fainter air-conducted tap. Now this teaches us right away two important truths about the speed of sound: 1) sound is slower than the light-waves that made us *see* our friend's motion; and 2) the speed of sound varies, depending on the material which conducts it. Actually sound travels fifteen times farther in iron and four times farther in water than in air during the same time. This difference in speed is due to the difference in elasticity and density of the materials. *The speed of sound increases with greater elasticity. The speed also increases if the density of the material in which it travels decreases.* There may seem to be some contradiction here; but remember that you have to consider both density and elasticity. Water is about 800 times as dense as air; but water is much, much more elastic than air.

In air the speed of sound is about one mile every five seconds, or about 1,100 feet each second; but if the temperature of the air rises, the speed increases a little. At any given temperature, however, all ordinary sounds travel with the same speed through the same medium; and a good thing this is! Think what a mix-up would occur if an orchestra tried to play a piece whose high

notes of the flute traveled to our ear faster than the low ones of the double bass; or if the voice of a loud soprano were heard more quickly than the soft accompaniment on the piano!

The relatively slow speed of sound in air accounts in part for the drawn-out rolling sound of distant thunder, for it may take several seconds before the noises from the most distant portions of the lightning stroke reach our ears.

Slowly though sound travels (compared to the speed of light) the speed of sound is still about ten times that of the most violent storms. Thus it matters very little, practically, if a wind is going while we try to shout to a friend across the river or the meadow; the wind can not "blow away" our voice. And yet, you will say right away, the wind can affect the sound very much, can indeed prevent us from being heard, if we try to shout against the wind. To understand this and many similar things we first want to hear more about the way sounds behave as they travel from one place to another.

If a sound-wave were allowed to spread undisturbed after leaving the source, much like an ever expanding soap bubble or balloon, it would seem to grow weaker and weaker the farther the wave traveled. You can see why: the bigger a balloon becomes, the thinner is the skin of which it is made, because it has to cover a greater area. Similarly, the energy of an expanding sound has to be spread over a larger and larger sphere, and less energy, and therefore less intensity, is present at any given portion of the expanding wave. Actually, if you compared the intensity of that portion of the same sound-wave that falls on your ear at distances of 2 feet and 6 feet from the source you would find that the sound intensity gets nine times smaller as the distance gets three times greater (6 feet $= 3 \times 2$ feet). If your distance had increased five times, the intensity would have dropped twenty-five times. In general, the intensity of the waves drops as the square of the increasing distance ($9 = 3^2$; $25 = 5^2$). This is a most important law in science, the inverse square law. It applies to many things, including the light-waves that spread away from a lamp in all directions.

Now, of course it never does happen that sound-waves spread indefinitely; sooner or later they will fall on some obstacle, and then many amazing things can happen, as they do in the case of light-waves.

Sound, like light, can be reflected. Here we see how a shout is bounced back from a number of surfaces, giving several echoes of our one Hello!

Reflection of Sound

Perhaps the simplest is reflection from a solid wall. In this, sound behaves like light falling on a good mirror. If we should stand right in front of such a "sound-mirror," and about 550 feet away, the noise made by clapping our hands loudly once would be reflected from the wall and come to us as an echo after one second—half a second each way. Multiple echoes occur where there are several reflecting surfaces in fortunate positions, as for instance in the canyons of the Rocky Mountains and Arizona, or in some buildings. In a certain château near Milan, Italy, a fortyfold echo can be heard.

Blind persons often train themselves to become sensitive to very faint reflections, and that helps them to find the presence and distance of obstacles. Similarly, when it is pitch dark, the bat flies around guided entirely by the echo of its own cries (these are so high-pitched that most persons can not hear them at all!)

Examples of reflection of sound are the whispering galleries in St. Paul's Cathedral in London and in other famous buildings. A word whispered near the curved wall of the gallery is reflected again and again as it travels along the wall, and thus can be heard at a great distance, giving the impression that the sound "creeps" along the curvature.

The gathering of sound in an animal's long ears is another application of the reflection of sound; so also is the megaphone that prevents sound from spreading and concentrates it in a beam, like the light in a searchlight.

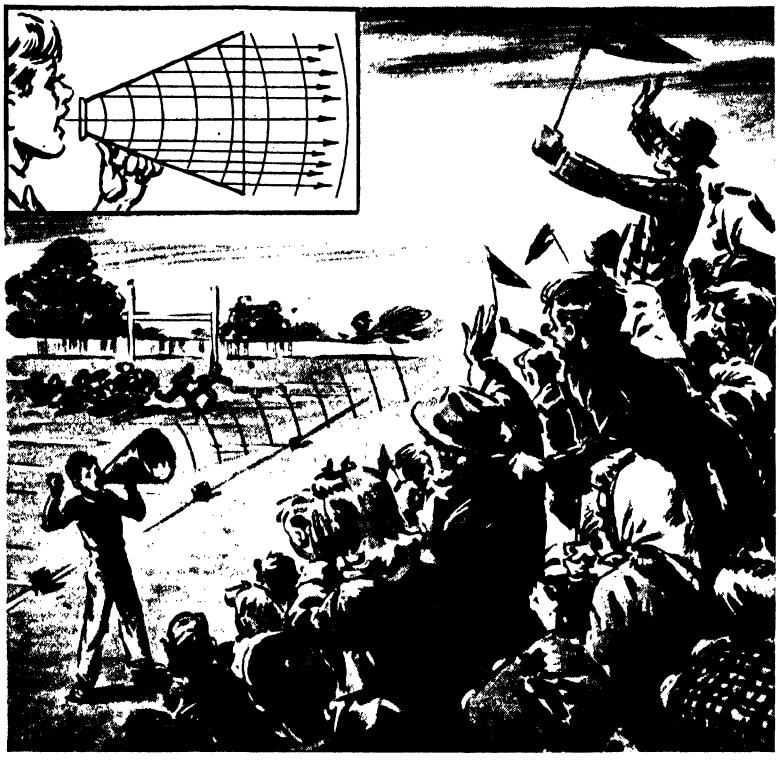
Now it seems quite reasonable that sound should be reflected from a solid, like stone or wood; and even from water. True enough —hardly any sound goes from air into water; almost all is reflected from the surface of the water. It is only a fable that a fish below water is frightened away by noise made at the shore. What makes the fish suspicious is any unusual motion it might see, or our shadow on the water.

Sound is also reflected, at least in part, when it passes into a layer of cooler or moister air, just as some light is always reflected from the boundary between two adjoining pieces of glass of differing density, or between air and glass.

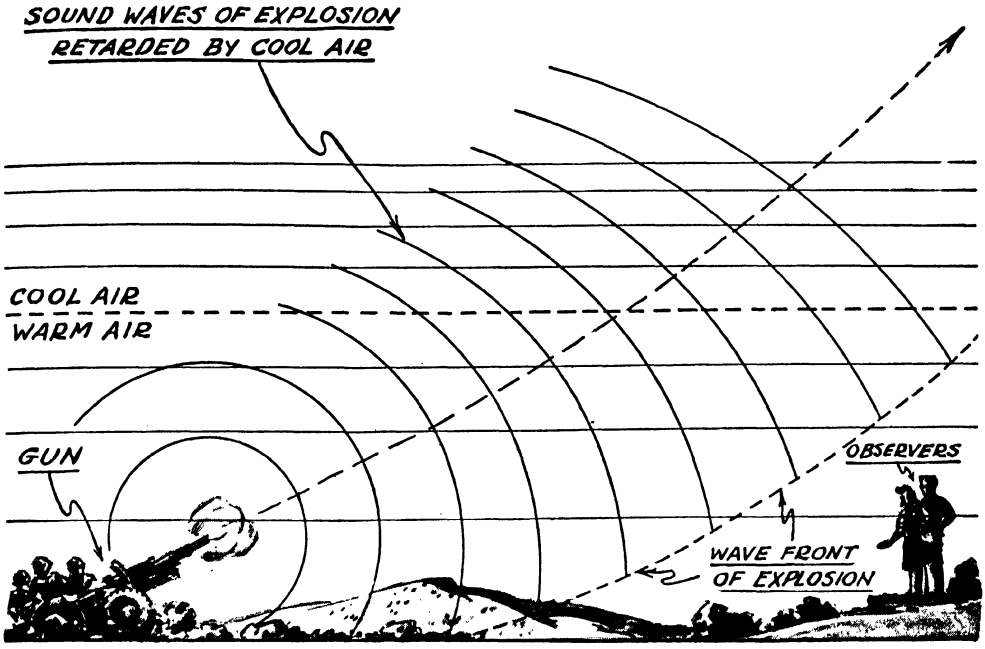
Refraction of Sound

What happens to that portion of light which is not reflected, but continues from air into glass? We know it is bent, or refracted. Sound-waves, too, are refracted, or bent, from their path when, in their course of travel, they enter a different medium.

Let us take a very interesting example: a sound-wave due to the firing of a gun travels away, expanding uniformly in all directions above ground, like half of a gigantic balloon. Now pay attention to what happens to that part of the sound-wave which travels toward you along the ground. Soon the upper end of this wave front expands into a region of air which is



A megaphone is a device used to concentrate sound-waves. It directs sound much as a flashlight directs a beam of light. The sound of the boy's voice is reflected from the sides of the megaphone.



When this gun is fired the observers will not hear the noise because sound can be refracted, or bent. Sound-waves travel faster in warm air than in cold air. Therefore, during the day when air is warmer nearer the ground, the sound will move more rapidly near the earth's surface, lifting the sound above the observers. The observers are said to be in a "silent area," though they stand only a mile from the explosion.

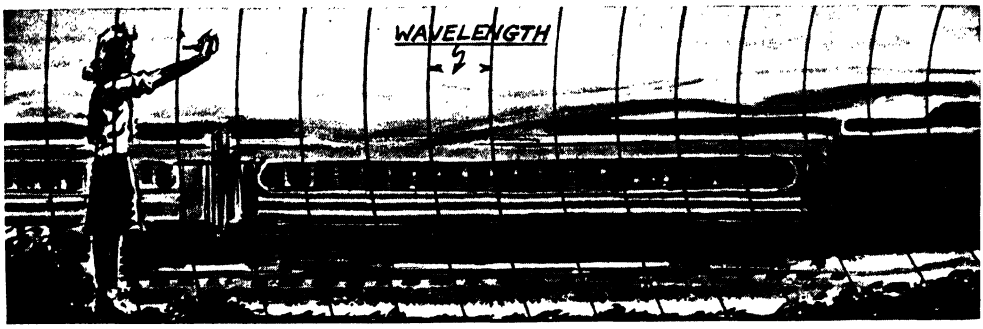
cooler, because, at least during the daytime, air is warmer near the ground and cooler above. As sound travels more slowly at a lower temperature, that part of the wave which is in the cooler region is retarded; but in the meantime the part in the lower, warmer region shoots ahead as before. The result of this difference in speed of the two ends of the wave front is that the wave is "lifted" up, clear over the head of an observer standing perhaps only a few miles away from where the gun is fired.

This, then, explains why there are often "silent areas" quite near to explosions. Some say that Napoleon's defeat at Waterloo was partly due to failure of his reinforcements to move up at an agreed signal of shots—simply because they were in a "silent area" where the sound of the signal did not reach them.

The opposite effect often occurs at night, and particularly over water where the temperature is a little warmer higher up in the air. Sounds which ordinarily would travel directly up into the sky are then refracted down, back to earth, and this accounts for the fact that at night our ears often pick up quite clearly distant noises that escape our hearing during the day.

During the day, the air above the ground gets a little cooler the higher we go, but at a height of thirty or more miles the temperature starts rising with height. And so it may happen that the explosion wave we have seen lifted up over observers a few miles away is now bent down again in the stratosphere and may reach the ground about eighty miles from the start of the explosion. Thus there can be, beyond the silent zone, another "zone of audibility" of the explosion!

Any unevenness of the atmosphere, be it one of temperature, humidity or wind velocity, has this bending effect on sound-waves. If you try to shout against the wind, your voice will be bent up into the sky instead of traveling straight to your friend across the meadow. The reason is that the wind near the ground, being retarded by friction, goes more slowly than wind higher up; and so the upper part of the wave fronts of your voice, traveling against the wind, are decreased in speed more than the portions of the wave fronts near the ground—the same thing that happens when the air is hotter near the ground. Now you see why a skilled hunter approaches the game with the wind against himself; not only is his scent kept



A train whistle seems to sound a higher note when it comes toward you than when it goes away. The vibrations are

away from the sensitive nose of the animal, but also what noise he may make in approaching may be bent up and over the ground.

Diffraction of Sound

You may have wondered whether there was any reason why the bat, finding its way unerringly through the dark attic of a house by listening to its own echo, should use cries of so high frequency that most humans can not even hear them. There is a very good reason for it, indeed. Cries of low pitch would not help the bat at all.

Think for a moment of a wooden post standing in the sea not far off shore. It does not seem to reflect any part of the water waves that hit its side; they just go right around the post and on to the shore. But if we were to row up near the post and produce small ripples on the surface of the water, the post would quite clearly reflect the small ripples that reach it. In other words, waves with a small distance between the crests, such as our ripples, are reflected, but waves with large distances between crests are not.

Now the distance between crests is called the *wave-length.* And it is true for all waves, not only for water waves, but also for light and for sound, that waves with large wave-lengths (like low-frequency sound) are not reflected by a relatively small obstacle; they bend around its edges and sweep right past—and this is called *diffraction.*

Sound-waves consist, not of crests and troughs, like ripples, but of compressions and rarefactions in the air through which they travel, so we measure the wave-length of a sound from one compression to the next. A high-frequency sound has a short wave-length; therefore it is not diffracted so much, but is reflected by most ordinary obstacles—and is much more useful to produce the distinct echoes which a bat uses to find its way than a low-frequency sound would be.

The Doppler Effect

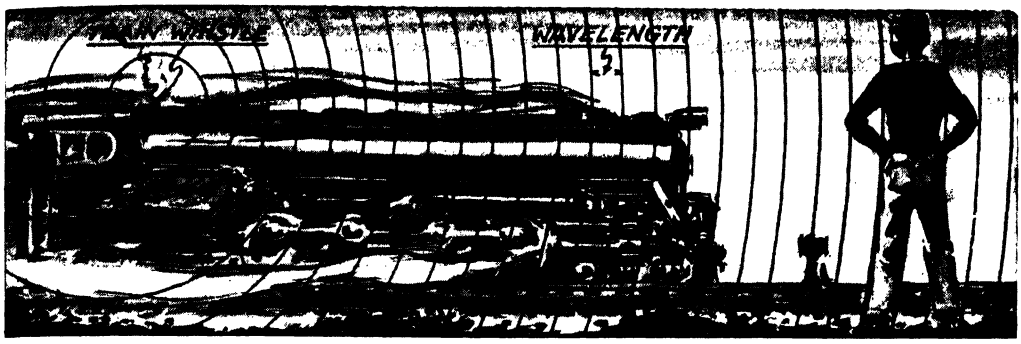
Have you noticed the change in pitch of a locomotive whistle as it passes by? It sounds much higher when approaching you than after it has passed, though, of course, actually the whistle blows the same note all that time. This kind of phenomenon is known as the "Doppler effect," named after the Austrian scientist who first explained it about 100 years ago.

Let us say the whistle actually blows all the time with a 500-cycle note (it sends 500 pulses each second into the surrounding air). Now if the whistle stays in one place, each pulse would travel about half a foot away before the next one is emitted, for the wave-length of a 500-cycle note is that distance. If, however, the whistle is mounted on a locomotive that moves toward you, then each successive pulse is "released" a little nearer to you, and crowds on the previous pulse. The distance between pulses coming toward your ear is now less than half a foot—that is, the wave-length has become smaller; more than 500 pulses will reach your ear in each second, and therefore the note sounds higher.

(A similar thing would happen if you were to approach a stationary source of sound. You would pass the pulses in the air at a greater frequency than if you had not moved, and the pitch of the sound would become higher.)

After the locomotive has passed us, we hear the opposite effect: now each successive pulse of the 500-cycle note is released farther away from us, the distance between pulses is thus increased, the wave-length is longer, and the whistle sounds lower. (Again, if you rapidly move away from the whistle the same lowering of pitch is heard.)

This change from a higher to a lower pitch



crowded together as the train approaches, but they come to you farther and farther apart as the train goes away.

of a moving source of sound is very noticeable if a shell or bomb or bullet passes by. Here a steady high-pitched sound is generated by the moving projectile itself, but the Doppler effect is the same as we have discussed for a locomotive whistle.

Interference of Sound

In almost everything that was said up till now we have assumed that we are listening to a very simple, single sound—either an explosion or a steady note of a given frequency. But actually, of course, we can distinguish various sounds even if they all arrive at our ear at the same time. If you have a little training you can quite easily pick out each of the various instruments of a large orchestra playing together. Also, if you listened to a chord played on a violin, you might be able to name each separate note of the chord. Furthermore, you know already that even each separate note played on a violin (or on any other instrument) actually contains some other, fainter notes, the overtones, which account for the richness and nice quality of a well-played instrument.

Now is it not wonderful that all those different notes, each trying to set up vibrations of its own in the air, do not destroy or distort one another? Each goes through the air to our ear as though the others were not there. Yes, even if two sound-waves, coming from different directions, crossed each other in "mid-air," they would not distort each other. To be sure, the air will make very complicated vibrations trying to accommodate so many different notes at the same time. But the ear, amazingly enough, can unscramble these vibrations and allows us, with some training, to perceive them separately.

There are some remarkable exceptions, when two sounds going through the air at the same time do interfere with each other. Imagine that there are close to each other two similar sources of sound, like the two prongs of a tuning fork. Each separately would send out a certain note of, say, 1,000 vibrations per second; but one is a little farther away from our ear than the other; thus at a given moment, while the wave from one prong tries to push all the air near our ear to one side, at the same instant the wave from the other source pulls that air to the other side—and so the waves from the two prongs always oppose each other at our ear, and no vibration at all is produced there. The two sources interfere with each other.

Sometimes just the opposite effect occurs. If the two sources are correctly placed in front of our ear the two waves arriving there can help each other, and make the resulting sound as big as both separate ones together.

Beat Notes

Another strange thing happens if two sources of sound with slightly different pitch are listened to at the same time. Let us say that one makes 500 vibrations a second, and the other 501. At first both send out waves which help each other and together make big vibrations in our ear; but after half a second the slower first source has fallen behind half a vibration and now the waves oppose each other, because they pull the air at our ear in opposite directions. After another half second the slower source has fallen behind another half vibration; and now the two sources help each other again, pulling the air in the same direction at the same moment.

This goes on, and thus we hear a fading-away of the sound once every second, and a building-up of sound in between. We say that the two sources send out "beats." In our example the frequency of these beats is, of course, one beat per second. But if the difference in pitch between the sources had

been greater, the beat frequency would have been greater also. When beats occur at a rate greater than twenty per second we actually hear the "beat notes" in addition to the two notes that are producing the beats!

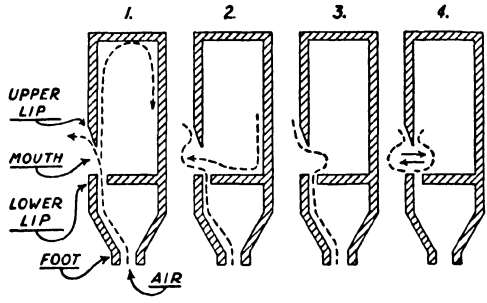
Now you will recognize that there ought to be many, many beat notes when a large orchestra is playing. That is so, but luckily we do not seem to notice any but the strongest beat notes. Depending on our musical training, we tend to find some combinations of notes objectionable, or dissonant, because of the particular beats they produce. But sometimes we depend on beats to produce pleasant combinations of sounds. The nice swelling sound of some bells, for instance, is due to slow beats between two or more notes of slightly different frequencies which a properly constructed bell produces.

Standing Waves

And now we come to a most important subject in sound which is at the same time perhaps the most difficult. You recall that two sounds of the same frequency, going through the air at the same time and in the same direction can, by "interference," cancel each other, or reinforce each other. But what happens if two such sounds go at the same time in *opposite* directions through the same volume of air?

You may have had the experience of standing at a pier and looking down into the stormy sea. Far out at sea you can see the high waves running toward the pier; but if you observe the water close by the pier, the crests of the waves do not travel any more toward the land, but have, so to speak, become stationary. The water quite close to the pier wall is agitated—it moves violently and regularly up and down; but a few feet farther out it is really quite calm, and another few feet beyond that the water is again moving up and down very strongly.

What happens is that traveling waves of a certain wave-length start to go through the water, but are reflected from the pier, and travel back against the stream of new waves. When these two wave trains—the reflected one and the yet unreflected one—meet, the motion of the waves *across* the water cancel out, since they tend to go in opposite directions; and all that the water does is to move up and down in certain regions that are called the *loops* of the resulting stationary wave. These loops are separated by regions which move very little; they are called the "nodes" (from the Latin for knots). And incidentally the distance from one node to the other, or between loops, coincides with half the wave-length of the two traveling waves.



The four diagrams that we show above will give a clear idea of the way in which sounds are produced in a pipe organ. 1. Air passes into the pipe through the foot. Part of this air passes out through the mouth. The rest travels up to the closed end of the pipe, from which it is reflected. 2. The reflected air pushes out the air stream that continues to enter the pipe by way of the foot. 3. As a result, the air inside the upper part of the pipe is rarefied. This causes the air stream coming from the foot to be sucked in. 4. The back-and-forth movement of the air stream is so rapid that it produces sound. The sound will continue as long as air passes from the foot of the pipe to the mouth.

Why should all this interest us in sound? Well, not only water waves, but also waves started in a string or in any other body can be so reflected from the ends that stationary waves are set up which make the body vibrate vigorously in certain regions. That is ideal for acting strongly on the surrounding air which transmits these vibrations as sound! Also, not only water waves or those in strings (which are transverse waves, remember?), but also sound-waves through the air in a pipe or vessel (which are longitudinal waves, successions of compressions and rarefactions) can form stationary waves. And many instruments make use of them.

Take, for example, one of the wind instruments which will all be discussed fully a little later—the organ pipe. The air comes in at the lower entrance, or "foot," is directed through the "flue" and against the sharp "upper lip" in the form of a thin but wide stream. When one blows air into the pipe the first compression travels up into the body of the pipe and is reflected at the closed end; on returning it pushes the air stream out to the left in our drawing. This creates a rarefaction just inside the pipe which travels up the organ pipe, is reflected, pulls back the air stream—and so a back-and-forth vibration of the air stream across the mouth is started which is usually so rapid that an audible sound is produced.

Of course, the length of the organ pipe should determine the pitch of the sound we

hear; if the tube is, for instance, made very long, it will take longer for each compression and rarefaction to be reflected back to the "mouth," and the vibrations of the air stream will be slower; the sound would have a lower pitch.

Now actually this picture is a little too simplified. In fact, soon after the first puff a succession of compressions and rarefactions travel up the pipe and are reflected; they have to travel back against the yet unreflected waves, and consequently stationary waves of sound are set up inside the pipe—just as stationary waves of water may be produced.

Even if the top of the organ pipe had been open, stationary waves would have been produced in the pipe! For even an open end reflects sound-waves (just as sound is reflected at the boundary to more humid or warmer air). The reason is that the air inside an open organ pipe behaves a little differently from the air outside. It is more constrained, less free to expand and contract. And this difference causes some sound to be reflected at the boundary between the two.

Thus stationary waves can be set up in organ pipes with open tops, and also in flutes, in brass instruments like the trumpet, and others. In all these cases, stationary waves have to be produced before sound is sent out; (and the wave-length of the sound we hear is just twice the distance between two successive nodes of those stationary waves).

In all string instruments, too, we actually set up stationary waves—not in the air, but in the string (of course these string waves are the up-and-down variety, transverse waves like water ripples).

Lastly, even in bells, drum diaphragms, cymbals and other bodies, such standing waves are set up on playing, only, of course, they are more complicated than in an air column or a string.

Resonance A scientist, using technical language, might say that a body resonates, or falls into very strong vibrations, if the frequency of a sound that hits it coincides, at least very nearly, with the frequency of the body's own, free vibration. Here is an illustration:

If you try to help a child on a swing to swing back and forth in a wide arc you will give it a little push every time the child just starts to swing away from you. If the swing moves back and forth once a second (we might say its frequency of free vibration is one cycle per second) you, too, will push just once a second; if you pushed more often you might even stop the swinging. For greatest motion your pushing should be timed to coincide in frequency with the swing's vibration—and then even a small effort on your part will result eventuall in a large motion of the swing. We might say the swing is in resonance with your pushes.

Or take this famous example: when a company of soldiers once crossed a bridge in parade step, the bridge started to sway back and forth and finally collapsed. What happened was that the frequency of the soldiers' steps unluckily was just right to set the bridge into resonance, producing swings so large the span broke.

Now sound-waves in air can do just what your hands did with the swing—they can, if they have the right frequency, set into very strong vibration the object on which they fall.

You can make a nice experiment with resonance in sound. By stepping on the right-hand pedal on the piano you can lift all the dampers on the strings inside. Sing a brief and loud note into the piano, and then bring your ear close to it—you will hear those strings resonate that correspond to your note; the piano "answers" you.

Air enclosed in a vessel can be made to resonate quite easily. The sounding box under a tuning fork is so designed that the enclosed air will resonate with the tuning fork itself, thereby increasing its sound output. Or, if you hold a big seashell to your ear you will hear a sound that is nothing but a magnification, by resonance of the air in the shell, of all the stray noises in the room.

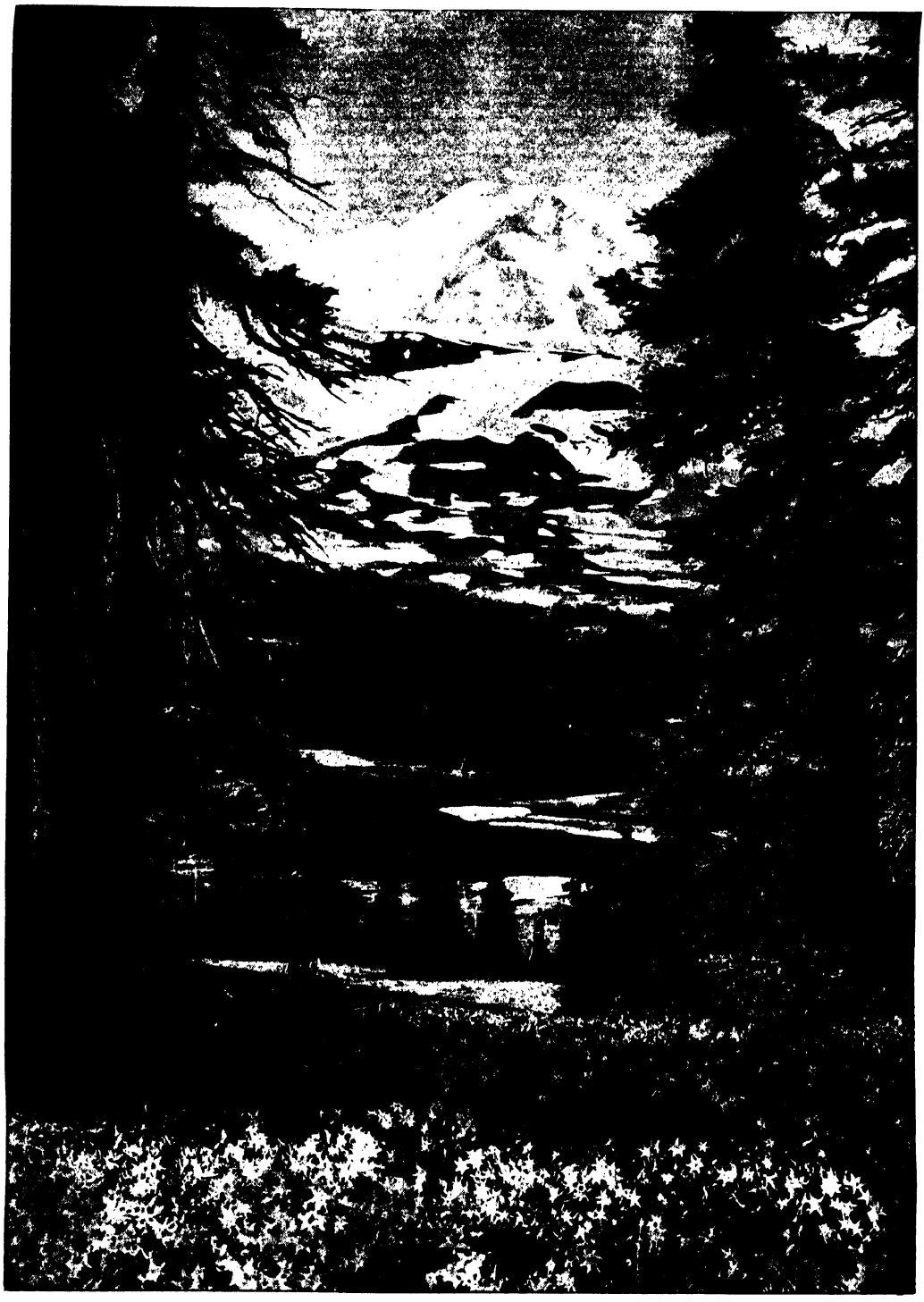
Blowing across the top of a bottle or a panpipe will also produce a note by resonance of the air enclosed. Lord Rayleigh, a British scientist who contributed very much to the study of sound, found that blind persons could judge the size of a room by its resonance to stray noises.

One of the most amazing applications of resonance is our own voice. Our vocal chords are short pieces of muscle in the region of the Adam's apple, which can be made to vibrate by the passing breath. By moving the tongue, jaw and cheeks we can change the shape of the mouth cavities so that they respond, by resonance, to various overtones of the vibrations of the vocal chords. This allows us to change the quality and, in part, the pitch of our voice.

By GERALD J. HOLTON.

THE NEXT STORY OF SCIENCE IS ON PAGE 3631.

A PICTURE OF NATURE'S FRAMING



Rainier National Park is about one hundred miles south of Seattle. It contains many beautiful woods and lakes. Its greatest feature is Mount Rainier (or Mount Tacoma) an extinct volcano, 14,408 feet high, crowned with a snowy glacier. There are two craters which still sometimes give off sulphurous fumes.

ONE NATION, INDIVISIBLE—PART II

IN one story in Volume Eight we told of recent events, and then went on to describe some of the things which our country produces. We spoke of what we may call the vegetable products. Now let us go on to speak of the animal and mineral products. We shall also tell what we make of all their products.

Philip Gendreau, N. Y.

The United States is a great manufacturing nation and exports machinery and other products to many other countries. Above, a scene in New York Harbor.

First let us speak of the animals. You have roast beef or steak for dinner sometimes, and you know the animal that furnishes it. Perhaps, if you live in the country or in a small town, you have a cow or several cows in the barn, and you know that farmers raise cattle for the butcher. But where does all the meat for the great cities come from?

You have perhaps read of the great cattle ranches of the West. There were many of them a few years ago which included thousands of acres. In other sections were millions of acres of government land over which cattle ranged, living out-of-doors all winter.

As the population has increased, much of this land has been needed for farms, and the great ranches are being broken up. So, many cattle can no longer get their living by grazing all the year, but must be fed a part of the time. Though the population of the United States increases every year, the number of cattle increases very little or not at all. Beef is becoming higher in price, and it is not likely to be much lower. Texas has the greatest number of cattle, and Iowa is next.

Nevertheless, the United States is still a great beef-producing country. We send a few thousand animals to Europe alive, though not so many as we did years ago. In some of the Western cities are packing houses, where the animals are slaughtered and prepared for market. The meat is stored in cold rooms, and is carried in cold cars all over the United States, and may be put in cold rooms on ships and sent to many parts of the world. Many million pounds are also sent in cans.

The humble hog furnishes a larger value than any other animal. Hogs are raised everywhere in the United States, but the largest number may be found in the Mississippi Valley, which also produces the most corn. Iowa raises the largest number, with Illinois and Indiana next. Our country stands at the head of the producers of pork and pork products.

In nearly every state sheep are raised, both for food and for their wool, but the greatest number are in western states, as Texas and California, though several other states have almost as many. In the production of wool we rank second, producing about one-eighth of the world supply. Australia is first, the Argentine Republic third, and Soviet Russia and the Union of South Africa contend for fourth place. We can not send any wool abroad but must buy in great quantities in order to get enough to clothe our people.

You would hardly believe that poultry and eggs are among the most valuable products of our country. Yet it is estimated that two hundred eggs are used in this country every year for every man, woman and child. Together poultry and eggs are worth hundreds

of millions of dollars every year. The prices change so often that it is difficult to say exactly how much. Iowa, Texas and Missouri are the leading states. We produce just about enough for ourselves, but do send some eggs away.

The same is true of butter and cheese, though we do send away some butter and more cheese. The value of these two articles is well over half a billion dollars a year. Of course, the value of the milk sold in our towns and cities is many millions more. Some of this, you know, is put into cans and sent abroad. Honey and wax are also important farm products, worth millions annually. California and Texas are leading states, as is New York with its many farms.

Fattening lambs on alfalfa, in Arizona.

While the sea is not precisely the United States, yet the food gotten from the water is a part of our national wealth. The value of the fish caught by our fishermen is about one-eighth of that of the whole world, and we send away great quantities of canned fish, especially salmon, which are nowhere else so plentiful as on the western coast of North America. We produce more than four-fifths of all the oysters eaten in the world, and no other oysters are so good.

In order to be certain that the fish will not be caught faster than there are new ones to take their places, the government has built fish-hatcheries at many different places. Here the eggs are hatched, and after the little fish are large enough to take care of themselves they are turned loose in the streams and in the sea. You have already learned that some fish eat the eggs of other fish.

We also raise more horses and mules than we need, and these are sent to Europe and even to Africa and Asia. The mule eats less than a horse and will keep strong on coarse, rough food on which a horse would starve.

Now we come to the third great class of products, which belongs to the mineral kingdom. In minerals the United States is very rich. In fact, the value of our production is almost equal to that of all the rest of the world put together, though this will not be true when the great stores of Russia, China and Canada are really opened. Mineral products are divided into metals and non-metals.

The most valuable of all our metals, both in usefulness and in money, is iron. Our country generally furnishes about one-third of the iron of the world, and about a third of the steel, which is made from iron. We shall tell you more of how iron is gotten from the ore and how it is then turned into steel. Pennsylvania, Minnesota, Michigan and Alabama furnish most of the iron ore, though some is found in twenty-five states.

Pictures, Extension Service, U. S. Dept. of Agriculture

The United States leads the world in pork production.

Next in value to iron is copper, and of this we furnish about a third of the world's supply. Copper is used for many things, but perhaps the most important use is as a conductor of

Courtesy, National Dairy Council
In a great cheese factory. Blocks of curd are being turned. This step is called cheddaring.

electricity. Nearly all the wires you see over which electricity passes are of copper, and it is also used in electrical machines. It is necessary in making weapons of war. Much of it is also used to cover wooden ships, as it is strong for its weight and the water does not affect it very much. Arizona, Michigan, Montana and Utah furnish the most.

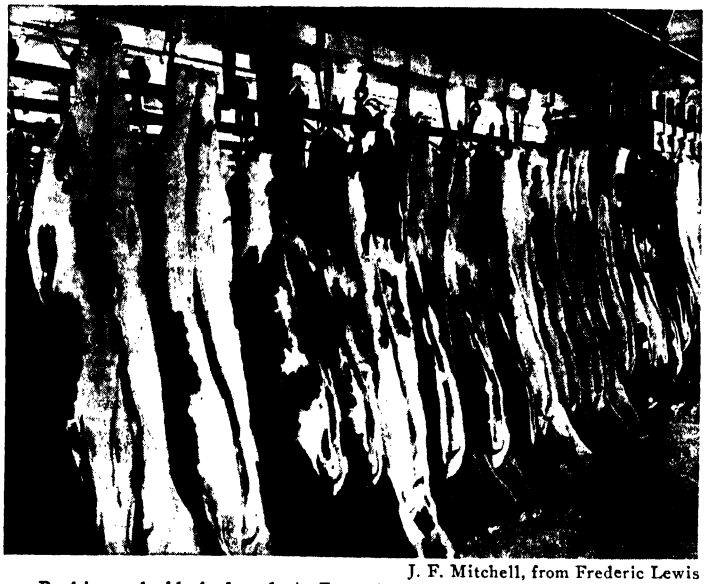
Next in value is gold, of which we furnish about one-eighth of all mined in the world. Our country stands fourth in gold production. South Africa is first. California, South Dakota and Alaska lead, and with Colorado, Utah and Arizona supply over two-thirds of all we produce. Some gold is obtained in about twenty-five states.

The next two metals are almost equal in total value and are often found together. These are silver and lead, but in most years the silver is worth a little more than the lead. Generally we produce about one-fourth of the silver of the world, which puts us in second place, with Mexico first. Utah, Idaho, Montana, Arizona, Colorado and Nevada lead in the production of this beautiful metal, which has so many uses you can name. Canada also produces much silver.

Lead is used for many purposes, both pure and when mixed with some other metals. Water pipes and tanks, electric batteries and bullets are all made of lead. When mixed with tin it makes solder, with which the plumber stops the leak in the pipes; mixed with another metal called antimony it forms the type metal from which this book is printed. We produce more than any other country—nearly one-fifth of the yearly supply. Canada, the German states and Mexico also furnish large quantities of this metal. In our country Oklahoma, Missouri, Idaho and Utah are the leading states.

Zinc is used to cover iron to prevent it from rusting, making what is called galvanized iron. Mixed with copper, it makes brass, which is very useful. Much is also used in the manufacture of paint, in electric batteries and in dyeing. We produce about one-third of the world's supply.

You have seen the white metal something like silver but much lighter in weight, called aluminum. This metal is never found pure, but it is one of the most abundant elements in the earth's crust. Most clays contain it, and in combination with other substances it forms beautiful gems in the earth. An Amer-



J. F. Mitchell, from Frederic Lewis
Beef is a valuable food product. Texas has the greatest number of cattle.

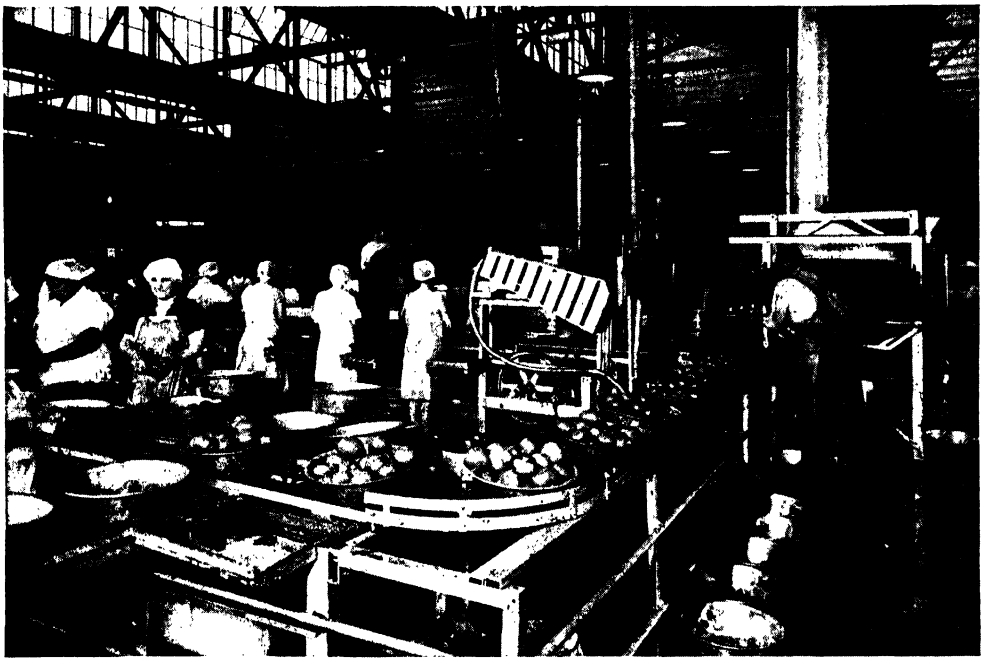
ican discovered a cheap way of separating it from the substances with which it is combined, and now we produce one-fourth of all that is mined. Aluminum is most familiar to us in the form of household utensils, but it is extremely important in the making of airplanes, automobiles, electric cables and some paints.

Another important metal is quicksilver, or mercury, which you see in thermometers and which is also used in making explosives, in medicine and in gold refining. California, Oregon, Texas and Nevada account for most of the mercury that is produced in the United States. Tungsten and molybdenum are two metals which are used to make special alloy steels for machine tools, aircraft and automobiles. Tungsten is also used in radio tubes and electric light bulbs. The United States is well supplied with molybdenum, but considerable tungsten has to be imported.

Many things that are minerals are not metals. The most important of these is coal, of which we produce between one-third and one-half of all that is mined.

Anthracite (hard coal) and bituminous coal (soft coal) are the two most important kinds. Pennsylvania furnishes nearly all the anthracite, though Colorado and New Mexico have a little. Pennsylvania also furnishes more bituminous than any other state, except West Virginia. Illinois ranks third. Coal is mined in thirty states.

Next in value is petroleum, of which we furnish much more than any other country, with Russia second. Besides kerosene, gasoline, lubricating oil, vaseline and paraffin, many other valuable products are obtained from this oil. It is found in Oklahoma, Texas, California, West Virginia, Kansas, Pennsylvania, Ohio and several other states. Along with oil is almost always found natural gas, for which wells are bored just as they are for oil. Many cities and towns in the United States are lighted and warmed by this fuel, which is conveyed by pipes like ordinary gas. In some cities most of the power is furnished by natural gas.



Sacramento, California, Chamber of Commerce

Canning tomatoes in one of the great Western canneries. Tomatoes are a rich source of vitamin C.

Next in value of our minerals is building stone. Some sort is found almost everywhere, and we have some of the best and most beautiful stones in the world. Marble, the limestones, the sandstones and granite are the ones chiefly used, and many different colors and degrees of hardness are to be found among them.

Vermont furnishes more marble than any other state, though Georgia and Tennessee

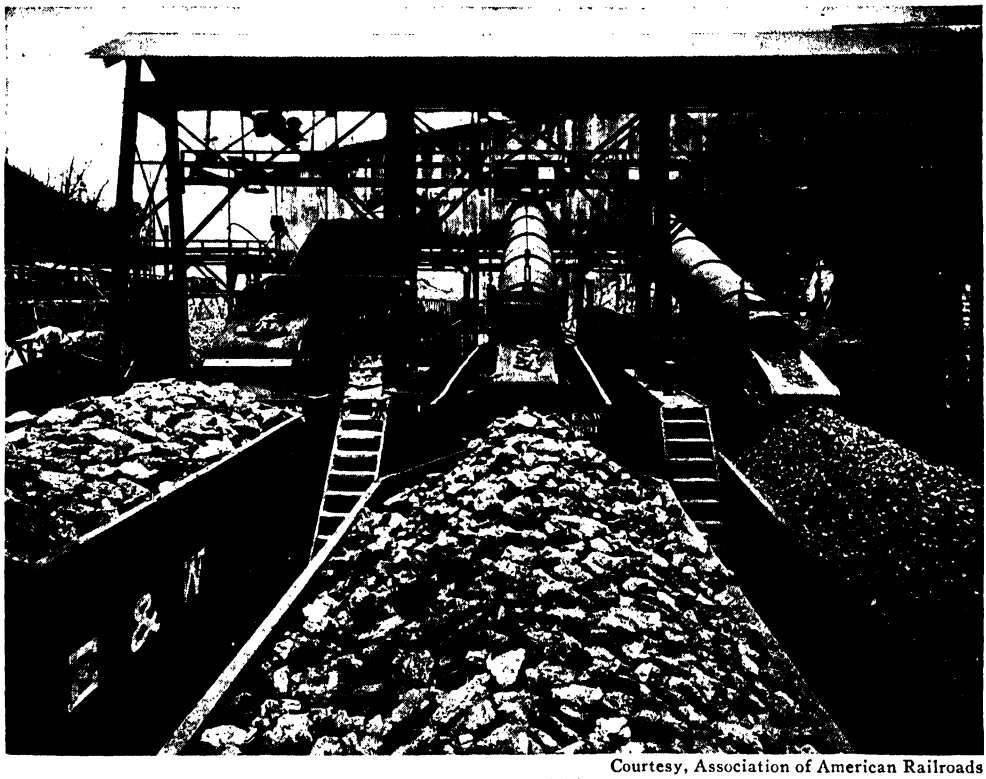
also have much beautiful stone of many colors. Nearly every state has some limestone, but the quarries of Indiana, Illinois and Kentucky are the most noted. Sandstone is found almost everywhere. Many states have quarries of excellent granite, but Vermont, Massachusetts, North Carolina, Wisconsin and New Hampshire furnish most.

Salt is produced all over the world, and though the United States makes more than any other nation, and exports much, we still import some.

Glass is, you know, principally melted sand. No other country makes so much as we do, for nowhere else are there so many people who can afford to buy glassware for their tables and to use so much glass in their windows.

There are dozens of other useful minerals found in the United States. The phosphate rock of Florida and Tennessee, used for fertilizer, is valuable, and so is sulphur. Grindstones are worth many thousands of dollars; borax is valuable; and so is mica, much used for stove windows and other purposes as well. We must not forget the rock from which cement is made, for this grows more valuable every year.

Nature has been kind to our country. No other land has so great a variety of animal, vegetable and mineral products. Yet no modern country can depend upon itself alone. If the United States were shut off from all the rest of the world we should be able to feed, clothe and shelter ourselves, but it would make a great difference in our way of living. We should have to do without many tropical products, especially foods and medicines. We could not mine enough tin, nickel, chromium, vanadium and manganese to make the metal alloys that are needed for so many important industries. We would be short of natural rubber also, though we have learned to make synthetic rubber that serves most of the same purposes.

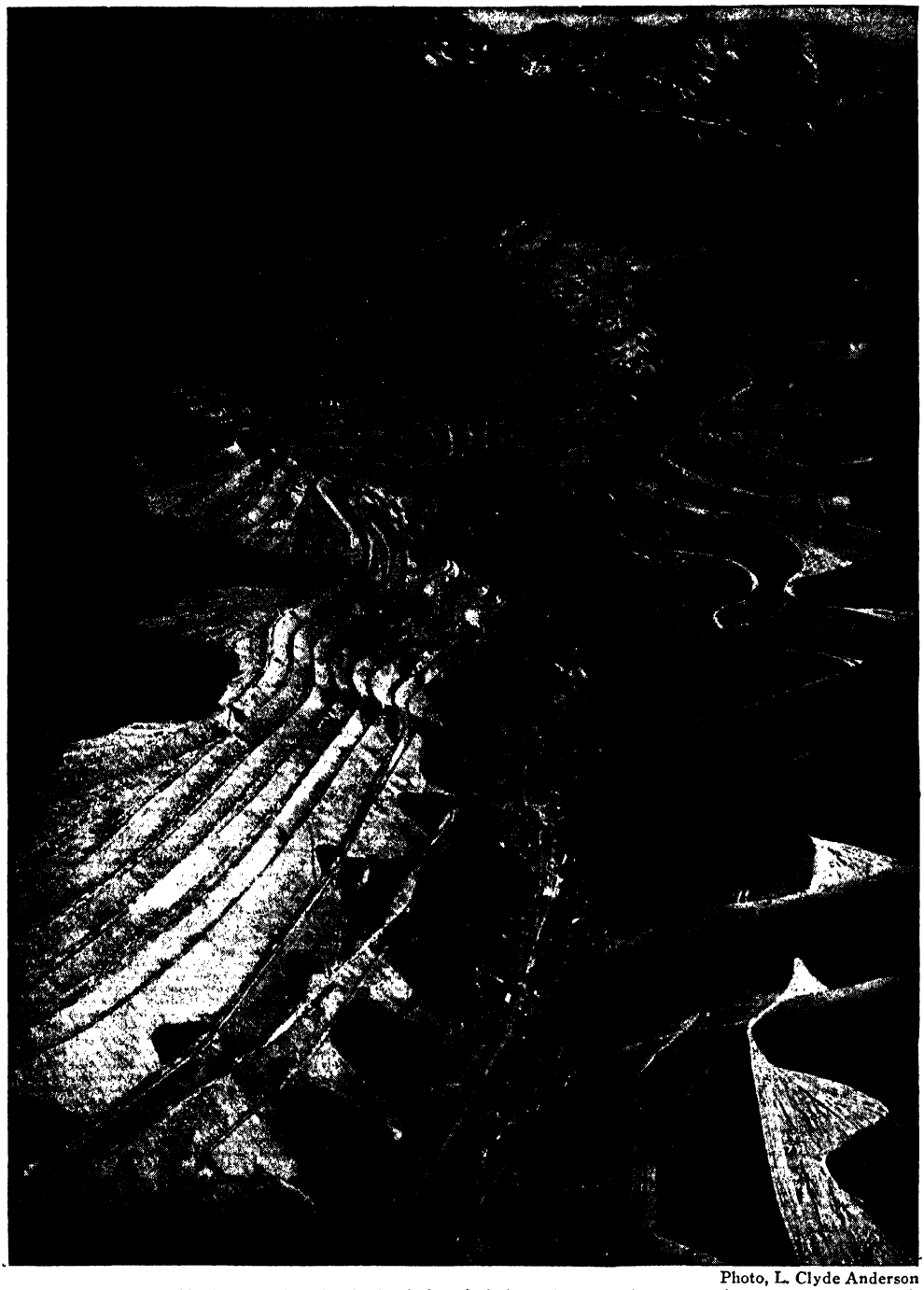


Courtesy, Association of American Railroads

Loading coal for shipment. Our country produces between one-third and one-half of all the coal that is mined.

It is usual to speak of most of the things of which you have been told above as food products and as raw materials for manufacturing. For example, cotton is the raw material and cloth is a finished product. Iron

MINING COPPER IN UTAH



Photo, L. Clyde Anderson

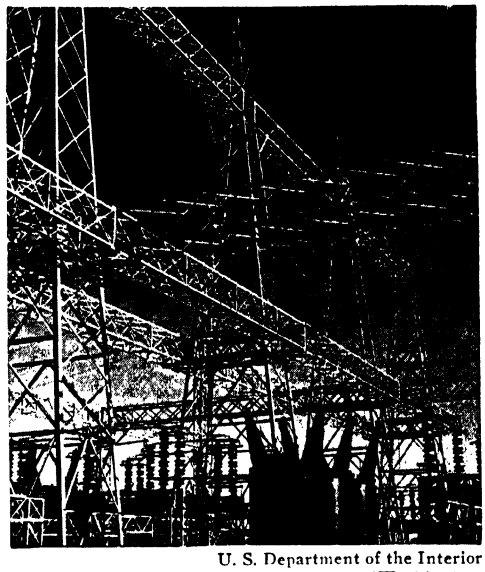
Utah copper mine, at Bingham, Utah. This is North America's largest open-cut copper mine, covering about 650 acres; the height of the mountain above the pit is 1,600 feet. Ore is mined by 29 huge electric shovels, with dippers holding 9 tons of ore. Fifty-eight electric locomotives move the ore along 95 miles of railroad in the mine. The mine has a capacity of about 142,000 tons a day. If the ore loaded in a single day were put on a single freight train, the train would be 21.5 miles long. The United States furnishes almost half the world's supply of copper.

ore is a raw material, steel rails for a railroad are a finished product. You must remember, of course, that the finished product of one factory may be raw material for another. Cloth, for example, is the raw material for a tailor.

The United States has become the greatest manufacturing country in the world, because it has the greatest stock of raw materials and because it has cheap coal and oil, and much water power. You must remember that power is necessary to run machines, and no matter how much raw material a country has, it can not become a manufacturing country unless it can get some sort of power to run its machines, and has also a cheap way of carrying raw material to the factories and of taking away the finished goods.

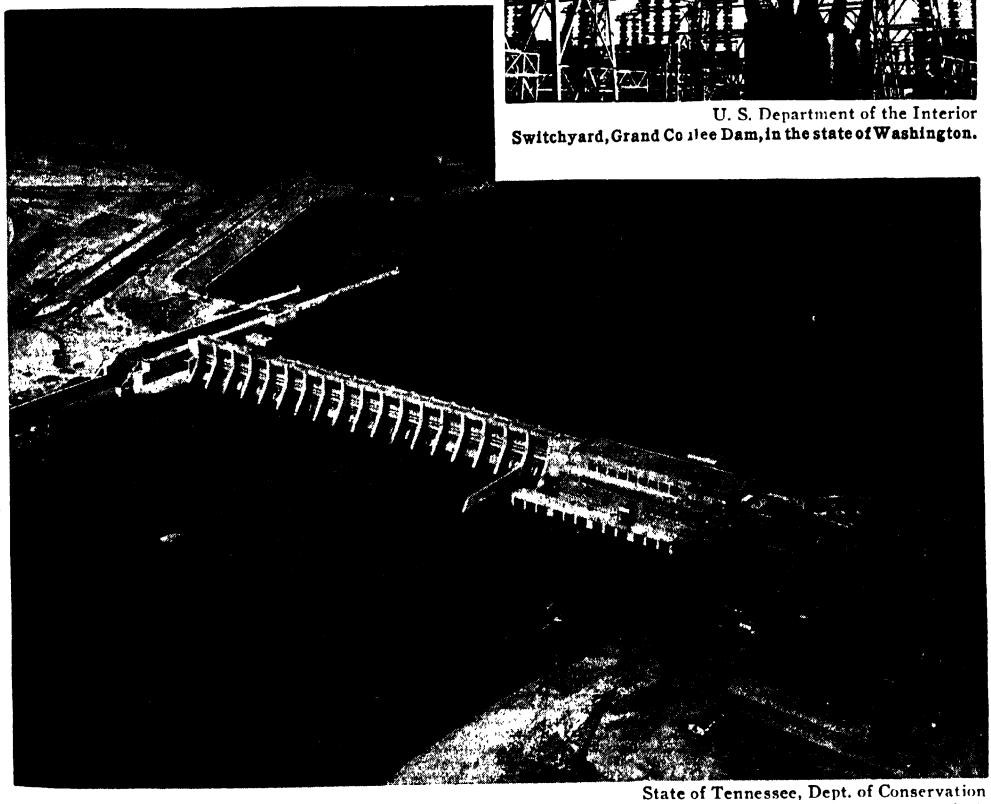
You know that our country has a rich supply of coal; and also that it has many swiftly running streams. These streams are made to furnish power by means of waterwheels. New England has many such streams; that is one reason why manufacturing developed early in that section.

Since 1900 there has been a vast increase in the use of electric power. On many streams great dynamos to develop electric power have been built. The power is then carried by wires twenty, fifty or more miles away to the factories, which have been built where there are railroads to carry the goods or whe e



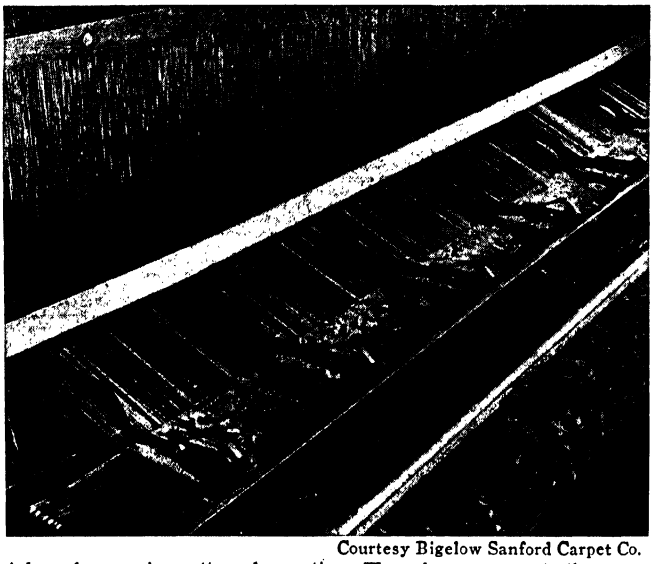
U. S. Department of the Interior

Switchyard, Grand Co ulee Dam, in the state of Washington.



State of Tennessee, Dept. of Conservation

Chickamauga Dam near Chattanooga, a unit of the Tennessee Valley Authority (TVA), a vast water-power project.



Courtesy Bigelow Sanford Carpet Co.

A loom for weaving patterned carpeting. We make more carpets than any other country, and Philadelphia makes more carpets than any other city in the world. Around 30,000 people are employed in carpet-making.

there is a good supply of labor. In many factories, instead of great engines to run the machines, you will see only an innocent-looking wire running into one corner of the building. This wire carries more power than several engines can develop.

Labor and skill add very much to the value of some kinds of raw material. For example, a lump or scoopful of iron ore costs almost nothing. If made into pig iron, it is worth a little more; made into a stove, it is worth still more; made into steel for railway rails, the value increases still more. The same amount of material made into knife-blades is worth a great deal, and then, if made into springs for watches, say, is worth many hundreds of dollars.

A pound of raw cotton costs only a few cents. When made into coarse thread, the value is increased, and when this thread is woven into cloth, the value becomes greater still. Or if the cotton is spun into fine thread and then made into lace, the value may be a thousand times as much as that of the raw cotton.

Some other raw materials are not increased so much in value because not so much labor and skill are spent upon them. A loaf of bread does not cost so much more than the wheat out of which it was made, but even here fine pastry and cakes are sold for much higher prices.

The United States was, at first, as you have been told, almost entirely an agricultural country. Since your grandfathers were born the nation has become the greatest manufacturing country in the world in the value of products.

Of all the manufactures in the country those of the greatest value are the food products. These are flour, meal and meat prepared for use, and similar things. They are important because without them we could not live. Minneapolis is the chief centre of the flour industry, and Chicago of the meat industry.

The next group to be mentioned is that of iron and steel and their products. The chief single item in this group is steel rails for railroads, either steam or electric. We make all our railroads need, and in far-away parts of the world you will find engines running on American rails. Pennsylvania is the chief state in such manufacture.

Much of the steel sent abroad goes in the form of electrical and agricultural machinery. Our country is the chief maker of all sorts of farming machinery, and also of sewing machines and typewriters. Some of the steel goes into the making of ships, though we have not until recently been a great shipbuilding country.

Lumber and timber products are very valuable. A large part of agricultural machinery, tools and implements is made of wood. Much of our paper is made of wood pulp. Furniture must not be forgotten. In fact, the wood products are almost numberless.

A great group of our manufactures is the textiles, which means "that which is woven." We may divide this group into wool, cotton, silk, linen and rayon and nylon. There are other classes made up of a combination of these. Our woolen manufactures are large, but we send very little abroad, as we need most of our production for our own people. In fact, we must buy much raw wool and much cloth also in other countries. Besides cloth there are carpets, stockings and knit underwear, and the like.

We make more knit goods than all of the rest of the world put together, and we make more carpets than any other country. More

knit goods are made in New York State than in any other, while in carpets Philadelphia holds first place. Taking all kinds of woolen goods together, Massachusetts is the first state.

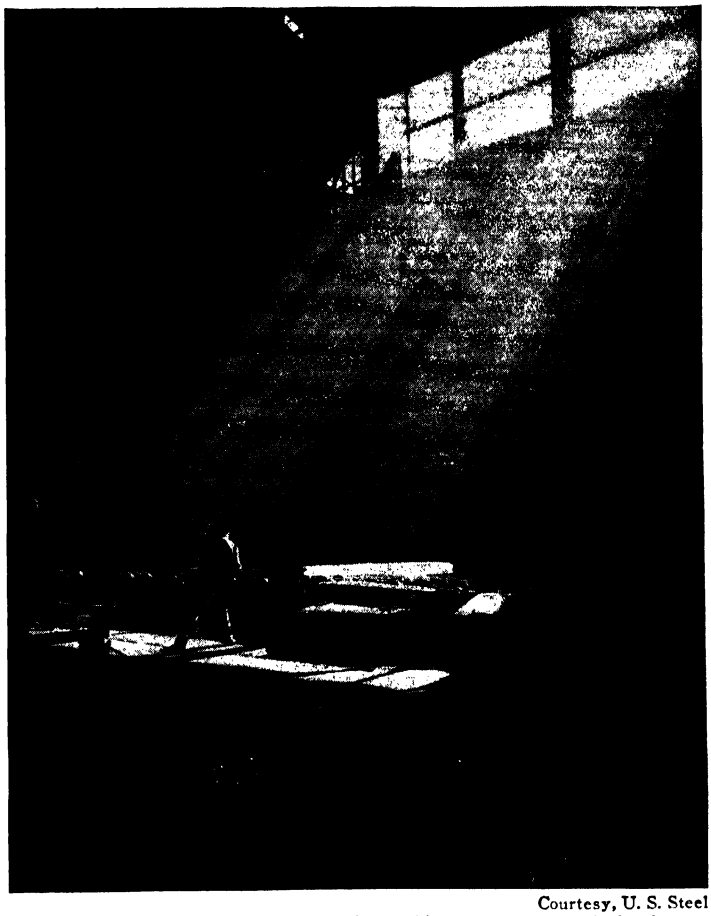
We manufacture much cotton goods, though we use only about one-half our crop of the raw cotton. This industry is almost entirely confined to the Atlantic states. The first cotton mill was built in Massachusetts about 1790, and for many years nearly all the mills were in New England. Since about the year 1880 the number of mills in the South has been increasing, and now there are hundreds of mills in the southern states and they use more cotton than the northern.

Massachusetts was formerly the leading state but several states have now passed her. North Carolina, South Carolina and Georgia stand first. Alabama and Massachusetts come next in most years. We send much cotton cloth to other countries, and may some day manufacture more.

Our country once used one-half of the raw silk of the world, but still we did not manufacture all we needed. Nearly all the raw silk used was imported. Though many attempts to raise silkworms in this country were made for nearly two hundred years, they were not very successful. No other country used so much silk as the United States, because no other people could afford to buy so much. The leading state in silk manufacture was New Jersey, with Pennsylvania next. The city of Paterson, in New Jersey, was one of the chief silk-manufacturing cities in the world. Today silk has been replaced to a large extent by synthetic fibers and textiles, such as rayon and nylon.

Though we grow very little flax for spinning, we bring in a great deal to be woven into cloth. The best linens are not made in the United States, however, but we make a great deal of linen crash for towels, besides much linen thread. Ireland, Holland and France are the great linen countries.

High in value is the group known as chemicals, drugs and dyes. This includes fertilizers of many kinds, which furnish food for plant life. They are made from such things as phosphate rock, ground bones, potash, cottonseed meal, and the refuse from slaughterhouses and fisheries. Medicines are made from our native plants or from plants imported from other countries and from minerals; and many kinds of dyes are also made. We have already told you that the cottonseed was once thrown away. Around gas works and oil refineries thirty years ago there was such a great quantity of a sort of



Courtesy, U. S. Steel

Dramatic scene in a steel mill. Iron, from which steel is made, is by far our most valuable metal. Some iron is found in twenty-five states.

tar left after the gas and oils had been taken out, that it was in the way. Chemists found in this ugly black substance more hidden treasures. Some of the most valuable medicines used by our doctors are now gotten from it, as well as brilliant dyes and a number of other useful chemical products. The value of this tar, once considered waste material, is many millions of dollars.

The next major group of our manufactures to be considered is paper and printing. When you think of the number of newspapers, magazines and books, the amount of wrapping paper used by the butcher, the grocer and other tradesmen, to say nothing of the number of paper bags used every year, you can easily see how it happens that the value is so great. Then, also, there is paper for writing, and there are hundreds of other uses for paper, of which you have probably never heard. Most paper is made wholly or partly of wood pulp. The finest paper is made from linen rags, but many other fibres are used. The United States produces as much paper as all the rest of the world.

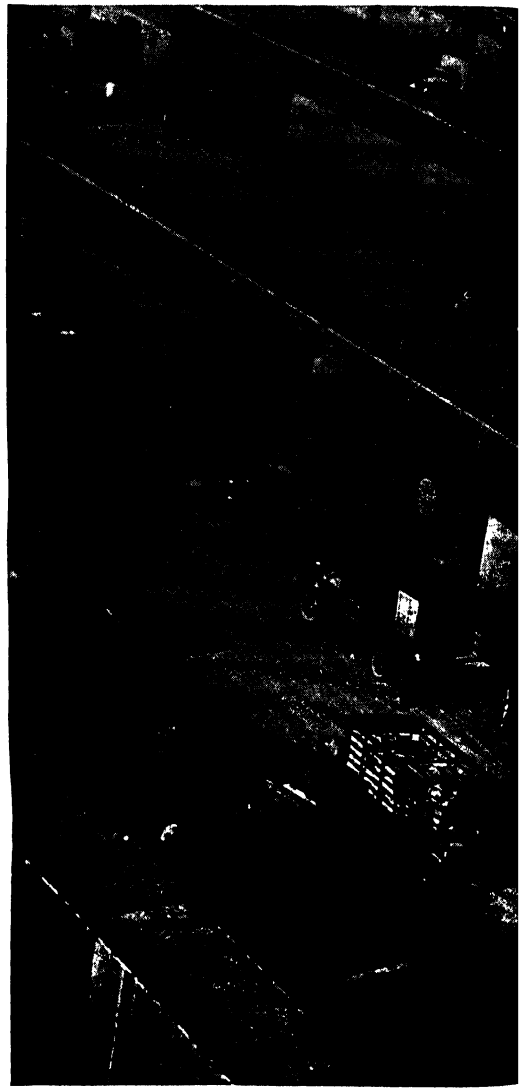
Now we come to leather, as the prepared skins of animals are called. When the skin is removed, it soon becomes dry and hard—so hard that it can not be used for shoes or other purposes. So it must go through many processes to make it soft. We tell how this is done elsewhere. The chief animals whose skins are used are cattle, sheep, hogs, goats and horses. We make very little horse or goat leather in this country. In all, we make about 40 per cent of the world's leather, and use up not only the skins of animals obtained in this country, but many from abroad.

The number of carriages, wagons, sleds and sleighs used to be very large, but after 1900, declined rapidly, while the manufacture of automobiles has correspondingly increased and is now one of our great industries. Motor vehicles amounting in value to more than three billion dollars are manufactured in most years. Hundreds of millions of dollars' worth are exported. Tobacco, too, sells for many millions of dollars. We grow about one-third of the world's crop, and export much.

There are many other things manufactured in this country. Nearly every little town in the states east of the Mississippi has one or more mills or factories of some sort, and there are many in the states west of the great river.

We learn some curious things if we study the long columns of figures that are sent out from the Census Office in Washington. We find that New York State makes ninety-nine out of every hundred collars and cuffs made in this country; that Connecticut makes about three-fourths of the watches and clocks and 65 per cent of the needles and pins.

Massachusetts makes over half of the boots and shoes, while New York is the centre of the clothing industry, for both men and women. This state made almost nine times as much clothing for women and almost three times as much for men as any other state, when the last census was taken. Michigan leads all other states in making



Freight yards in Philadelphia where long trainloads

motor cars. Sometimes a state leads because of nearness to the raw material used in an industry. Sometimes the reason seems to be that the first factories built in the state were successful and other men were encouraged to build. Factories were built in New England years ago because there was so much power furnished by the streams.

Now, when we learn that a country does much manufacturing, we know that it must have easy ways of getting raw materials and of sending away what its factories make. In Holland, you were told, more goods are carried by canal boat than by railway. In many other countries a very large part of all the freight is carried by river or canal.

Though the United States has many rivers, not very much use is made of them, as the railroad is quicker. Many canals were dug before the Civil War, but some of them hav been allowed to fall into disuse or fill up. Some have been dug recently. Several important canals are in operation, however. The most important is the Erie Canal, of which we have spoken elsewhere, and the Lake Washington Canal at Seattle. About

Courtesy, Pennsylvania Railroad

of food for the great city are brought each day. Feeding the millions in our cities is a major industry.

Harold M. Lambert, from Frederic Lewis

Smoke pouring from tall factory and mill chimneys may usually be taken as a sign of prosperity; most of our cities and large towns depend upon manufacturing for part of their income.

one-quarter of all the miles of railroad in the world are in the United States. The number of miles is about 235,000.

Some railway systems include thousands of miles of track under one management. You can go from New York to New Orleans without changing cars. The passenger cars on these trains have every convenience, and one can go from New York to San Francisco in less time and with less fatigue than the journey from New York to Boston required a hundred years ago. No other people travel so much. If all the distances traveled by passengers in the United States were divided equally, it would amount to a journey of about one hundred and sixty miles a year for every one of us.

The railways formerly used steam locomotives exclusively, but some are turning to electricity. In the story of the train we show you some great electric locomotives. There are many light railways which use motors built into the cars, like the street cars or like the elevated or underground railways in our cities. In some parts of the country electric railroads connect the cities and small towns, and electric locomotives also pull freight trains.

For most of the time in the United States there has been more work than there have been workers. In the earliest days, when land was free to all, few people would work on the farms of others when with a little trouble they could get farms of their own. After the Revolution all the unoccupied land became the property of the government.

This land was first sold at a very low price to settlers, and later the government gave a farm of 160 acres to everyone who would work it. Many millions of acres were given away, and now there are fertile farms and thriving towns and cities where there were no inhabitants not so many years ago. The free land is not quite all gone yet.

Most of the government land remaining, however, is not suitable for farming. Some of it is rough mountains and hills, but some of it would bear good crops if there were more rain. In some sections there is rain or snow in the winter and streams fed by melting snow in the spring. Therefore great dams have been built to catch this water, which would be wasted, and save it for times of need. In the western states millions of acres of desert have been made fruitful by means of the precious water. In other places deep wells have been sunk.

Now, what of the people of our country? You were told in our Second Volume that, besides the English, some Scotch, Irish, French, Germans, Swiss and Swedes came to this country before the Revolution. For a time after the Revolution very few foreigners came, but after 1830 the number became larger, but not so many as one hundred thousand came any year until 1842. Until 1860 nearly all who came were from Great Britain, Ireland and Germany. After the Civil War the number of immigrants increased very greatly. Not so many came from Great Britain, Ireland, Germany, Norway and Sweden or any other countries of northern Europe. Many came from Canada before 1895, but fewer come now.

After about 1890 immigrants began to come in greater numbers from central or southern Europe, and from Asia. Russia, Austria-Hungary and Italy furnished the largest numbers. Some came to escape per-

SHIPBUILDING IN WORLD WAR II

Courtesy, U. S. Steel

During World War II, American shipbuilders built many steel ships by a method called prefabrication (making before). Various sections of the ship were made at the same time in different parts of the shipyard; when finished, they were assembled and welded together in the yard. The picture shows a bow for a transport vessel being brought to the place of assembly. This method saved time but was not altogether satisfactory. Today American shipbuilders no longer prefabricate and assemble ships in the same yard. In some cases, however, prefabricated ship parts are loaded on barges and shipped to the places where they will be assembled.

secution, some to improve their condition, some to avoid military service. Some came intending to spend their lives, while others expected to work a little while, save their money and go back to their native land. Most of them came first to New York, and as they entered the harbor, one of the first things they saw was the great Statue of Liberty with her torch upraised.

They were of many races and spoke many different languages. They had not been used to free government, and many of them were very poor. They were willing to work, however, and to do the kinds of hard and dirty work which the native-born American did not like to do.

CHILDREN OF IMMIGRANTS HAVE RISEN TO POSITIONS OF DIGNITY AND POWER

Their children went to the public schools, learned to speak English, and many of them went to high school and college. In New York City are many important merchants and manufacturers who came to this country poor immigrant boys.

Some well-known doctors and lawyers are the sons of parents who never learned to speak English well. In Europe they would not have had the opportunity to become educated, but would have been compelled to remain laborers for small wages all their lives. This country allows every boy or girl to rise as high as his or her ability and industry will permit.

THE NEW LAWS WHICH SET LIMITS TO FURTHER IMMIGRATION

For many years some observers of American life had been saying that immigrants were coming in greater numbers than could be quickly Americanized. After the first World War it seemed that all Europe wished to come to the United States. Congress passed an act in 1921 which limited immigration to 3 per cent a year of the number of foreign-born living in the United States in 1910. For example, in 1910 there were a little more than 120,000 natives of the Netherlands living in the United States. Three per cent of this number is a little more than 3,600, and this is the number of Dutch who were allowed to come to the United States in a year. The same sort of calculation was made for every other nation. In 1924 the percentage was lowered to two, and the census of 1890 was taken as a basis. In 1929 another complicated law went into effect which fixed the number (quota) allowed to enter at about 153,000 a year divided among the nations in proportion to the number of that nationality already in the country, but citizens of Canada, Central and South America may come in freely. The yellow races were not admitted at all, but in 1943 Chinese were included among those permitted to enter according to quota.

MUCH OF OUR GREATNESS IS DUE TO OUR BELIEF IN EDUCATION

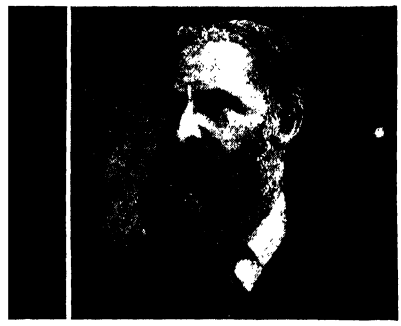
You have learned something of what the American has done in the past in the History of Our Land. In other parts of our book we tell you of the famous writers, inventors, painters and sculptors. But no mention of America is complete without speaking of the American's belief in education. No other country spends so much money on its schools. In every state of the Union, public schools are free for every child, and most states offer a high school besides. Some states, and even a few cities, support free colleges and universities for their young men and young women.

Where the colleges and universities are not supported by the state, rich men have given many millions of dollars for buildings and to pay the salaries of the professors. These wonderful gifts astonish the European, for nowhere else have men of wealth been so liberal. They have also given large sums to establish public libraries, build art galleries and museums, and to found institutions to study scientific and social subjects.

As I read over this story I fear that it sounds boastful. Perhaps it is, for I have preferred to tell you of the things in which our country has been most successful—farming, raising of livestock, manufacturing, transportation. But there are certain other things of which we can not be so proud. In obedience to the law and respect for the rights of our neighbors, other nations surpass us. Our politics are not always clean. We can only hope that as the years go on we shall improve, and every one of us will do his part to make our country a better place in which to live.

Someone has called America the "melting-pot of the world." By this he meant that in our country people of different races, different languages, different religions and different ideas of life are living here together, and out of all the confusion will some day come the future American. Just what he will be like no one can say. He is certain to be unlike the American of the earlier days.

THE NEXT STORY OF THE UNITED STATES IS ON PAGE 3357.



Edward Gibbon wrote of Rome's history; David Hume, of England's; and Sir James Bryce, of American democracy.

THE ENGLISH HISTORIANS

THE earliest British histories were written during the Middle Ages, by priests or monks. In the shelter of their churches and monasteries they could find peace and time for the study of the past. Books to consult were scarce, but they filled out the gaps in their knowledge by listening to the conversation of travelers and by gathering tales which had passed down from father to son for countless generations.

Three great historians of those early days were Baeda, or the Venerable Bede, as he was called, Geoffrey of Monmouth, and Laweman, or Layamon. Baeda lived about 673 to 735. He wrote in Latin. He described the history of the English people from the time Julius Caesar invaded the land down to 731, the year in which Bede probably finished the book. Although he tried to be accurate, neither he nor Geoffrey nor Layamon can be relied on today for factual truth. They often brought into their "histories" legends and myths.

We are fortunate, however, that they did so, for otherwise many fascinating stories would have been lost to us. Geoffrey included in his HISTORY OF THE BRITISH KINGS, for instance, a long account of Brut, mythical founder of the British race. According to Geoffrey, this Brut, or Brutus, was a descendant of the kings of Troy, who fled to England after killing his father. He found England uninhabited "except for a few giants," and founded a New Troy, which became the city of London. Among his descendants, Geoffrey wrote, were Cole (Old King Cole), King Arthur, and King Lear and Cymbeline, who were later put into plays by Shakespeare. Although modern historians think that none of these kings may have existed, their stories are rich additions to English literature.

Geoffrey of Monmouth was a Welshman, who lived about 1110 to 1154. Like Baeda, he wrote in Latin. Most of Geoffrey's history was rewritten into English verse by Laweman, a poet-priest who was almost a century younger than Geoffrey. The dates of his birth and death are not known. Laweman's story of Brut, in which elves and fairies move about as freely as real people, is interesting reading today.

Another medieval history, said to have been launched with the help of King Arthur, took three hundred years to write. This was the ANGLO-SAXON CHRONICLE, an account of events in England, by years, from Caesar's invasion down to the crowning of Henry II in 1154. Hundreds of monks in many different monasteries carried the chronicle along. Most of the entries are brief, dry summaries of the principal events of a year. But not all of them are dull. The entry for the year 937 includes a stirring Anglo-Saxon poem, THE BATTLE OF BRUNANBURH, about a fight betwen the West Saxons and invading Scots and Norsemen.

When the flood of new learning, the Renaissance, glowed across Europe between 1300 and 1600, most people looked back with scorn upon the Middle Ages, as upon a barbarous period not worth studying. A few chroniclers continued or translated the work of the medieval monks, among them Raphael Holinshed (?-1580) and John Stow (1525-1605). But the world was changing. The Renaissance had planted a new idea of history in the minds of Englishmen. Walter

Raleigh (1552-1618) expressed it when he wrote that history should "teach by example of times past such wisdom as may guide our desires and actions." Sir Walter set out to write a HISTORY OF THE WORLD, while he was in prison, but he got only as far as 130 B.C. He did not carry out his purpose very well, and he spent time on such matters as the location of the Garden of Eden.

The half-century after Raleigh's death in 1618 saw England embroiled in a bloody Civil War. Many Englishmen have since written histories of this important period, but only one man wrote history of any standing during the period itself. England for 150 years afterward took its view of the war from that one man's writing.

WHAT THE EARL OF CLARENDEN WROTE ABOUT ENGLAND'S CIVIL WAR

He was Edward, Earl of Clarenden (1608-74), a follower of King Charles I. When the war broke out, he fought for his king, and fled into exile with the king's son when Charles was captured, tried and executed by Oliver Cromwell. Clarenden hated Cromwell and his followers. He wrote a HISTORY OF THE REBELLION in part as a record of the mistakes which had lost the royal cause. "Correct these mistakes," he said, "and the kingdom of England can be regained for the Stuarts." The monarchy was restored before the history was published. Clarenden's book helped to blacken the memory of Cromwell for most Englishmen until the nineteenth century, when another historian, Thomas Carlyle, retold the story from a new point of view.

Clarenden's account of the Civil War reads in places like a romance. The writer had fought and fled, he had hidden in forests and sailed as a fugitive over the English Channel to France. He was able to put all the excitement and suspense into his account, and it remains, in spite of its one-sided point of view, a work of literature still enjoyable.

England took back her Stuart kings in 1660; but she threw them out a second time in 1685, and asked William of Orange, a Dutch prince whose mother was a Stuart, to rule England. He consented, and England soon settled down to a long period of internal peace. This period saw two developments which greatly affected the writing of history. One was a new interest in collecting information, in finding out facts. The British Museum was founded in 1753, and the first edition of the ENCYCLOPEDIA BRITANNICA appeared between 1768 and 1771. This new spirit in scholarship naturally spread to the study of the past. Historians began to search more carefully for the truth.

The other development of importance was the great increase in reading and writing. For the first time authorship became a money-making occupation. Few historians from Bede to Clarenden ever dreamed of gaining much from their exertions. Now there were plenty of eager readers.

Inspired partly by the hope of profits, a number of writers turned out "complete" histories of Britain and of the world, which are worthless from modern standards. Among those who tried a hand at these were the novelists Tobias Smollet and Oliver Goldsmith. They should have stuck to their novels. One man, David Hume (1711-76), moved out of his proper occupation to write a more worthy history. Hume was a philosopher, and became a historian by accident. After trying without success to secure a position as teacher of philosophy at Edinburgh and Glasgow universities, he finally became a librarian at Edinburgh. With plenty of historical source books now at hand, he decided to write a history of England. The first volume caused no stir when it was published, and Hume, bitterly disappointed, planned to go to France, change his name and try to forget his ambitions and failure. But war broke out between England and France (the French and Indian War in America), and he could not get to France. He went ahead with his second volume, therefore—and this was a success.

GIBBON'S STIRRING HISTORY OF THE ROMAN EMPIRE

Philosophy gives its disciples a broad and understanding view of life. Hume's history, therefore, stood head and shoulders above those of Smollet, Goldsmith and other minor historical writers of his time. But towering high above them all, and perhaps above all histories in the English language, is the mammoth work of Edward Gibbon, THE DECLINE AND FALL OF THE ROMAN EMPIRE. Gibbon spent sixteen years on this work. It covers a period of 1,300 years, from the age of the Roman Emperor Trajan to the capture of Constantinople by the Turks in 1453. Grandly conceived, and written from beginning to end with the stately dignity of an organ march, it is perhaps the most ambitious literary achievement of any single man.

Gibbon was born in 1737, in Putney, now a part of London. Born a Protestant, he

became a Catholic and then changed back to Protestantism, finally becoming indifferent to religion. He allowed his father to persuade or bully him into giving up the girl he loved (she later became Madame Necker, wife of a famous European banker and mother of the equally famous writer, Madame de Staël). He served four years as a soldier.

THE MAGICAL HOUR THAT GAVE GIBBON THE IDEA OF WRITING HIS HISTORY

After half a lifetime of fumbling and small failures came the turning point in Gibbon's career. He was visiting Rome in 1764, and had just spent a day looking over the ruined grandeur of that greatest of ancient cities. Years later he wrote down the incident in his MEMOIRS: "I must not forget the day, the hour, the most interesting in my literary life. It was on the 15th of October, in the gloom of evening, as I sat musing in the Capitol, while the barefooted friars were chanting their litanies in the temple of Jupiter, that I conceived the first thought of my history."

From that moment onward Gibbon's life took on new force and purpose. His previous disappointments and failures seemed now to contribute to the success of his mighty task. He gave to his history all his time and enthusiasm and devotion. Even the failures of his past years were brought to serve the great work. He noted that his knowledge of military affairs gained in the army had "not been useless to the historian of the Roman Empire." And he described Parliament, in which he served a few years, as a "school of civil prudence, the first and most essential virtue of a historian." Gibbon poured out his life as if it were an offering to his gigantic task. He died six years after the work was finished.

Gibbon's work made such a tremendous impression that few histories of independent and individual merit appeared for more than a generation. The next brilliant and memorable historian was, in part, a disciple of Gibbon. This was Thomas Babington Macaulay. Except for his balanced, rhetorical style, and the fact that he also never married, Macaulay was the opposite of Gibbon. Born in 1800, he had written a COMPENDIUM OF UNIVERSAL HISTORY and a long verse romance before he was eight. At college he made a remarkable record as a writer and debater, and at the age of twenty-five he wrote an essay on Milton which made him famous throughout England. At thirty he entered Parliament, and four years later he was sent to India as legal adviser to the Supreme Council. Though he was there only four years, his work laid the foundations of the Indian educational system and codes of criminal law. He returned to England in 1838, and served in Parliament continuously until 1847.

During most of his political and legal career Macaulay continued to write the historical and critical essays upon which much of his fame rests. These generally began in the form of book reviews, but would soon branch off into an independent study of the subject which far outreached the work of the author he was reviewing.

MACAULAY'S FINE HISTORY THAT "WORKING MEN CAN UNDERSTAND"

Macaulay has often been criticized for bias, shallowness and lack of true wisdom. But his flashing, exciting style made up for his shortcomings as a discerning student in the eyes of his readers. His most ambitious work was a long and detailed HISTORY OF ENGLAND. In 1848, after the first and second volumes had appeared, Macaulay received a vote of thanks from a workingmen's club for "having written a history which working men can understand." The history was never finished and covers only a very few years of the last part of the seventeenth century. But it was perhaps the most popular single work to appear in England during the nineteenth century. In one year Macaulay received the equivalent of more than $100,000 from its sale.

The things which influence the happiness of mankind, Macaulay wrote, "are not achieved by armies, or enacted by senates. . . . They are carried on in every school, in every church, behind ten thousand counters, at ten thousand firesides." Put these things into history, he claimed, and people will not have to read romances to be thrilled.

Macaulay practiced what he preached. He searched everywhere for the vivid details which could bring the past to life. He would visit the scene of some historical event about which he was writing in order to catch the "feel" of the place. He read constantly the rhetorical masterpieces of the world in order to keep his vocabulary in trim. Macaulay died in 1859.

Thomas Carlyle's HISTORY OF THE FRENCH REVOLUTION ranks perhaps next to Macaulay's HISTORY OF ENGLAND among the most exciting histories written in English. We tell you about Carlyle elsewhere in our book. See the Index under this author's name.

Henry Thomas Buckle (1821-62), considered one of the best chess players in the world before he was twenty, showed in his HISTORY OF CIVILIZATION that the growth of peoples and nations could be treated scientifically, a new idea for history-writers. Samuel Rawson Gardiner (1829-1902), took the seventeenth century as his special province, and wrote in great detail of the stormy days of the Stuart kings, of Cromwell and of the English Commonwealth. George Grote (1794-1871), a banker and member of Parliament, applied his knowledge of money matters and politics to the study of the ancient Greek republics. He produced a HISTORY OF GREECE which was long considered the best in its field.

Possibly the finest all-round historian of the nineteenth century, however, was John Richard Green (1837-83). From 1860 to 1869 Green was a minister among the poor people of London's East End. He loved his parishioners, and hated the drabness and poverty of their lives. These feelings shaped the book which he published in 1874, A SHORT HISTORY OF THE ENGLISH PEOPLE. He called it "a history, not of English kings or English conquests, but of the English People." Green's book traced the whole of England's development, and was the first English history to be written from the point of view of the common man. It has remained popular to this day.

In these books, and in others written toward the end of the century, historians were beginning to follow two new roads. One group, influenced by science, devoted their lives to specialized study of small periods or single aspects of history. Another group took all mankind for their province. They claimed that all parts of the life of humanity are related, and should be recorded and compared if men are to understand themselves and their world.

A GREAT BOOK ABOUT AMERICA WRITTEN BY AN ENGLISHMAN

One of the specialists was James Bryce (1838-1922). In addition to being a member of Parliament and an ambassador to Washington, Lord Bryce was an eager and painstaking student of democracy. He called his work, THE AMERICAN COMMONWEALTH (published in 1888), a study of the "nation of the future." It is an examination of the Constitution, federal, state and local governments, the party system and public opinion in the United States. After noting the faults as well as the virtues of democracy, Bryce asserts his faith in it as the best government for men. More than thirty years later, in 1922, Bryce cast some doubts upon his own earlier beliefs. In MODERN DEMOCRACIES he set forth the ideals of democracy, and contrasted them with the real conditions he found in such countries as the United States, France, Canada and Australia.

H. G. WELLS ATTEMPTED TO TELL THE WHOLE HISTORY OF MANKIND

Bryce concentrated on a single subject. The Englishman who wrote the best-known history in our century adopted the opposite approach. He was H. G. Wells (1866-1946), and he called his work OUTLINE OF HISTORY. This appeared in 1920. Wells said it was "an attempt to tell, truly and clearly, in one continuous narrative, the whole history of life and mankind."

The son of a professional cricket player, Wells studied science in college and worked for some years as a store clerk. Then he started writing popular novels about scientific wonders of the future. From these he turned to novels about the personal and social problems of Englishmen. Thus he had been writing novels for upward of thirty years before beginning on history; and he carried the knack of creating interesting yarns over into his story of the past. Wells successfully presented for the first time a complete panorama of the whole of history. In this impressive task he had the help of scholars who wrote on their own special "areas," or interests.

The personal approach has been generally avoided in the immense "co-operative histories," put together by groups of scholars in the great English universities. These vast undertakings contain special studies of numerous small compartments of history, each by a man who has devoted much of his life to learning about that compartment. Two of these are the CAMBRIDGE MODERN HISTORY and the OXFORD HISTORY OF ENGLAND.

Our ancestors were human beings like ourselves. They desired the same things, had our failings and made the mistakes we are inclined to make. Every tragedy of the past warns us not to fall into the same pit. Every heroic deed and new discovery points the way to greater achievements. The success or failure of men's efforts to control and improve their world may depend upon their understanding of history—the events and the forces behind them.

By DONALD W. CRAIG.

THE NEXT STORY OF LITERATURE IS ON PAGE 3312.

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Jupiter (Zeus) on Mount Olympus. His throne is an eagle. In his left hand are thunderbolts.

Who Were the Old-World Gods?

IN reading poetry in any modern language, and sometimes also in prose, we are met by the poetic ideas of the Greeks. They come to us chiefly in the names and the doings of the many gods who to us form the fabric of ancient mythology. The early Greeks worshiped these gods, remember.

If we do not know the meaning of these names, once held to be divine, we shall miss much that is beautiful in both ancient and modern literatures and art. So here we give a number of the most widely used names of gods. They show us what the men of old thought, and also their struggle to understand life.

The Greek and the Roman mind sought explanations of the world around them through a vivid imagination. Whatever they could not understand they thought to be the work of a god, and accepted their fancies as a religion. The Greeks dramatized the universe through their family of gods.

The Romans did the same when the time came, but presently Greek ideas, and especially Greek art, ruled the Roman mind, and then came a fusion of the mythologies of the two races—the Greeks and the Latins. Greek gods and Roman gods, which had represented similar ideas, were often identified as the same. Therefore, we find them frequently spoken of as if they were the same beings. Modern research has shown us that this is wrong, and that there were often real differences between Greek and Roman gods whom we regard as pairs.

For instance, the Greek Pallas Athene is generally accepted now as a counterpart of the Roman Minerva, the Greek Zeus as the Roman Jupiter, Artemis as Diana, Hera as Juno, and so through a long list of dupli-

cations. Students of mythology, however, will point out differences. As it is desirable that we should have a general knowledge of all these things, however, we here give an outline based on similarities which are more pronounced than differences. The Latin name is given first and the Greek name after it.

The Greeks peopled the world with a variety of gods corresponding with all the beautiful and terrible sights of the world, with all the powers and all the processes of nature. No star shone in the heavens, no cloud veiled the daylight, no wind shook the leaves, but they saw, in imagination, a god presiding over it.

Gea, or Terra, the Earth, they pictured as the mother of all earthly things, married to Cœlum (Uranus), the sky. Man was born from a bit of earth, saturated with water and warmed to life by the sun's rays, and when he died his venerable mother took him back to her bosom.

So all things were the work of the gods. That was the spirit in which the most intellectual of the ancient races interpreted the world and its life. Some gods were near and familiar, some remote and grim. The Greeks conceived of Olympus, their highest mountain, on the boundary between Macedonia and Thessaly, rising nearly ten thousand feet into the blue, as the home of the greater gods. There Zeus, afterward identified with Jupiter, had his palace.

From Olympus Jupiter presided over all the gods; to Olympus he summoned them. Mount Olympus was chosen as the dwelling-place of the gods because it was the highest of all the Greek peaks, and poets imagined that it touched the sky. The Greeks called the Olympians the twelve principal gods; they were the gods we know best by their Roman names — Jupiter, Neptune, Pluto, Mars, Vulcan, Apollo, Vesta, Juno, Minerva, Diana, Venus, Ceres. The Greek names for these and other gods are given in these pages after the Roman names.

Jupiter (Zeus,) son of Saturn and Rhea, was king of gods and men. He dwelt on Olympus, and with a nod could shake the universe. Saved from the cruelty of Saturn by his mother, Jupiter was intrusted to the care of shepherds and fed with goat's milk. When grown up, he dethroned his father; but before he could take his place he had to fight fearful giants, who threw on the gods tremendous rocks. Some of these, falling down into the sea, made the islands; others made the mountains. Jupiter married Juno. Thursday (in Latin *Jovis dies,* which has made the French word *jeudi*) was consecrated to Jupiter. The king of the gods is generally represented as a powerful man sitting on a throne; his right hand holds thunderbolts, and his left holds Victory; his sceptre is an eagle.

Juno (Hera) was the queen of heaven. She presided over marriages and births. She is figured as a stately matron bearing a sceptre or a crown; a peacock, called Argus, is always by her side. In Rome her festival was called the Matronalia.

Saturn (Cronos), meaning Time, son of Terra, married Rhea. Fearing his sons would divest him of his powers, Saturn used to devour them at their birth—a symbol meaning that Time consumes our lives. However, Rhea was able to save Jupiter, Neptune, Pluto and Juno. Saturn, dethroned by his son Jupiter, found a refuge in a part of Italy called Latium, where he became the king of mortals and made them so happy that his time, in which freedom and equality prevailed, was celebrated ever after by great festivals, the Saturnalia. Saturn was represented as an old man bent with age, holding a sickle. We also see him figured on buildings with a veil, probably because Time is obscure and covered with a misty veil.

Minerva (Pallas Athene) was the goddess of wisdom, science and art. She is famous for her dispute with Neptune regarding the town of Athens to which at last her name was given. This goddess was a favorite, and Jupiter would grant her anything. All that she promised to mortals infallibly happened. Athens built in her honor the famous Parthenon, for which Phidias carved her statue in gold and ivory. According to the different characters in which she appeared, Minerva held a distaff, a spear, a helmet, or a twig of an olive tree. The owl and the cock are always somewhere by her.

Vesta (Hestia) was the goddess of fire. Her name means "hearth and home." From the remotest times of Asia and Greece her worship consisted chiefly in keeping alight the fire consecrated to her, and in Rome this sacred task was intrusted to virgins called, after her, the Vestal Virgins. This was so important that whoever let the fire go out had to undergo a severe punishment. Vesta was represented clad in a white gown covered with a purple mantle. She held a torch or a lamp.

Apollo, a son of Jupiter, was born in Delos island. Exiled from Olympus, he found a refuge at the court of King Admetus, and roamed the earth for a long time, till Jupiter

intrusted him with the care of spreading light over the world. Thus Apollo drove the chariot of the Sun, and enjoyed eternal youth. Apollo is also the god of music, arts, medicine and poetry. On buildings Apollo was generally represented as a beautiful young man with a bow, the arrows symbolizing the rays of the sun.

Diana (Artemis), a daughter of Jupiter, twin sister of Apollo, had several attributes. On earth she was Diana, goddess of the woods and the hunt; in the sky she was Phœbe (Selene), goddess of the Moon; in the lower regions she was Hecate. Maidens, especially, prayed to her. Diana's most famous temple was at Ephesus, but the Diana of Ephesus was really a distinct deity of Asiatic origin. Diana is generally shown barefooted, in hunting dress, with a quiver on her shoulder, or a crescent on her brow, a symbol of the Moon.

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Mercury (Hermes), son of Jupiter and Maia, was the messenger of the gods and wore wings on his cap and heels. His rod with snakes showed his magic powers. We see him here with Pegasus, the winged horse of the Muses.

Ceres (Demeter) taught men to till the soil, to sow, to reap and to bake. In Greece her most famous temple was that of Eleusis, where mysteries were regularly performed to the glory of the goddess. We most often see Ceres represented as a running traveler. She is looking for her daughter Proserpina, in searching for whom she spent most of her life. Ceres is also figured as a comfortable matron adorned with a wreath of corn, a symbol of fruitfulness.

Vulcan (Hephæstus), a son of Jupiter and Juno, was ugly, misshapen and lame, but the most industrious of all the gods. He used to do all sorts of works. He made jewels for the goddesses, thunderbolts for Jove, weapons for Achilles. Vulcan was the god of iron, brass, gold and silver. In his statues Vulcan, the father of the blacksmiths, holds a hammer in the right hand and pincers in the left. Poets set his dwelling in an island covered with rocks, from the top of which flames and smoke used to run down. This idea has given us the word volcano.

Mercury (Hermes), son of Jupiter, was the gods' messenger, patron of travelers, of merchants, and even of rogues. A splendid talker, aware of everything, present everywhere, always ready to help, he played a very important part in Olympus and on the earth. In his statues his hat and feet are adorned with two little wings as symbols of his swiftness; he holds a purse as the emblem of commerce, or his famous rod entwined with snakes as the emblem of his magic power. Wednesday (in Latin *Mercurii dies*, which has given the French *mercredi*) was consecrated by the ancients to Mercury.

Mars (Ares) was the god of war. Though not invincible, Mars was always accompanied by Victory. On ancient buildings he is represented under the somewhat uniform features of a strong man armed with a helmet, a pike and a buckler. Tuesday (in French *mardi*, from the Latin *Martis dies*) was consecrated to him.

Venus (Aphrodite) used to preside over the pleasures of love, her son (Cupid, or Eros) over marriages and births, and especially over love affairs. Venus was renowned for the prize she was awarded by Paris for beauty, against Juno and Minerva. Venus is beautiful, young and smiling. Sometimes her foot rests on a shell, sometimes she sits in a chariot drawn by two swans. Many sculptors have tried to make statues of Venus. The best known is the famous Venus discovered at Melos in 1820, now perhaps

the great single treasure of the Louvre in Paris. Friday (in French *vendredi,* from the Latin *Veneris dies*) was her day.

Bacchus (Dionysus), son of Jupiter, taught men to plant the vine, and was deified. This god's usual train was very important. Silenus, his companion and tutor, first attended him; then followed nymphs, the Bacchantes, satyrs and shepherds. Great revels, the Bacchanals, were held in his honor. Bacchus is generally represented riding on a barrel, crowned with garlands of vine, or with two horns, the emblem of power.

Themis was the goddess of equity, law and peace. In Olympus she sat by Jupiter and helped the god as a counselor of justice. Her chief attributes in sculpture and pictures are scales and a sword. We also see her blindfolded, to designate her impartiality in the character of a judge.

Cupid (Eros), son of Venus, was the god of love, or rather Love itself. As soon as Cupid was born Jupiter, guessing all the troubles he would cause, wished his mother to get rid of him. But Venus hid the child in the woods, where she fed him on goat's milk. There he made his famous arrow and first tried it on animals before he could use it on men. Cupid is generally represented as a winged child six or seven years old. Armed with a bow and a quiver full of sharp arrows, he goes about among gods and men. His violent passion for Psyche, whose beauty roused the envy of his mother, ended by his marrying her. His worship is associated with that of his mother Venus.

Iris was the messenger of the goddesses, but especially of Juno. Iris is usually pictured in art as a graceful maiden with shining wings. Poets pretended that the rainbow was the trail of the feet of Iris as she ascended from Olympus with a message.

Hebe (Juventas), cupbearer of the gods on Olympus. She is represented crowned with flowers, and with a cup in her hand. The name of Hebe is joined to that of the youth, Ganymede, who took her place when she married.

Hercules (Heracles) was the son of Jupiter and a mortal. Juno hated him and he was forced to perform twelve tasks supposed to be impossible. When the mortal part of him died he was translated to Olympus and given Hebe as his wife.

The Graces (Charities) were three in number: Aglaia, Thalia and Euphrosyne. They were the embodiment of grace and beauty, and their power extended over all humans. They bestowed on men gaiety, grace, humor and good manners.

The Muses, nine sisters, were each the symbol of an art: Clio, the muse of history, reads in a book. Euterpe, the muse of lyric poetry, invented the flute and is pictured playing it. Thalia presided over comedies; she holds a mask and looks bright and playful. Melpomene, tragedy, has a grave attitude and carries a sword. Terpsichore, dance, is a fair maiden, young and lively. Erato, the muse of love lyrics, is a fine, merry girl crowned with roses. Polyhymnia, the muse of the sublime hymn, appears in thoughtful mood. Urania, astronomy, wears a starred gown and bears a globe. Calliope, the muse of epic poetry and eloquence, is represented as a stately young woman. Pegasus, the winged horse, belonged to the Muses.

The Hours meant to the Greeks not the divisions of the day, but those of the year. They were the goddesses of the seasons. They were responsible for the opening and closing of the doors of Olympus, for the education of children, and for the general rules of human lives. That is why they always attend marriages, as we see in pictures.

The Fates (Moiræ) were three sisters: Clotho, Lachesis and Atropos. Immutable in their devices, they held a mysterious thread meaning the course of life, and nothing could prevent them from cutting it when the hour of fate had struck. Clotho, sitting, holds the distaff and spins the thread. Lachesis rolls up the thread on the spindle. Atropos mercilessly cuts the thread which is supposed to measure the life of each and every mortal.

THE LESSER GODS

TO the ancients, wherever there was life there were gods. Thus the Greeks peopled the heavens with divinities. Though not so powerful as the main gods, lesser divinities played a part of their own, as, for instance, that of guiding the clouds, helping the winds to rise, and so on. Intrusted with special missions, these gods were the attendants of the great Olympian powers and the confidants of mortals.

Prometheus deceived Jupiter and stole a spark of fire out of Olympus to give it to men. But the king of the gods revenged himself cruelly by chaining up Prometheus

PICTURES OF OLD-WORLD MYTHS

THE THREE FATES SPINNING THE THREAD OF LIFE, BY J. M. STRUDWICK

PSYCHE, BY ALFRED DE CURZON

PSYCHE'S GARDEN, BY J. W. WATERHOUSE

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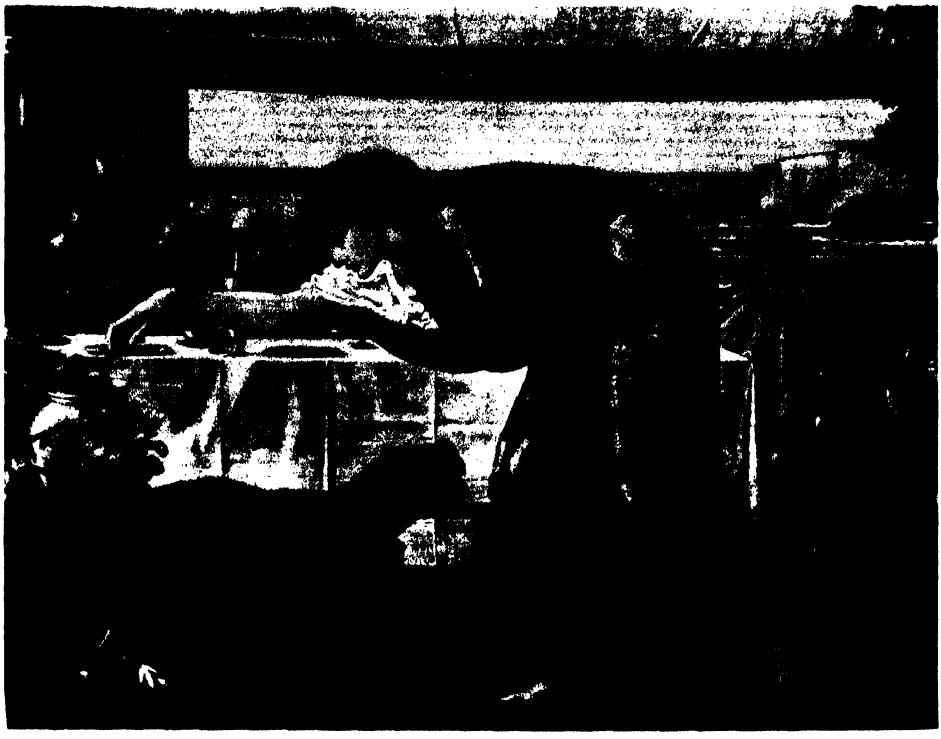
APOLLO. FROM THE PAINTING BY BRITON RIVIERE.

IN THE ARMS OF MORPHEUS. FROM THE PAINTING BY W. REYNOLDS STEPHENS.

THE MIRROR OF VENUS. FROM THE PAINTING BY SIR EDWARD BURNE-JONES

APOLLO AND DAPHNE. FROM THE PAINTING BY HENRIETTA RAE

VENUS AND ANCHISES. FROM THE PAINTING BY SIR W. B. RICHMOND



CIRCE. FROM THE PAINTING BY SIR EDWARD BURNE-JONES

on the Caucasus and condemning him to be the everlasting prey of a vulture which devoured his liver. However, men were henceforth in possession of fire, the symbol of intellect and knowledge that Jupiter did not mean to grant them. Prometheus was finally rescued from his sufferings by Hercules.

Aurora (Eos), goddess of the dawn, announced the advent of the chariot of the Sun. The ancients represented her clad in a pale yellow dress, holding a torch as if to herald the Day. Some poets figure her riding the famous winged horse Pegasus, or chasing Night and Sleep.

Hyperion, a son of Cœlum and Terra, was the father of the Sun, but the poets often give his name to the Sun itself.

Sol (Helios), the Sun, had great altars in the ancient world. The Egyptians even consecrated to him a whole city, Heliopolis. It was by the name of the Sun that people used to swear faithfulness to their engagements. Helios is now pictured driving his chariot with the horses breathing fire, or as a fair young man crowned with sunbeams.

Phaeton was a son of Helios. Having once deserved a reward, Phaeton asked to be intrusted with the driving of the Sun's chariot for one day. The horses of Helios soon marked the change. They wandered out of the right path, and the sky was threatened with a conflagration, and the earth dried up to its very core. Phaeton was cast down by the gods into the river Eridanus.

The Stars. A sacred origin was ascribed to the luminous bodies in the firmament. Their principal part was to hear the prayers of mortals in all the difficult circumstances of life. Because of their nearness to Olympus the astral bodies were supposed to support any request addressed to the gods.

Lucifer (Phosphoros) is the planet Venus, the Light-bringer, when seen before sunrise as the Morning Star. She was the daughter of Jupiter and Aurora, and the leader of all the other stars. She was represented driving white horses through the sky to herald Dawn, or Aurora.

Vesper (Hesperos) is Venus as the Evening Star. Italy and Spain, both lands situated in the west, where the Sun sets, were called Hesperia, or the Western Land.

The Heliades, daughters of Helios, are known for their grief at the death of their brother Phaeton. They wept for months and months, till the gods changed them into poplars.

Luna (Selene), the Moon, was the greatest divinity of the heavens next to the Sun. Selene was identified in later times with Aphrodite. To the Greek poet Pindar she was the eye of night. To the Latin poet Horace she was the queen of silence. Monday (in French *lundi,* from the Latin *Lunæ dies*) was her day.

The Hyades (the Rainers) were the sisters of Hyas, and their great inclination for hunting was fatal to him. They wept so bitterly over his death that Jupiter, touched by their grief, changed them into stars. When they rose with the Sun they were to the Greeks a sign of approaching rain.

The Pleiades were the seven daughters of Atlas who were changed into stars because their father had tried to read the secrets of the gods. They were called Pleiades after a Greek name meaning to navigate, because they appeared in May, a month favorable to sailors.

Orion was a famous giant and son of Neptune, a clever hunter whose death was brought about by the jealousy of Diana. But after he had died she so regretted her anger that she claimed from Jupiter a special place in the heavens for Orion.

Sirius, or the dog star, is called after Orion's faithful hound Sirius. The Greeks feared him and offered him great human sacrifices. The name means scorching, and Sirius marks the season of the greatest heat. In English we speak of the "dog days."

Callisto, an Arcadian king's daughter, was loved by Jupiter and was changed into a bear by jealous Juno. Arcas, her son, was hunting once in the woods and met the bear, and was preparing to shoot it. Jupiter, to prevent the tragedy, put an end to both their lives, and awarded them a place in heaven under the names of Great and Lesser Bear.

Pandora was the first woman. Jupiter made her out of clay, endowed her with most beautiful gifts, and gave her a box which she was to present to the man she married. Accompanied to earth by Mercury, Pandora appeared to Prometheus; but he refused to open the fatal box, which she took to Epimetheus. Pandora has remained the image of temptation. She was to the Greeks as Eve is to us.

Epimetheus, brother of Prometheus, married Pandora to obtain possession of her box, but his curiosity was punished, for the box was full of evils, which spread over the earth. Only Hope remained at the bottom of the box. That is why men still may be cheered by Hope.

The Winds were poetic divinities, chil-

dren of Sky and Earth. Their king, Æolus, held them back in deep abysses, and the terrible prisoners roared behind the gates of their caverns till Jupiter decided to let them loose. The ancient poets had a different myth for each of the four winds:

1. **Eurus,** a wind blowing from the south-east, was represented as a flying youth, violent and disorderly.

2. **Boreas** was a north wind, generally shown as a white-haired old man.

3. **Notus** (Auster) was a hot and stormy wind blowing from the south. We see him pictured holding a watering-can, emblem of the rain the south wind brings.

4. **Zephyrus** was the gentle west or north-west wind. The Greeks loved it because it brought freshness over their parched land. Poets fancied Zephyrus as a sweet and serene young man with butterfly wings. Our word zephyr, meaning a gentle breeze, comes from his name.

Tempestas had her temples in Greece and in Rome. We find her pictured on ancient monuments with an angry face and threatening aspect.

GODS OF HOME AND FATHERLAND

Manes was the name given to the spirits of the dead. The ancients believed that the Manes presided over the cemeteries.

Mnemosyne was called the goddess of memory, this Greek word meaning "memory." Poets made her the mother of the nine Muses, because to memory mankind owes the progress of science.

Mithras was a king of Persia, adored as a god of the Sun. His worship was introduced into Rome and continued until Christian times. Mithras was generally represented as a youth with a turban on his head knocking a bull down to show his power.

Eris was called Discordia by the Romans. A sister of Ares, she was a dangerous deity, spreading discord in Olympus as well as on earth. Everyone feared her, so that Jupiter ended by driving her away from Heaven. The painters represent her as a ghastly woman shabbily clad and holding a dagger. Her head is often entwined with serpents, and her usual attendant is Bellona.

Nike was the Greek goddess of victory. She was a daughter of Pallas and Styx, and is often shown as a winged figure carrying a palm or a wreath, guiding the horses of victors in battle, or writing their names on a shield.

Lares and **Penates** were the gods of the hearth whose worship was in great honor among the ancients. Lares were spirits of dead ancestors, and it was thought they could still play a part in domestic affairs. They were represented in small statues so that they could be easily taken about when the family moved. Our cherished family treasures are often termed "lares."

Genius (Dæmon), the patron saint of every man, presided over births. Everybody had his own and sacrificed to him on his birthday. Some were good genii, some bad. The good genius was represented as a fair young man crowned with flowers; the bad genius as an ugly old man holding an owl, the bird of ill omen or of woe.

Fortuna, the daughter of Night and Chaos, was blind, the leader of all the gods and of all humans, with whose fate she dealt through her three ministers, the Parcæ. Only the Oracles could foresee and reveal what was written in the inexorable book of Fate. Fortuna is represented with a horn of plenty, meaning that she is the sovereign of riches; or with a sceptre as emblem of her power; or holding a wheel as symbol of her fickleness and instability.

Æsculapius, son of Apollo and a mortal, was a prince known for his cleverness in the art of curing sickness. He even once succeeded in bringing the dead to life, but Jupiter, angry with jealousy, struck him dead. Legend has made him the father of physicians. In statues he is represented sitting on a throne, one hand leaning on a serpent's head, suggesting his power over evil.

Hygeia, the goddess of health, was the daughter of Æsculapius. The ancients represented her as a veiled figure to whom the matrons consecrated their locks. Our word hygiene is connected with her name.

Hymen, the god of marriage, was pictured among the ancients as a handsome youth crowned with flowers, holding a torch in one hand, and in the other a yellow veil destined to cover his bride.

Morpheus was the son of Somnus and the god of dreams. The artists made him a sleeping child surrounded by poppies, his favorite flowers, because poppies induce dreams.

Somnus (Hypnos) was the god of sleep. This word gives us the French word *sommeil,* for sleep, and our word somnambulism.

GODS OF COUNTRY AND TOWN

Vertumnus, the god of the gardens and orchards in Rome, married Pomona, the goddess of the fruit trees. The earliest garden produce was offered to him. This happy couple used to grow old and young again every year and never died, suggesting the regular rounds of the seasons.

Flora was the goddess of flowers among the Romans. She married the wind Zephyrus in May, and both held a high rank in the train of Spring.

Pomona, a beautiful nymph, presided over the gardens in Rome. She was most often pictured sitting on a basket of flowers and fruits, or holding a horn of plenty.

Pales was the goddess of Roman shepherds. Her festival, the Palilia, came each year on the day of the foundation of Rome by Romulus.

Terminus was a Roman deity who presided over frontiers and boundaries, and revenged any usurpation of land. He was at first represented under the shape of a big square stone, but afterward artists gave him a human head placed on a milestone.

Janus was supposed to be the first king to reign over Italy. Having once offered hospitality to Jupiter, he was endowed with the gift of knowing the past and the future. As the guardian of gates he was represented by artists as having two faces, looking both ways. As the Romans made a great warrior of Janus, his temple was opened only in wartime. It is interesting to note that this famous temple was closed only three times during the whole of Roman history. January is called after Janus, as it was the first month in the later Roman calendar.

GODS OF THE WATERS

Oceanus. To the ancients the ocean was a huge river surrounding the earth. Oceanus, the son of Uranus and Terra, is the chief god of all waters. Being as old as the world, Oceanus was represented as an aged man sitting on the sea and pouring out water.

Tethys, daughter of Uranus and Terra, married her brother Oceanus, and gave birth to three thousands nymphs, the Oceanids. Tethys is generally seen driving a seashell, her chariot, followed by a train of dolphins, tritons and Oceanids.

Nereids. Nereus, son of Oceanus and Terra, had fifty daughters, the Nereids. He is represented as a gentle and peaceful old man, full of justice and kindness; and the Nereids as beautiful girls riding dolphins, their hair adorned with pearls. The Nereids were the nymphs of the Mediterranean, as the Naiads were the nymphs of the fresh water, and the Oceanids, of the ocean.

Neptune (Poseidon), a son of Saturn and Rhea, was a brother of Jupiter and Pluto. When the three brothers divided the wealth of Saturn, Jupiter took the earth, Pluto took the lower regions, and Neptune was given the sea. Neptune rode in his chariot over the sea drawn by horses. Statues generally represent the god of waters with a long beard, holding a trident. Oceanus was the older god of waters. Neptune belonged to the younger family. He and his brothers, Jupiter and Pluto, conquered the older gods.

Amphitrite, wife of Neptune, mother of Triton, is pictured driving a shell on the sea with the Nereids as her attendants.

Triton, son of Neptune and Amphitrite, was a demigod—half man, half fish. He played the part of the herald of Neptune.

Proteus, a sea god, was the shepherd of Neptune, whose flocks embraced seals, sea lions and all sorts of big fishes. As a reward for his services Proteus had received from Neptune the gift of prophecy. The famous shepherd could assume different shapes and disappear at will. The name of Proteus is often used to describe somebody quick at moving from one place to another, or quick at changing faces. The adjective "protean" comes from his name.

Glaucus, a sea god, gifted with a special power of prophecy, was Neptune's soothsayer, or foreteller of events. His statues resemble Triton's, except that his beard is white and dripping, his arms are fins, and his chest is covered with seaweed.

The Harpies were monsters with the faces of old women and the bodies of vultures. They caused famine wherever they passed, and emitted a fearful odor. Drive them away as you could, they would always come back. Jupiter and Juno used them against those they wished to punish.

Circe was a daughter of the Sun. She was supposed to be clever enough to make the stars come down from heaven. Sea travelers could hardly escape from her charms. With her magic she changed men into lions, tigers and other beasts. She turned the crew of Ulysses into swine; but with the aid of Mercury he succeeded in forcing Circe to change them back to men.

Charybdis, a daughter of Neptune, having stolen a part of the flock of Hercules, was stricken down by Jupiter and changed into a dangerous whirlpool in the Strait of Sicily.

Scylla, a beautiful nymph, had been changed into a monster by jealous Circe. Terrified by her ugliness, she threw herself into the sea and became a rough rock which has since been called after her, between Italy and Sicily. Scylla and Charybdis were both deemed by the ancients as most dangerous to navigators. We say of a man coming upon two dangers together and not knowing which to flee from, that he is "between Scylla and Charybdis."

The Sirens were three sea nymphs to whom the oracles had predicted life as long as they could detain navigators on their way. This they did by singing so sweetly that sailors in passing ships were drawn, spellbound, and wrecked upon the isle. Ulysses stopped the ears of his crew with wax and had the men tie him to the mast. As the ship approached the place, Ulysses was enthralled by the lovely music. But he was tied fast, and his men heard nothing, so they rowed safely by. Some artists picture the Sirens as fish-tailed maidens; others show them as half woman, half bird.

The Gorgons, three famous sisters called Stheno, Euryale and Medusa, lived a long way over the ocean, at the end of the earth. Medusa, their queen, who offended Athene, had her hair changed into snakes, and her eyes were given the fatal power of turning into stone every human they looked upon. The Gorgons are represented with enormous heads interwoven with snakes. In art, the best head of Medusa is a masterpiece by Leonardo da Vinci in one of the galleries of Florence.

The Cyclops, three monstrous giants, sons of Neptune, were so ugly with their single eye that Jupiter cast them down into the lower regions. Vulcan adopted them as the chief workers of his forge. The most famous Cyclops was Polyphemus.

The Rivers were personified as sacred children of Oceanus and Tethys; they numbered three thousand, and the ancients would never cross a stream without having uttered a prayer.

The Naiads presided over rivers and fountains. Pictures show them as young nymphs with naked legs and arms, crowned with aquatic plants.

Arethusa was a woodland nymph who loved the chase. One day, while she was bathing in a stream, Alpheus, god of the stream, fell in love with her. Arethusa implored Diana to help her escape and the goddess changed the nymph into a fountain. Poets have loved this myth.

From an old print

The Sirens enticing a boat upon the rocks. The men, enthralled by song, do not notice the danger until it is too late.

Ladon was a Greek river famous for the encounter on its banks of Syrinx and Pan. The nymph, fearing the love of Pan, was changed into reeds, which have continued to grow along rivers ever since. From these reeds Pan made his flute with seven pipes.

The Fountains were the daughters of Oceanus and Tethys, for whom great rituals were held in Greece. Inspirers of the Muses, the best-known fountains were: Aganippe, Hippocrene, Castalia and Pyrene. The Fountain of Youth has also remained famous for its power of giving back youth. Ponce de Leon sought for it.

GODS OF MOUNTAINS AND WOODS

The Mountains were regarded by the ancients as genii, each representing a special production of the land.

The Fauns (Satyrs), scattered about in the country, chiefly waited upon Bacchus. Poets make them the terror of shepherds and nymphs.

Daphnis was a shepherd of Sicily whom the Muses had gifted with the love of poetry. He was translated to heaven by his father Hermes.

Aristæus, a son of Apollo, was brought up by the nymphs, who taught him to grow olives and keep bees.

Priapus represented the fruitfulness of nature. The Greeks worshiped him as the god of gardens. He was generally represented half length, with a ram's horns and a leafy wreath, or else holding some fruits.

Marsyas was a satyr who disputed with Pan the invention of the flute. He was known as a great musician, the first who wrote music down. Apollo was jealous and put him to a terrible death. The unfortunate Marsyas was generally represented as tied to a tree ready to be flayed, or as a satyr playing a pipe.

Pan was the god of all shepherds and flocks. He was represented as an ugly satyr with the body of a goat, with horns, and untidy hair and beard. He often carries a pipe, his supposed invention. Pan generally terrified those he approached, and the word "panic" has come from his name. Once he had a music contest with Apollo, which Apollo, of course, won.

Echo was one of Juno's attendants. She fell in love with Narcissus, but, when disdained by him, retired to a cavern and died, though her voice remained in the rock. That is how the Greeks explained the echo.

Narcissus was a beautiful youth who caught sight of his image in a river and fell in love with it. He remained so long admiring his face in the waters that he took root and turned into a flower—called after him.

The Hamadryads were nymphs whose lives depended on the lives of certain trees, with which they were supposed to live and die. Homer shows them escaping from trees.

The Dryads were nymphs that presided over the trees. They were represented as women with roots for the lower part of their bodies, and shoulders covered with hair. They wore oak leaves for crowns.

The Woods were the first places where men gathered to worship their gods. It seemed to them that in the shade of woods the gods would more easily and more freely come down to earth. The most venerated forests were: Epidauria, consecrated to Æsculapius, the father of medicine; Nemea, where Hercules was feasted; Dodona, where the oaks were supposed to foretell events.

The Volcanoes, especially Mount Etna, in Sicilia, were supposed to be the forges of Vulcan, and to communicate with the lower world. The ancients made use of volcanoes to predict the future. They threw precious things, even human victims, into the craters. The word volcano comes from Vulcan, the blacksmith of the gods, who was thought to dwell in a fiery mountain.

The Hesperides, also called Atlantides, were daughters of Atlas, and the owners of a famous garden. The garden of the Hesperides held golden fruits, and was guarded by a dragon with a hundred heads and several voices. It was among the twelve works of Hercules to kill this dragon and carry off the golden apples.

Atlas, one of the Titans conquered by Jupiter, was changed into a mountain and condemned to support the vault of heaven on his shoulders. The Greeks imagined this fable because of the great height of Mount Atlas in Africa. Its peak was supposed to touch the heavens. Atlas is still represented as a giant standing on the ocean and supporting a globe on his shoulders.

Mount Helicon was one of the favorite dwelling-places of the Muses. Helicon is also famous for the river Hippocrene, which flowed from its summit; for the tomb of Orpheus; and for a sacred wood where rites were celebrated to the glory of Apollo.

Parnassus, one of the highest mountains of the ancient world, had two famous summits—one consecrated to Apollo and the Muses, the other to Dionysus.

THE LOWER WORLD

The Infernal Regions were underground places sheltering the dead. They embraced four different regions: Erebus, Hell, Tartarus and Elysium. There were four rivers: the Styx, Acheron, Cocytus and Lethe.

Tartarus was the palace of the gods of the lower world and their train. It spread a long way inside the earth, and was surrounded by a triple wall of brass. No dead mortal ever penetrated into Tartarus.

Elysium was the residence of virtuous souls after death. Some of the ancients placed Elysium in an African island, some in Italy. The name Champs Elysées in Paris means Elysian Fields.

Hell was the terrible place of all punishments and tortures, a land of fire supposed to be surrounded with fearful marshes and brazen rivers which left no hope of escape to the dead.

Erebus was the underground place nearest to earth, the way to Hell or Elysium. The ancients believed that the shadows of the unfortunate who had not been buried would wander for a hundred years in Erebus before they knew where to settle.

Styx was a famous river winding round Hell in circles. Its waters were supposed to run with mud through darkest lands. The gods always swore by the Styx.

Acheron was a river like the Styx. It was represented as a very old man clad in damp cloth, with an owl generally standing by.

Cocytus, an infernal river, ran into the Acheron. Its stream was supposed to be made of the tears of the wicked. It was the river of lamentations.

Pluto was the third son of Saturn and Rhea, to whom the lower regions had been given when Jupiter was given Heaven and Neptune the Ocean. Pluto dwelt in Tartarus. Because of his ugliness he could never find a willing wife, and had to carry off Proserpina, whom he made queen. His attribute is the cypress, the dark foliage of which expresses melancholy and grief.

Proserpina was a beautiful maid whom Pluto carried away to make his queen. The ancients believed that nobody could die had not Proserpina herself cut the threads of their lives with the aid of Atropos.

Charon, a son of Erebus and Nox, conveyed the shades of the dead over the Styx and the Acheron. Charon was old and mean, and those who had no money could not enter the boat. This is why the ancients never failed to put a coin in the mouths of their dead. Those who had not been buried were not entitled to the crossing, and the legend supposed them wandering for a hundred years on the river bank. Charon is pictured in sombre garb, sullied by the black slime of the foul waters. He stands in his boat and plies the oars.

Cerberus, Pluto's three-headed dog, was the keeper of the gate of Hell. His part was to prevent the dead from getting out of their prison, and to prevent the over-curious from entering it before they died. On ancient medals Cerberus always stands by Pluto, but on buildings he is generally chained up by the side of Hercules, who dragged him from the lower worlds.

Rhadamanthus was one of the three judges, with Æacus and Minos, before whom the dead had to appear after they were buried. Their tribunal was called the Field of Truth, because neither lie nor slander could approach it. Rhadamanthus was represented on a throne holding a sceptre.

Æacus was one of the three judges of the dead, with Rhadamanthus and Minos. Æacus was the father of Peleus and the grandfather of the famous Achilles.

Minos, brother of Rhadamanthus, was one of the three judges of the dead. We most often see him sitting among the shadows of the dead.

Nemesis is often mistaken for one of the Furies. Nemesis should be called the goddess of compensation. Her part was to deal as equally as possible with happiness and misfortune over mankind. Had a man been very happy so far, Nemesis was to send him his share of trials to balance the good, or vice versa.

Thanatos, or Death, was the implacable enemy of mankind. He dwelt in Tartarus. Thanatos was supposed to have a heart of iron and bowels of brass. Some sculptors close his eyes, veil his head, and give him a sickle, the attribute of death.

Lethe. After the dead had remained a certain time either in Elysium or Hell, they were entitled to reincarnation in another body on earth. But before they left the lower regions they had to drink water of the river Lethe, which would wipe out all memories of their former life. Our words lethal and lethargy come from Lethe, which means the sleep of forgetfulness.

The Furies were the ministers of the vengeance of the gods on mankind. There were three principal Furies—Alecto, Tisiphone and Megæra.

These names of gods and goddesses, and of other creatures of the vivid imagination of man in the classical lands, are far from exhausting the personnel of the old mythologies. Anything that was striking and mysterious was personified as a god, and their varying attributes became the framework of ancient poetry. A knowledge of mythology is a key that unlocks for us an understanding of the world in its brilliant youth. Many writers of modern times draw upon the old myths.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3354.

THE BRANDING OF TOMMY*

WOULD you like a picture of Tommy trying to make a scholar of himself? What drove him oftenest to the weary drudgery was, perhaps, the alarm that came over him when he seemed of a sudden to hear names of the bursars proclaimed and no Thomas Sandys among them. Then did he shudder, and he hastily covered the round table with books and sat for hours sorrowfully pecking at them every little while to discover that his mind had soared to other things, when he hauled it back as one draws in a reluctant kite.

Sometimes Mr. Cathro, the Dominie, had hopes of him other than those that could only be revealed in a shameful whisper with the door shut. "Not so bad," he might say; "if he keeps it up we may squeeze him through yet. The mathematics are his weak point, there's nothing practical about him (except when it's needed to carry out his devil's designs) and he cares not a doit about the line AB, nor what it's doing in the circle K, but there's whiles he surprises me when we're at Homer. He has the spirit o't, man, even when he bogles at the sense."

In his great days, so glittering, so brief, Tommy, looking back to this year, was sure that he had never really tried to work. But he had. He did his very best, doggedly, wearily sitting at the round table. . . . An hour afterwards he might discover that he had been far away from his books, looking on at his affecting death and counting the mourners at the funeral.

Aaron and the Dominie met one day in the square, and to Aaron's surprise Mr. Cathro's despondency about Tommy was more pronounced than before. "I wonder at that," the warper said, "for I assure you he has been harder at it than ever the last nights. What's more, he used to look doleful as he sat at his table, but I notice now that he's as sweer to leave off as he's keen to begin, and the face of him is a' eagerness too, and he reads over to himself what he has wrote and wags his head at it as if he thought it grand."

"Say you so?" asked Cathro, suspiciously; "does he leave what he writes lying about, Aaron?"

"No, but he takes it to you, does he no'?"

"Not him," said the Dominie, emphatically. "I may be mistaken, Aaron, but I'm doubting the young whelp is at his tricks again."

The Dominie was right, and before many days passed he discovered what was Tommy's new and delicious occupation.

For years Mr. Cathro had been in the habit of writing letters for such of the populace as could not guide a pen, and though he often told them not to come deaving him he liked the job, unexpected presents of a hen or a ham occasionally arriving as his reward, while the personal matters thus confided to him, as if he were a safe for the banking of private histories, gave him and his wife gossip for winter nights. Of late the number of his clients had decreased without his noticing it, so confident was he that they could not get on without him, but he received a shock at last from Andrew Dickie, who came one Saturday night with paper, envelope, a Queen's head, and a request for a letter for Bell Birse, now of Tilliedrum.

"You want me to speir in your name whether she'll have you, do you?" asked Cathro, with a flourish of his pen.

"It's no just so simple as that," said Andrew, and then he seemed to be rather at a loss to say what it was. "I dinna ken," he continued presently with a grave face, "whether you've noticed that I'm a gey queer deevil? Losh, I think I'm the queerest deevil I ken."

"We are all that," the Dominie assured him. "But what do you want me to write?"

"Well, it's like this," said Andrew, "I'm willing to marry her if she's agreeable, but I want to make sure that she'll take me afore I speir her. I'm a proud man, Dominie."

"You're a sly one!"

"Am I no!" said Andrew, well pleased. "Well, could you put the letter in that wy?"

"I wouldna," replied Mr. Cathro, "though I could, and I couldna though I would. It would defy the face of clay to do it, you canny lover."

Now, the Dominie had frequently declined to write as he was bidden, and had suggested

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alterations which where invariably accepted, but to his astonishment Andrew would not give in. "I'll be stepping, then," he said coolly, "for if you hinna the knack o't I ken somebody that has."

"Who?" demanded the irate Dominie.

"I promised not to tell you," replied Andrew, and away he went. Mr. Cathro expected him to return presently in humbler mood, but was disappointed, and a week or two afterwards he heard Andrew and Mary Jane Proctor cried in the parish church. "Did Bell Birse refuse him?" he asked the kirk officer, and was informed that Bell had never got a chance. "His letter was so cunning," said John, "that without speiring her, it drew ane frae her in which she let out that she was centred on Davit Allardyce."

"But who wrote Andrew's letter?" asked Mr. Cathro, sharply.

"I thought it had been yoursel'," said John, and the Dominie chafed, and lost much of the afternoon service by going over in his mind the names of possible rivals. He never thought of Tommy.

Then a week or two later fell a heavier blow. At least twice a year the Dominie had written for Meggy Duff to her daughter in Ireland a long letter founded on this suggestion, "Dear Kaytherine, if you dinna send ten shillings immediately your puir auld mother will have neither house nor hame. I'm crying to you for't, Kaytherine; hearken and you'll hear my cry across the cauldriff sea." He met Meggy in the Banker's Close one day, and asked her pleasantly if the time was not drawing nigh for another appeal.

"I have wrote," replied the old woman, giving her pocket a boastful smack, which she thus explained, "and it was the whole ten shillings this time, and you never got more for me than five."

"Who wrote the letter for you?" he asked, lowering.

She, too, it seemed, had promised not to tell.

"Did you promise to tell nobody, Meg, or just no to tell me," he pressed her, of a sudden suspecting Tommy.

"Just no to tell you," she answered, and at that,

"Da-a-a," began the Dominie, and then saved his reputation by adding "gont." The derivation of the word dagont has puzzled many, but here we seem to have it.

It is interesting to know what Tommy wrote. The general opinion was that his letter must have been a triumph of eloquent appeal, and indeed he had first sketched out several masterpieces, all of some length and in different styles, but on the whole not unlike the concoctions of Meggy's former secretary; that is, he had dwelt on the duties of daughters, on the hardness of the times, on the certainty that if Katherine helped this time assistance would never be needed again. This sort of thing had always satisfied the Dominie, but Tommy, despite his several attempts, had a vague consciousness that there was something second-rate about them, and he tapped on his brain till it responded. The letter he despatched to Ireland, but had the wisdom not to read aloud even to Meggy, contained nothing save her own words, "Dear Kaytherine, if you dinna send ten shillings immediately, your puir auld mother will have neither house nor hame. I'm crying to you for 't, Kaytherine; hearken and you'll hear my cry across the cauldriff sea." It was a call from the heart which transported Katherine to Thrums in a second of time, she seemed to see her mother again, grown frail since last they met—and so all was well for Meggy. Tommy did not put all this to himself but he felt it, and after that he *could not* have written the letter differently. Happy Tommy! To be an artist is a great thing, but to be an artist and not know it is the most glorious plight in the world.

Other fickle clients put their correspondence into the boy's hands, and Cathro found it out but said nothing. Dignity kept him in check; he did not even let the tawse speak for him. So well did he dissemble that Tommy could not decide how much he knew, and dreaded his getting hold of some of the letters, yet pined to watch his face while he read them. This could not last forever. Mr. Cathro was like a haughty kettle which has choked its spout that none may know it has come a-boil, and we all know what in that event must happen sooner or later to the lid.

The three boys who had college in the tail of their eye had certain privileges not for the herd. It was taken for granted that when knowledge came their way they needed no overseer to make them stand their ground, and accordingly for a great part of the day they had a back bench to themselves, with half a dozen hedges of boys and girls between them and the Dominie. From his chair Mr. Cathro could not see them, but a

foot-board was nailed to it, and when he stood on this, as he had an aggravating trick of doing, softly and swiftly, they were suddenly in view. A large fire had been burning all day and the atmosphere was soporific. Mr. Cathro was so sleepy himself that the sight of a nodding head enraged him like a caricature, and he was on the foot-board frequently for the reason that makes bearded men suck peppermints in church. Against his better judgment he took several peeps at Tommy, whom he had lately suspected of writing his letters in school or at least of gloating over them on that back bench. Today he was sure of it. However absorbing Euclid may be, even the forty-seventh of the first book does not make you chuckle and wag your head; you can bring a substantive in Virgil back to the verb that has lost it without looking as if you would like to exhibit them together in the square. But Tommy was thus elated until he gave way to grief of the most affecting kind. Now he looked gloomily before him as if all was over, now he buried his face in his hands, next his eyes were closed as if in prayer. All this the Dominie stood from him, but when at last he began to blubber—

At the black-board was an arithmetic class, slates in hand, each member adding up aloud in turn a row of figures. By and by it was known that Cathro had ceased to listen. "Go on," his voice rather than himself said, and he accepted Mary Dundas's trembling assertion that four and seven make ten. Such was the faith in Cathro that even boys who could add promptly turned their eleven into ten, and he did not catch them at it. So obviously was his mind as well as his gaze on something beyond, that Sandy Riach, a wit who had been waiting his chance for years, snapped at it now, and roared "Ten and eleven, nineteen" ("Go on," said Cathro), "and four, twenty," gasped Sandy, "and eight, sixteen," he added, gaining courage. "Very good," murmured the Dominie, whereupon Sandy clenched his reputation forever by saying, in one glorious mouthful, "and six, eleven, and two, five, and one, nocht."

There was no laughing at it then (though Sandy held a levee in the evening), they were all so stricken with amazement. By one move-

ment they swung round to see what had fascinated Cathro, and the other classes doing likewise, Tommy became suddenly the centre of observation. Big tears were slinking down his face, and falling on some sheets of paper, which emotion prevented his concealing. Anon the unusual stillness in the school made him look up, but he was dazed, like one uncertain of his whereabouts, and he blinked rapidly to clear his eyes, as a bird shakes water from its wings.

Mr. Cathro first uttered what was afterward described as a kind of throttled skirl, and then he roared "Come here!" whereupon Tommy stepped forward heavily, and tried, as commanded, to come to his senses, but it was not easy to make so long a journey in a moment, and several times, as he seemed about to conquer his tears, a wave of feeling set them flowing again.

"Take your time," said Mr. Cathro, grimly, "I can wait," and this had such a helpful effect that Tommy was able presently to speak up for his misdeeds. They consisted of some letters written at home but brought to the school for private reading, and the Dominie got a nasty jar when he saw that they were all signed "Betsy Grieve." Miss Betsy Grieve, servant to Mr. Duthie, was about to marry, and these letters were acknowledgments of wedding presents. Now, Mr. Cathro had written similar letters for Betsy only a few days before.

"Did she ask you to write these for her?" he demanded, fuming, and Tommy replied demurely that she had. He could not help adding, though he felt the unwisdom of it, "She got some other body to do them first, but his letters didna satisfy her."

"Oh!" said Mr. Cathro, and it was such a vicious oh that Tommy squeaked tremblingly, "I dinna know who he was."

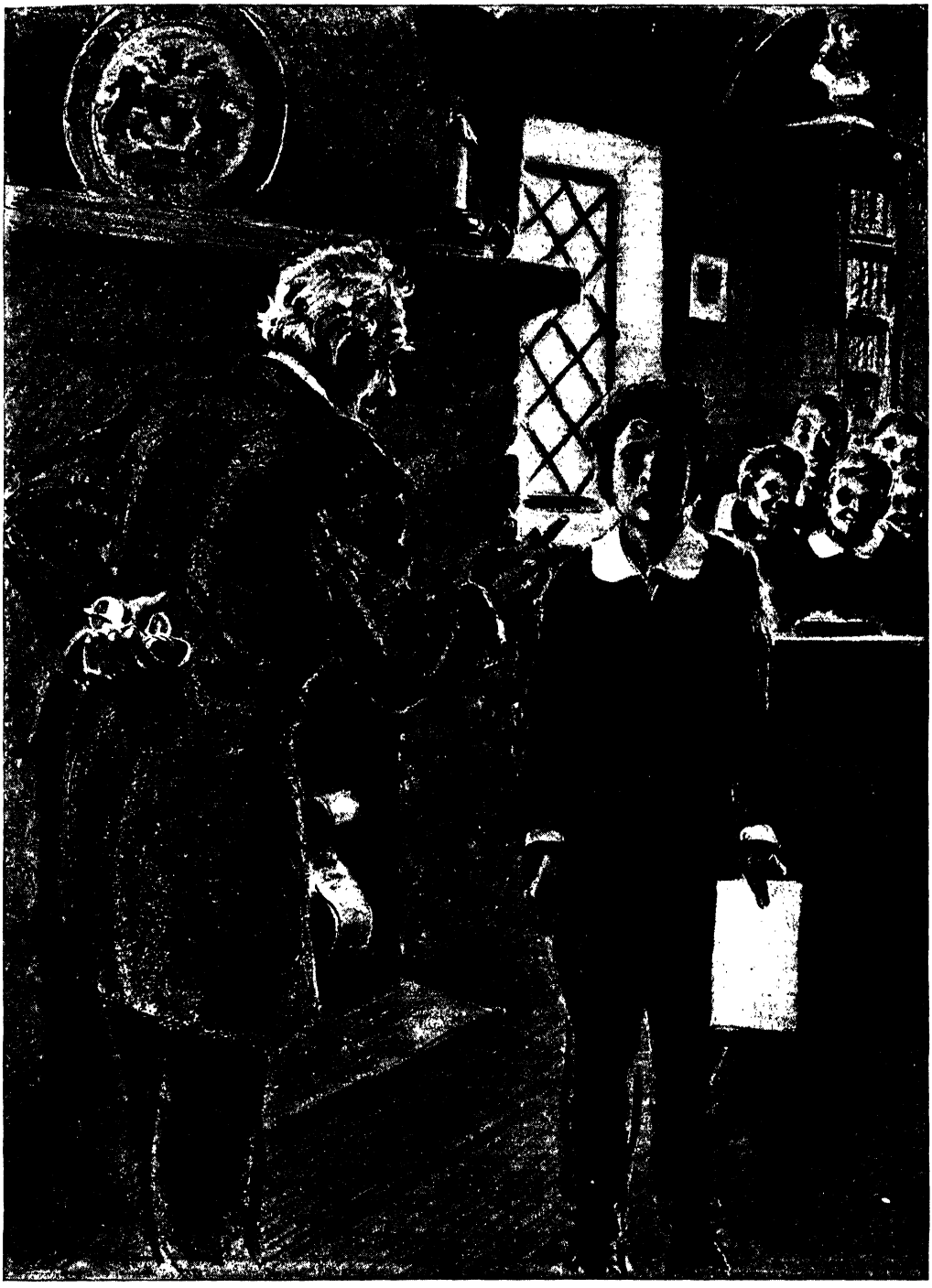
Keeping his mouth shut by gripping his underlip with his teeth, the Dominie read the letters, and Tommy gazed eagerly at him, all fear forgotten, soul conquering body. The others stood or sat waiting, perplexed as to the cause, confident of the issue. The letters were much finer productions than Cathro's, he had to admit to himself as he read. Yet the rivals had started fair, for Betsy was a recent immigrant from Dunkeld way, and the letters were to people known neither to Tommy nor to the Dominie. Also, she had given the same details for the guidance of each. A lady had sent a teapot, which affected to be new, but was not; Betsy recognized it by a scratch on the lid, and wanted to scratch back, but politely. So Tommy wrote, "When you come to see me we shall have a cup of tea out of your beautiful present, and it will be like a meeting of three old friends." That was perhaps too polite, Betsy feared, but Tommy said authoritatively, "No, the politer the nippier."

There was a set of six cups and saucers from Peter something, who had loved Betsy in vain. She had shown the Dominie and Tommy the ear-rings given her long ago by Peter (they were bought with 'Sosh checks) and the poem he had written about them, and she was most anxious to gratify him in her reply. All Cathro could do, however, was to wish Peter well in some ornate sentences, while Tommy's was a letter that only a tender woman's heart could have indited, with such beautiful touches about the days which are no more alas forever, that Betsy listened to it with heaving breast and felt so sorry for her old swain that, forgetting she had never loved him, she all but gave Andrew the go-by and returned to Peter. As for Peter, who had been getting over his trouble, he saw now for the first time what he had lost, and he carried Betsy's dear letter in his oxter pocket and was inconsolable.

But the masterpiece went to Mrs. Dinnie, baker, in return for a flagon bun. Long ago her daughter, Janet, and Betsy had agreed to marry on the same day, and many a quip had Mrs. Dinnie cast at their romantic compact. But Janet died, and so it was a sad letter that Tommy had to write to her mother. "I'm doubting you're no auld enough for this ane," soft-hearted Betsy said, but she did not know her man. "Tell me some one thing the mother used often to say when she was taking her fun off the pair of you," he said, and "Where is she buried?" was a suggestive question, with the happy tag, "Is there a tree hanging over the grave?" Thus assisted, he composed a letter that had a tear in every sentence. Betsy rubbed her eyes red over it, and not all its sentiments were allowed to die, for Mrs. Dinnie, touched to the heart, printed the best of them in black licorice on short bread for funeral feasts, at which they gave rise to solemn reflections as they went down.

Nevertheless, this letter affected none so much as the writer of it. His first rough sketch became so damp as he wrote that he had to abandon his pen and take to pencil; while he

SENTIMENTAL TOMMY'S PUNISHMENT



Mr. Cathro had certainly intended to end the scene with the strap, but as he stretched out his hand for it he had another idea. He crossed to the fireplace, and picking up a charred stick, wrote with it on the forehead of startled Tommy the letters "S.T." All of the pupils were so taken aback that for some seconds nothing was heard but Tommy wiping his brow. Then, turning again to Tommy, Mr. Cathro said, "Wipe away, Sentimental Tommy, try hot water, try cold water, try a knife, but you will never get these letters off you; you are branded for ever."

was revising he had often to desist to dry his eyes on the coverlet of Aaron's bed, which made Elspeth weep also, though she had no notion what he was at. But when the work was finished he took her into the secret and read his letter to her, and he almost choked as he did so. Yet he smiled rapturously through his woe, and she knew no better than to be proud of him, and he woke next morning with a cold, brought on you can see how, but his triumph was worth its price.

Having read the letter in an uncanny silence, Mr. Cathro unbottled Tommy for the details, and out they came with a rush, blowing away the cork discretion. Yet was the Dominie slow to strike; he seemed to find more satisfaction in surveying his young friend with a wondering gaze that had a dash of admiration in it, which Tommy was the first to note.

"I don't mind admitting before the whole school," said Mr. Cathro, slowly, "that if these letters had been addressed to me they would have taken me in."

Tommy tried to look modest, but his chest would have its way.

"You little sacket," cried the Dominie, "how did you manage it?"

"I think I thought I was Betsy at the time," Tommy answered, with proper awe.

"She told me nothing about the weeping-willow at the grave," said the Dominie, perhaps in self-defense.

"You hadna speired if there was one," retorted Tommy, jealousy.

"What made you think of it?"

"I saw it might come in neat." (He had said in the letter that the weeping-willow reminded him of the days when Janet's bonny hair hung down kissing her waist just as the willow kissed the grave.)

"Willows don't hang so low as you seem to think," said the Dominie.

"Yes, they do," replied Tommy, "I walked three miles to see one to make sure. I was near putting in another beautiful bit about weeping-willows."

"Well, why didn't you?"

Tommy looked up with an impudent snigger. "You could never guess," he said.

"Answer me at once," thundered his preceptor, "was it because—"

"No," interrupted Tommy, so conscious of Mr. Cathro's inferiority that to let him go on seemed waste of time. "It was because, though it is a beautiful thing in itself, I felt a servant lassie wouldna have thought o't. I was sweer," he admitted, with a sigh; then firmly, "but I cut it out."

Again Cathro admired, reluctantly. The hack does feel the difference between himself and the artist. Cathro might possibly have had the idea, he could not have cut it out.

But the hack is sometimes, or usually, or nearly always the artist's master, and can make him suffer for his dem'd superiority.

"What made you snivel when you read the pathetic bits?" asked Cathro, with itching fingers.

"I was so sorry for Peter and Mrs. Dinnie," Tommy answered, a little puzzled himself now. "I saw them so clear."

"And yet until Betsy came to you, you had never heard tell of them?"

"No."

"And on reflection you don't care a doit about them?"

"N-no."

"And you care as little for Betsy?"

"No now, but at the time I a kind of thought I was to be married to Andrew."

"And even while you blubbered you were saying to yourself, 'What a clever billie I am!'"

Mr. Cathro had certainly intended to end the scene with the strap, but as he stretched out his hand for it he had another idea. "Do you know why Nether Drumgley's sheep are branded with the letters N.D.?" he asked his pupils, and a dozen replied, "So as all may ken wha they belong to."

"Precisely," said Mr. Cathro, "and similarly they used to brand a letter on a felon, so that all might know whom *he* belonged to." He crossed to the fireplace, and, picking up a charred stick, wrote with it on the forehead of startled Tommy the letters

"S.T."

"Now," said the Dominie complacently, "we know to whom Tommy belongs."

All were so taken aback that for some seconds nothing could be heard save Tommy indignantly wiping his brow; then "What is he?" cried one, the mouthpiece of half a hundred.

"He is one of the two proprietors we have just been speaking of," replied Cathro, dryly, and turning again to Tommy, he said, "Wipe away, Sentimental Tommy, try hot water, try cold water, try a knife, but you will never get these letters off you; you are branded for ever and ever."

THE TWELVE LABORS OF HERCULES

A LEGEND OF ANCIENT GREECE

As well as cultivating all that is beautiful in art and letters, the ancient Greeks worshiped sheer physical strength. High in honor among their heroes was Hercules, whom they adopted as the patron of strength. "The labors of Hercules" has become a well-known phrase, and the separate titles of the labors are often quoted today. In his youth Hercules roused the jealousy of Eurystheus, king of Argolis; and the gods placed the heroic youth in the power of the King for a term of service. Eurystheus gave Hercules the following tasks.

THE SNAKE WITH A HUNDRED HEADS

THE hydra was a monstrous water snake with many heads, which grew again as fast as they were cut off. This fierce monster devastated Argolis, dragging both men and beasts into the swamp where it lived, and there strangling them. Hercules was aided by his friend Iolus, who applied a lighted firebrand to the stumps immediately after Hercules had cut off the heads with his sword. They both dipped their arrows in the hydra's poisonous gall so that the wounds they gave should be incurable.

SLAYING THE LION

A DREADFUL lion was terrifying the inhabitants of a district in Argolis, coming out of the forest from time to time and killing the inhabitants of the neighboring villages. So powerful was the beast that none dare attack it, and neither sword nor arrow could pierce its skin; but Hercules seized the lion in his powerful arms and forced it on its back. Then he knelt upon it and strangled it with his hands. The hero removed its invulnerable skin, and ever after that he wore it around his own shoulders.

THE CAPTURE OF THE SACRED STAG

THERE lived on the Ceryneian Mountain a wonderful stag that was sacred to Diana, the goddess of hunting. Its horns were of pure gold, its hoofs were of brass, and it was so fleet of foot that no man had ever been able to catch it. Hercules was commanded to capture it and to bring it unhurt to Eurystheus. This he succeeded in doing after a full year's chase through the forests of Greece. As he was returning the wrathful Diana met him, but she was appeased when he told her his story.

CLEANSING THE STABLE

ONE of the labors of Hercules has given a proverb to the world, for when we wish to call a task almost impossible of accomplishment, we speak of it as "cleansing the Augean stables." Augeas was king of Elis and the owner of some three thousand head of cattle. The stables in which these cattle lived had never been cleansed and were in a terrible state of filth, so that the task of cleaning them out in one day seemed impossible even for Hercules. Yet he easily effected it by breaking down a part of the wall, and diverting through the stables a river that flowed close by, thus washing out thoroughly the horrible mire and filth within.

THE ARCADIAN BOAR

THE neighboring state of Arcadia was in great danger of being ruined by a huge boar which came down from Mount Erymanthus, and spared neither man nor beast. Hercules was accordingly sent to capture the beast. The boar had hitherto defied all the attacks and ruses of the Arcadian shepherd folk; but when the terrible monster saw Hercules it turned and fled up the snow-clad mountains, with Hercules in full chase. He succeeded in bringing it to Eurystheus, who was so terrified at the sight of it, however, that he crept into a cask to hide.

THE BIRDS WITH THE BRAZEN WINGS

THE marshy forests around Lake Stymphalis, in Arcadia, were infested by some voracious birds whose wings, talons and heads were of brass. These birds fed on the flesh of men and animals. When sent to slay them, Hercules was puzzled how to get near them, so inaccessible was their nest. He therefore begged Minerva, the goddess of brave deeds, to help him, and she gave him a brazen rattle. Hercules stood on the shores of the lake and made the woods re-echo with a terrible din. The startled birds flew out into the open, and Hercules shot them one by one with his poisoned arrows.

THE MAD BULL OF CRETE

MINOS, king of Crete, an island to the south of Greece, had once promised to sacrifice a huge bull to Neptune, god of the sea. Because of its great size and beauty, however, Minos had kept it for himself. The bull went mad and began to destroy the crops of the island. Hercules captured it, and brought the raging beast alive to Mycenæ as his seventh labor, but King Eurystheus foolishly let it loose, and it crossed the Isthmus of Corinth and ravaged the valley of Marathon, in Attica.

THE MAN-EATING HORSES

DIOMEDES, king of Thrace, was so cruel that he was wont to throw all strangers to some wild horses, which devoured them. Hercules, with some of his brave friends, sailed to Thrace, attacked and captured the tyrant, and gave the King to his own horses to eat. Hercules then brought the horses over the sea to Mycenæ, and drove them up into the mountains, where they were torn to pieces by other wild beasts.

THE GIRDLE OF THE AMAZON QUEEN

IN his ninth labor Hercules had also to make a long journey. This time he was sent to fetch the girdle of Hippolyte, the queen of the warlike Amazons who dwelt in the land of Scythia, in the south of the country we now call Russia. Some say that he killed the Queen after a hard fight, and others that he only captured her and gave her in marriage to his friend Theseus. At any rate, he succeeded in his object of bringing the famous girdle back to Eurystheus.

THE BATTLE WITH THE GIANT

FAR away from Greece, in the unknown western sea, there was an island called Gades. Traders brought strange tidings thence of a three-bodied giant named Geryon, who owned beautiful herds of cattle and a two-headed dog to watch over them. Hercules was sent to fetch these cattle. Many are the tales told by the Greek poets about this journey—how, for instance, scorched by the heat, he tried to shoot the sun-god, who, admiring his audacity, gave him a golden bowl wherein he sailed to the island, passing through the Strait of Gibraltar, the rocks on either side being called the Pillars of Hercules in memory of the mighty Hercules' journey through them.

The hero slew the giant's herdsmen and his two-headed dog, but just as he was driving off the cattle Geryon came up in hot haste and seized him. After a terrific struggle Geryon was defeated. Even then all was not peaceful sailing homeward, for in Italy a fire-breathing giant called Cacus stole some of the herd, and hid them in a cave, dragging them backward, so that their tracks should deceive their owner. Hercules, however, heard the lowing of the cattle, gripped Cacus to death, and set them free.

THE GOLDEN APPLES

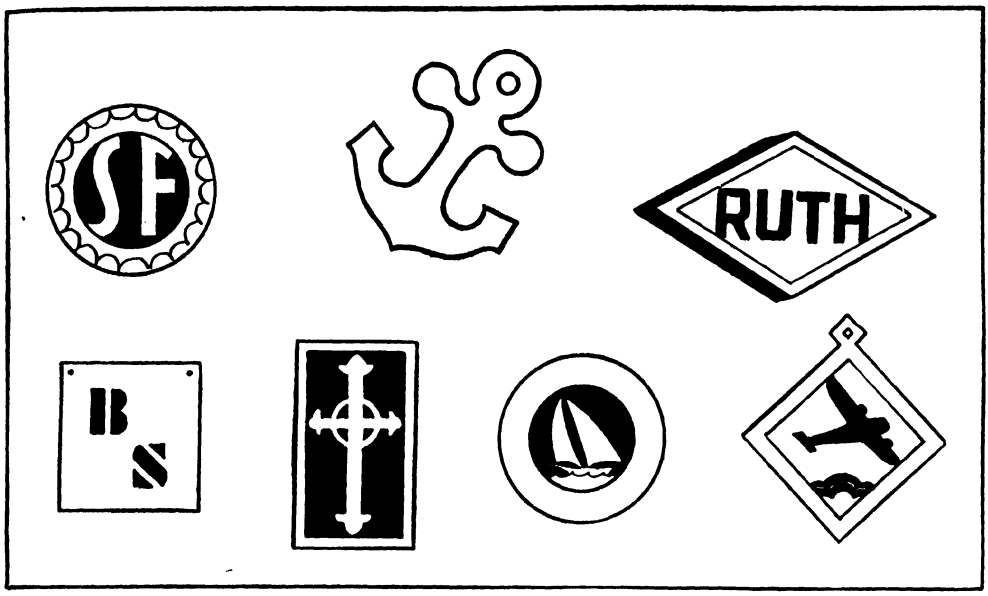
IN a beautiful land in the west of Africa lived some nymphs called the Hesperides. It was their duty to guard the fruit which Mother Earth had presented to the goddess Juno as a bridal gift. A sleepless dragon guarded the orchard where grew the golden apples, and the way that led to it was full of difficulties. After many wanderings and terrible fights with giants and tyrants, Hercules succeeded in catching Nereus, one of the gods of the sea, who changed into all kinds of shapes in his endeavors to escape from the strong hands that gripped him. Finding all his wiles of no avail, he resumed his natural shape and sent Hercules to Atlas, who agreed to steal the fruit, on condition that Hercules support the heavens while Atlas was away.

Atlas thought that at last he was rid of his heavy task, and suggested that he take the apples to Eurystheus. Hercules agreed to this plan provided Atlas would hold the heavens a minute while he put a pad on his shoulders to ease the pressure. The giant took up his burden once more and Hercules seized the apples and went off.

THE DOG OF THE UNDERWORLD

AT the entrance to Hades, the abode of the dead, there kept guard a three-headed dog named Cerberus, whose duty it was to prevent the living from entering and the dead from escaping out of the shadow-kingdom. Pluto, the dark-visaged king of the Underworld, gave Hercules permission to take the dog up into the light, provided that he did not use weapons. This Hercules, by his mighty strength, succeeded in doing, and he also led it back uninjured. Hercules was then freed from his labors.

THE NEXT STORIES ARE ON PAGE 3441.



1. A series of cut-outs made from plastics; they may be used as dress-clips, pins or shade-pulls. Details may be scratched on with a sharp tool and filled with quick-drying lacquer of a contrasting color.

TRY YOUR HAND AT PLASTICS

HOW would you like to have someone place a big, solid block of jade or ruby or carnelian in your hands, wave a magic wand and say, "Go ahead, make anything you want out of it—you can saw it, plane it, sand it, drill or shape it like a block of wood, and then polish it off like a gemstone?"

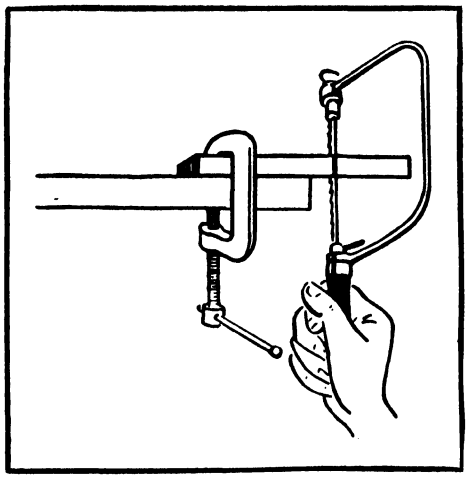
That is exactly what you can do with some of the new synthetic resins popularly called plastics, which have all the flashing warmth of color found in different beautiful jewel stones.

This miracle of modern science is no doubt familiar to you in such commonplace articles as knife handles, gear-shift knobs, radio cabinets, costume jewelry, and the like, but you have possibly thought of it merely as a commercial product out of the grasp of millions of boys and girls and men and women who like to make nice things.

Until recently, this was so. But now the material is available in many different shapes in department, hardware and arts and crafts stores. Many school "activities" groups and hobby clubs are showing skill with the new plastics. Even the inexperienced worker can turn out an article that is beautiful and professional looking. The colors and jewel-like finish of the material need only a little polishing to bring them out. There is no dyeing, staining or painting to be done.

Chemically, these plastics are known as "cast phenolic formaldehyde polymers," and the raw materials are phenol (carbolic acid) crystals and formaldehyde. Combined in huge vats, these are heated and form an inert material, waterproof, acid- and alkali-proof, tasteless and odorless. After heating, the material is then poured into leaden molds of various shapes to cool and harden, while a change called polymerization, takes place. This is neither a physical nor a chemical union in the usual sense, but an actual combination and rearrangement of the molecules into a substance which is not found in nature, and which cannot be again restored to its original forms.

Although there are over a hundred different kinds of synthetic plastic materials, the "cast phenolics" are the ones generally



2. Fret-saw used for cutting out designs.

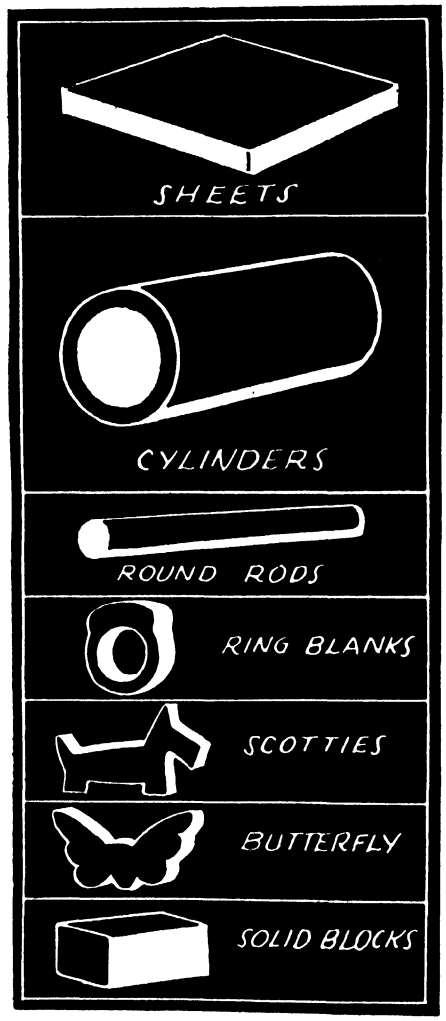
used in hobbycraft work with ordinary woodworking and metalworking tools.

The hand tools which may be used in working with plastics are, generally speaking, any which may be used for wood or metal, such as hack-saws, fret-saws, files, drills (but not augurs), engravers' points and almost any other tools except those with knife-edges, like planes. Fine-toothed saws cut more smoothly than coarse saws, and coarse grinding wheels faster than fine. Power tools, of course, are much faster and easier to work with, and practically any machine in the school shop (or your own, if you have a shop) may be used.

The fret-saw is a most useful tool if used properly. It can be employed in cutting out designs from flat sheet material, or in making intricate curves and patterns. When cutting sheet material, clamp the sheet to a table (as shown in the sketch), with the part to be cut projecting over the edge of the table. Then hold the saw with the blade vertical, the handle down, and saw with even up-and-down strokes. Any other method is likely to twist and bend the blade. When sawing in this manner, the points of the teeth should be pointed toward the handle. Cut on the down-stroke. When holding the saw horizontally for cutting rods, shapes, etc. in a vise, the teeth should be reversed, pointing away from the handle. Always use medium to fine-toothed blades.

Plastics may easily be bent by putting them in water that is almost boiling for a period equal to three minutes for each $\frac{1}{8}$" of thickness in the material. You can bend it with your hands, or with clamps, holding it in position until cooled. It is not wise to bend material thicker than $\frac{1}{8}$" too much, in fact, not more than 30 degrees.

Rub with sandpaper both surfaces to be joined. Then apply a thin coat of special plastic cement (no other will hold) to each surface, and hold the parts together a few moments until the cement dries slightly. Wipe off excess cement immediately, before it hardens. It is quite strong two or three hours after the pieces are joined, but for hardening finally, it should be put aside overnight. In working with plastics, as indeed with almost any sort of material, it is a



3. A few ways in which the resin block is cut.

good plan not to rush any process, but to make haste slowly, as the saying goes.

You can make attractive and colorful designs by inlaying with lacquer. Scratch the design into the surface with an awl or other sharp-pointed instrument. Then rub quick-drying lacquer of a contrasting color into these scratches. Wipe off excess lacquer immediately. Larger surfaces may be covered in the same way if they are first roughened so that the lacquer will hold.

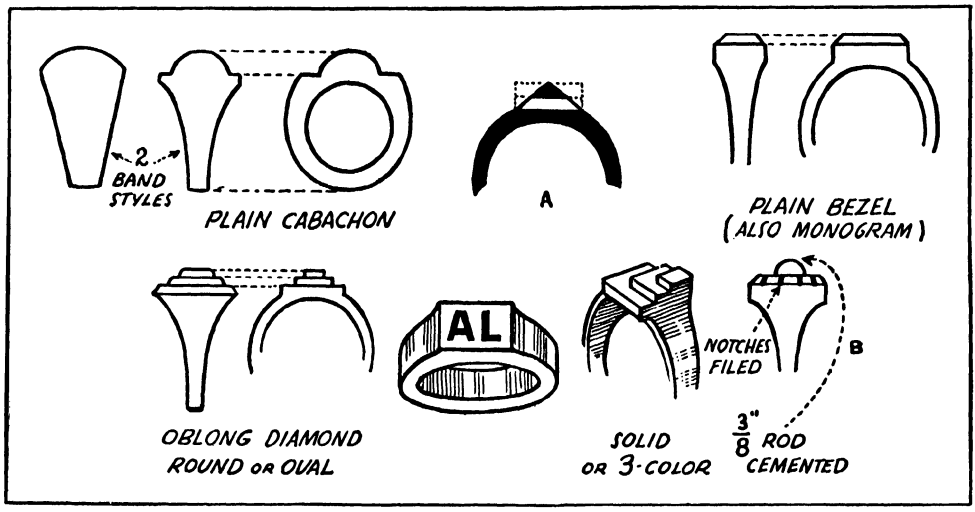
Success in bringing out a brilliant jewel-like finish on plastics depends upon how carefully you remove the marks of previous operations before proceeding with the next.

First, remove tool marks with medium sandpaper. Second, remove these sandpaper marks with a finer sandpaper (about # 8/0). Finally, remove this "frosted" appearance and bring out the brilliant finish with a polishing compound. This compound is first rubbed on with a piece of old carpet or cloth (or on the buffing wheel of a power tool) and the plastics are then rubbed briskly against it.

Many beautiful and useful objects may be made easily by any boy or girl from this jewel-like material, but there is space for only a few of the simpler ideas in this article. For more intricate and larger projects and designs you may find many useful suggestions in the popular science magazines or in Andrew J. Lockrey's Plastics in the School and Home Workshop.

It is best to start off with something easy, like a ring. For this purpose, plastics are cast in the form of tubes. First slice your piece to the proper width you desire, then proceed with one of these suggestions.

The first operation in making a ring is sizing—cutting out the inside to fit your finger. This can be done either with a ½" rat-tail file or with a piece of sandpaper wrapped around a dowel-rod or round pencil. After it is the proper size, fine-sandpaper it, and then polish. The easiest way to polish the inside of a ring is to tie a cloth to the bench, rub the cake of compound on the cloth, then run the cloth through the ring, hold it taut, and rapidly rub the ring back and forth.



4. Ring designs to be worked out on plastic materials.

Flat-topped rings can be engraved with a sharp-pointed tool, or a "stone" of another color material can be cemented in place. Designs A and B show two methods of doing this. A shows the top piece and the ring body filed down together after cementing. In B the top piece is set like a jewel, and it therefore must be shaped and polished before cementing. To do this, take a piece of ¼" rod and rub the end on sandpaper like a pencil until it is of the proper shape. Fine-sand and polish in the same manner, and then saw it off the end of this rod and cement it in position. It would be very difficult to shape and polish such a small piece in any other way. You will soon acquire skill in this process.

Many different bracelet designs may be worked out easily, with as little or as much work as you want to put into them. The plainest form of bracelet consists merely of polishing the bracelet blanks included in the kit after slightly rounding the edges.

A shows an inlaid design, the intricate-looking carving being accomplished by scratching the traced leaf design with any sharp-pointed tool, filling the scratches with lacquer, then sanding and polishing the whole thing.

B is made in the same manner, except that the scratches are made by laying the bracelet flat on the table and turning it against the tool. Where you want the lacquer to stick, be sure that the surface is roughened and sanded.

C is also done in the same way, except that a portion of the bracelet is sanded and lacquered, and the balance of it is polished without any lacquer. Another method is to make a series of fine file marks close together all over the shaded portion of the bracelet, and then partially polish this scratched portion. This makes a two-tone effect. The light portions (in the sketch) are, of course, left smooth and polished.

D is another idea offering an unlimited number of variations, and it also permits you to use up any small scraps you have on hand. These scraps are cut into any desired shape, the bottoms sanded, and then cemented (as shown) to a strip of strong ribbon which has already been cemented in a circle to the proper size.

E is made by filling heart shapes in from each side, and then scratching the connecting lines which complete the heart design.

F is a variation of the same idea. The dark oval is scratched in and lacquered. Many different designs may be worked out in this manner.

Following are some helpful things to remember in working with plastics.

1. Save every scrap of plastics, because these can be worked into small ornaments for various projects, assembled in mosaics and used in many other ways.

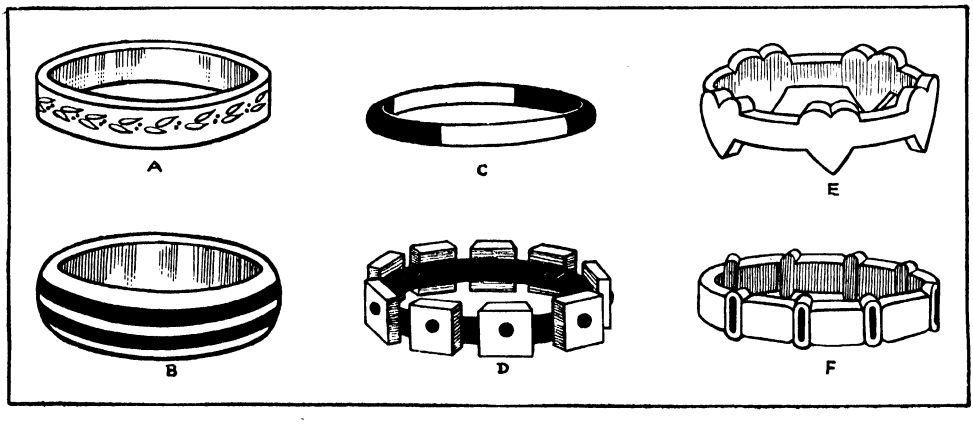
2. Temporary joints, when you want to stick two pieces of plastic together only while they are being worked on, can be made with ordinary glue. The pieces can then be separated easily by soaking in hot water.

3. When you drill plastics, pull out the drill every so often, or the fine powder resulting from your drilling will clog the drill and make the material hot. Turn the piece over when you are just about to break through and drill from the other side. In this way you will not chip the material.

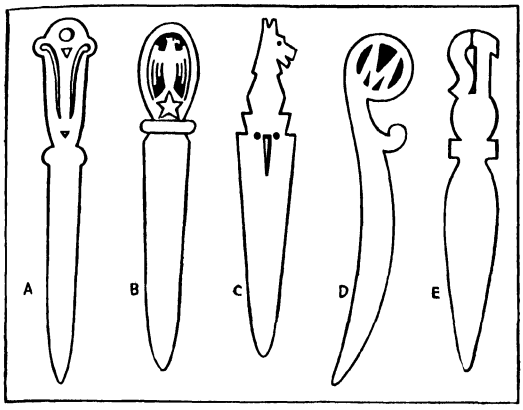
4. Always do as much polishing as possible before you put the various pieces in your project together.

5. Remember that you must always sandpaper or roughen any two pieces of plastic that you desire to cement together. Clean off excess cement before it hardens, or you may scratch the project when you attempt to remove it later.

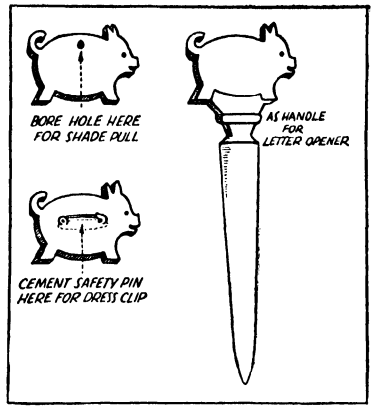
6. Do not waste time in trying to work with dull tools or worn-out sandpaper.



5. Some striking bracelet designs.



6. Designs for letter openers.



7. How to use animal designs.

7. Nearly all power tools may be used on plastics, except those with knife edges. The most useful tool is a motor-driven buffer, which could also be used for sanding and shaping and drilling.

8. The acrid smell you may notice when cast phenolic plastics on which you are working become too hot is not harmful.

9. You can cut and polish plastics more quickly by holding the piece of plastic in your hand, and fastening the sandpaper or buffing surface to the work-table. You can exert much greater pressure with less effort in this way. It is also the only way in which you can protect square corners.

10. To file round or sharp corners in plastics, wrap round dowel sticks or square blocks in sandpaper, and then use these as you would a file.

Article and illustrations by Harry Tankoos and Andrew Jules Lockrey, U. S. Plastics Craft Corporation.

WHO AM I?

CAN you solve the riddles that follow? If you cannot, turn to page 3380 and you will find the solutions.

1. I am not in water or in air, but I am in a potato. Peaceful men should praise me, for I end every set-to. Who am I?

2. I'll give you my first letter, my second letter, my third letter. Why, I'll give you all my letters! Yet I'll always be the same. Who am I?

3. A very young man wants to have me, but when he has me he no longer wants me. Knife in hand he attacks me and does his best to annihilate me. Yet he knows that it is all in vain. Who am I?

4. I am very polished but sometimes as brutal as I can be. Some curse me, others praise me, and yet I treat all alike. Who am I?

5. I belong only to you; yet others use me much more than you do. I was here before you and shall still be here when you are no longer here. Who am I?

6. With my head I'm the delight of many a princess royal; without my head I'm indeed poor and humble. Who am I?

7. Although generally quite spotless, I associate with the blackest characters. If I didn't, however, I'd be almost worthless. Who am I?

8. You'll say "Oh! Oh!" when you try to spell my name. If you want to write it, I'll give you something with which to write it. Who am I?

9. I have leaves, but I'm no tree. I sometimes have tables, but I'm no banquet hall. You can digest me if you try hard enough, but I'm no food. Who am I?

10. The name I had before being born is of no use to me when I am born. If you wait for me, perhaps you shall see me, but no matter how hard you try, you'll never see me to-day. Who am I?

11. Give me a boat and we'll sail the seas together. Give me nine tails and I'm a terror. I'm a cousin to royalty and I'm a famous woman, who did much to emancipate other women. Who am I?

12. I have no visible means of support, but I support countless millions. Yet I do not complain for I have a faithful follower, who never abandons me. Who am I?

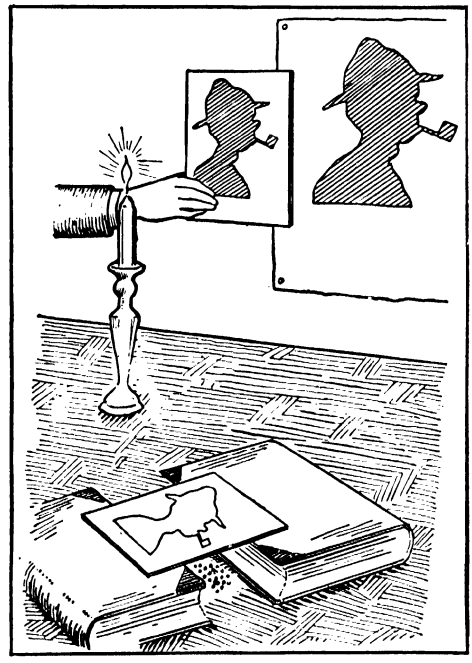
A MYSTERIOUS FIGURE ON A SCREEN

HERE is a very mystifying trick that will puzzle your friends. Set up a screen on the wall and place a candle on a table, about two feet away. Announce to your friends that you are going to take a perfectly clean piece of glass, rub it with silk and hold it between the candle and the screen. A magic figure will then appear on the screen.

Your friends will be amazed at this surprising performance, all the more so because they apparently witnessed all the preparations for it. Can it be, they will wonder, that this astonishing result was produced by pure magic? And yet, as we shall now see, no magic at all was involved.

Here is the explanation of the trick, which is based upon a well-known property of electricity. In the first place, much of the preparation for the trick has to be done while your friends are absent from the room. First, lay two books of the same thickness on the table, face downward and about four inches apart, as in the picture. File an ordinary cork bottle-stopper with a fine file and deposit the powder thus obtained in the space between the two books. Be sure that you cover all the space. On a rectangular piece of glass draw a profile in glycerine, filling it in solidly. This profile should be small enough to fit the space between the two books. Finally, set up your screen on the wall and put a candle on the table about two feet away from the screen.

Now your friends may be summoned to watch you perform the trick. The room must be left in darkness, except for the candle. Show your friends the piece of glass, which in the dim light will appear to be without markings of any sort. Then proceed with the trick. Lay the glass across the two books, so that the profile will be in the space between them; rub the surface of the glass



with a piece of silk. Your friends will see all this and will think nothing of it. But this is what will be taking place. As you rub the glass, you will be charging it with electricity. The cork powder under the glass will be attracted to it, just as iron filings are attracted to a magnet. Normally, all the cork powder would drop off as soon as the charge on the glass was exhausted. On your prepared glass, however, the particles of cork will stick to the portions of the glass to which the glycerine has been applied. Therefore, when you hold the glass between the candle and the screen, the figure that you have drawn will appear, as if by magic, upon the screen.

SAILORS' HITCHES AND SPLICES

ON page 340 we saw how sailors make their knots. There are other ways in which sailors must make use of ropes. They must make hitches, which are really a kind of knot; they must also splice ropes—that is, join two ropes together by uniting their ends without knots. In this article we see how to make hitches and how to splice ropes.

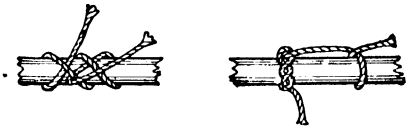
We show the simplest hitch in figure 1. This is called a half hitch. We pass the end around a bar and its own standing part, and then down between its own part and the bar. The next hitch, called the timber hitch, is made in the same way, except that the end is passed not once, but several times around

1. The half hitch. 2. The timber hitch. 3. The clove hitch.

its own part, as in figure 2.

In making the clove hitch, shown in figure 3, we pass the end around the bar, cross it over the standing part, pass it around the bar again and then pass it between its own part and the bar. The rolling hitch is made in the same way; but the second half of the operation consists in passing the rope twice around the bar, and in passing the end under both the turns, as in figure 4. The timber and half hitch (figure 5) combines two hitches which we have already seen, and is made by making first a half hitch, and then making a timber hitch with the end part, as shown in figure 2.

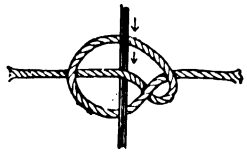
Now we come to what is called the handspike hitch. This hitch is frequently used



4. The rolling hitch. 5. The timber and half hitch.

by sailors when the two ends of the rope are fastened, and when they wish to exert pressure upon the rope. First of all we make a loop in the rope, and then we pass the end of the bar through the loop, under the rope, in the loop and then out through the loop again. It will then be as seen in figure 6. When we pull out the bar again, the rope is free, without any knot or hitch at all.

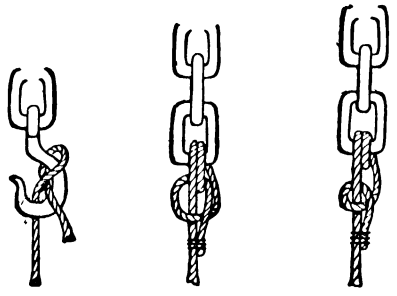
The Blackwall hitch, as seen in figure 7, is used on board ship for suspending cargo from the hook of a crane. This hitch is made by passing the end of a rope around the back of the hook and under its own part, taking care that the two parts of the rope



6. The handspike hitch.

are on opposite sides of the hook.

The fisherman's bend is used to fasten a rope to a shackle or ring. To make it, we pass the rope twice around the ring and put the end through the turns. For security, the end must be tied to the standing part with strong string, an operation that is known as "stopping back." Figure 8 shows



7. A Blackwall hitch. 8. The fisherman's bend. 9. Round turn, half hitch.

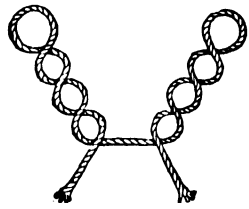
the fisherman's bend. The round turn and half hitch is made in the same way, except that the end is passed through only one of the turns, as seen in figure 9.

The series of loops seen in figure 10 is what is called a catspaw. We take a part of the middle of the rope and form two bights. We take one of these in each hand and twist them around an equal number of times. Thereby we make two series of loops, one at the end of each of the bights. A bar or spike may now be passed through the two series of loops.

We now come to the splicing of the ropes. This process is considerably more difficult than making knots or hitches. It is a very valuable accomplishment, however.

The eye splice is the method of making a

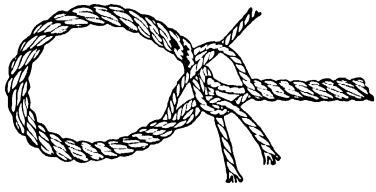
permanent loop at the end of a rope. We take the end of the rope and unlay, or open out, the three strands for about 4 inches. Then we place these against the standing part at the spot which will give a loop of the desired size. We take the middle strand and, after prizing up one of the strands of the standing part, pass the free strand be-



10. A catspaw.

neath it. We then pass the other two strands, one on each side, under the other strands of the standing part, and work the loop up tight, slightly tapering the strands by pulling off a little of the hemp.

The usual practice is to cut one or more of the yarns composing the strands of the rope. After the first tuck has been completed with all strands, we pass them under the strands of the standing part again, taking care that each free strand passes over one of the standing strands before entering beneath the next strand. The ends are now again further tapered, and the process repeated a third time. All ends are now clipped off short after the splice has been well ham-

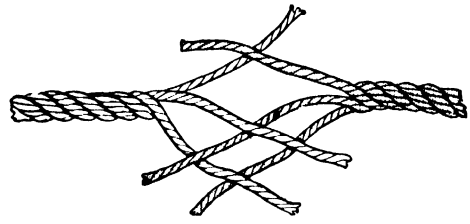


11. The eye splice.

mered, and then fine spun-yarn is bound around the joint. Binding with spun-yarn, when done the reverse way to the lay of the rope, is called serving. These instructions and the illustration in picture 11, if followed carefully, will enable us to make a good strong eye splice.

We are now going to make a splice, or join, between two ropes. The end of each of these ropes must be unlaid, or unraveled, for a few inches. Then we fit the ends of each rope accurately together, so that the ends of one lie between the ends of the other. This process is called crutching, or marrying the ropes. We now pass each strand over one strand of the opposite rope and tuck it under the next strand. When this has been done once with each strand of each rope, as illustrated in figure 12, we taper the ends a little and repeat the process. We finally clip off the ends and, if it is necessary, we tie around with spun-yarn.

A long splice is used where no increase in the circumference of the rope is required. To begin with, each rope must be unlaid about three times as far as for a short splice. Then the parts are married, as if we were making a short splice. Now we take one of the strands of the right-hand rope and unlay it still further, filling up the groove thus made with the corresponding strand of the left-hand rope. This must be done till only a short end of the left-hand strand



12. Marrying a rope.

remains entirely free.

We repeat the same operation on the left-hand rope, filling up with the corresponding right-hand strand. We now have two long strands in the middle, and at some distance on each side of them there will be a very long strand, and a very short one.

We must now deal with each one of these three points separately. We divide the strands at each point and tie the corresponding divisions together. Then we tuck the ends at each point thus formed and tuck them under the second strand, having passed over the first one.

Next, we taper the ends and tuck them a second time over a strand and under the second from it; then we hammer and stretch the rope well and cut off all loose ends. We ought now to have a rope almost as strong as if there had been no splicing. A rope spliced in the manner that we have described will stand almost any strain to which we could subject a brand new rope. If our spliced rope does not stand up well, the splicing was probably carelessly done.

THE NEXT THINGS TO MAKE AND TO DO ARE ON PAGE 3375.

ACCIDENT and HEALTH INSURANCE

ACCIDENTS and illness are unhappy things to talk about, but no one can expect to live a lifetime without having some kind of accident or becoming ill. Some accidents and illnesses are serious and may result in long periods of invalidism.

The newspapers contain spectacular accounts of accidents in the street and highways and public places, but nearly as many accidents occur around the home. Somebody trips on a rug. Somebody falls off a stepladder. Somebody is careless in cooking dinner, and is burned. Accidents incurred in the playing of sports and swimming also account for a large number of injuries, big and little. Despite constant campaigns to reduce the number of accidents, there are still approximately 100,000 accidental deaths and nearly 9,000,000 non-fatal injuries in the United States each year.

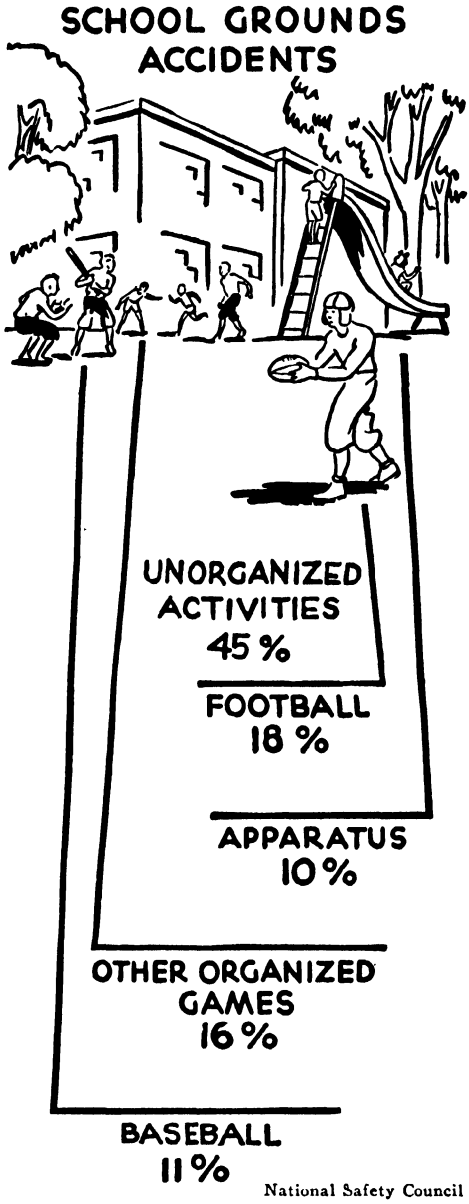
It has been estimated that around 3,000,000 people are constantly ill in the United States throughout the year and that over half the illness is caused by respiratory diseases, chiefly colds and influenza.

The pain and suffering caused by accidents and illness tell only half the story. Loss of time from school and work and medical and hospital expenses often make the pain seem worse. Money spent in this country for doctors, services, hospitalization, nursing care, drugs, medicines, X-rays, and special treatments, amounts to a huge annual sum. Added to this expense is another much larger amount that is lost to wage earners throughout the nation by reason of their loss of wages or income while sick or otherwise disabled.

Accident and health (sickness) insurance is a form of insurance devised to protect against these economic losses. It protects the earnings of wage earners and furnishes financial aid to the family of the breadwinner by the payment of his doctor and hospital bills. Today, business and professional men, farmers, industrial workers, clerks, and those engaged in various occupations, whose earning power is shut off for a week, a month, or sometimes years, because of accidents or illness, can insure themselves against this financial loss by accident and health insurance.

Protection is available to all types of workers and the cost (called the premium)

ranges from a few cents a day for small or limited policies to several dollars a month for policies paying larger amounts (called indemnities). Policy is another name for an



National Safety Council

insurance contract. Most accident and health policies are cancelable policies—that is, they are sold for a definite term such as a week, a month, or a year, similar to contracts of fire insurance and automobile liability insurance. There are, however, policies which cannot be canceled or terminated by the insurance company until the policyholder reaches an age at which he usually has no further earning power—most often at sixty or sixty-five years. These non-cancelable policies cost more than the cancelable policies.

Some of the more common types of accident and health policies are:

Commercial Policy. This is usually issued to persons whose occupations are in the less hazardous classes such as office workers, teachers, lawyers, salesmen, and executives and those men and women in business positions whose regular incomes are fairly good.

Industrial Policy. This is issued to persons engaged in more hazardous occupations such as farmers, steel workers, oil workers, miners and others. These policies are usually purchased by persons with lower incomes. Many of these policies are also issued to "white-collar" and non-industrial workers whose incomes are limited. Industrial policies are sold by the payment of a weekly premium or a monthly premium. Many times these policies contain a funeral or death benefit of $100.00 or $200.00, which is payable for natural or non-accidental death.

Automobile Accident Policy. This insures specifically against loss of time or expense due to automobile accidents. It should not be confused with the automobile fire and theft or liability policies.

Limited Policy. A great many limited policies are sold through newspapers and magazines, and by radio advertising. These policies are limited to payment of indemnities for specific accidents or illness and are popular because of the low cost.

Group Accident and Health Insurance. This form of insurance has increased rapidly during the past five years. Group insurance is sold largely to industrial plants, stores and other commercial organizations where the advantage of deducting premiums from the payroll lowers the cost of the insurance. Most of these group accident and health policies do not include payment for occupational accidents, since these are already taken care of by workmen's compensation acts. They provide small indemnities proportionate to the wages of the employees and may be combined with group life insurance

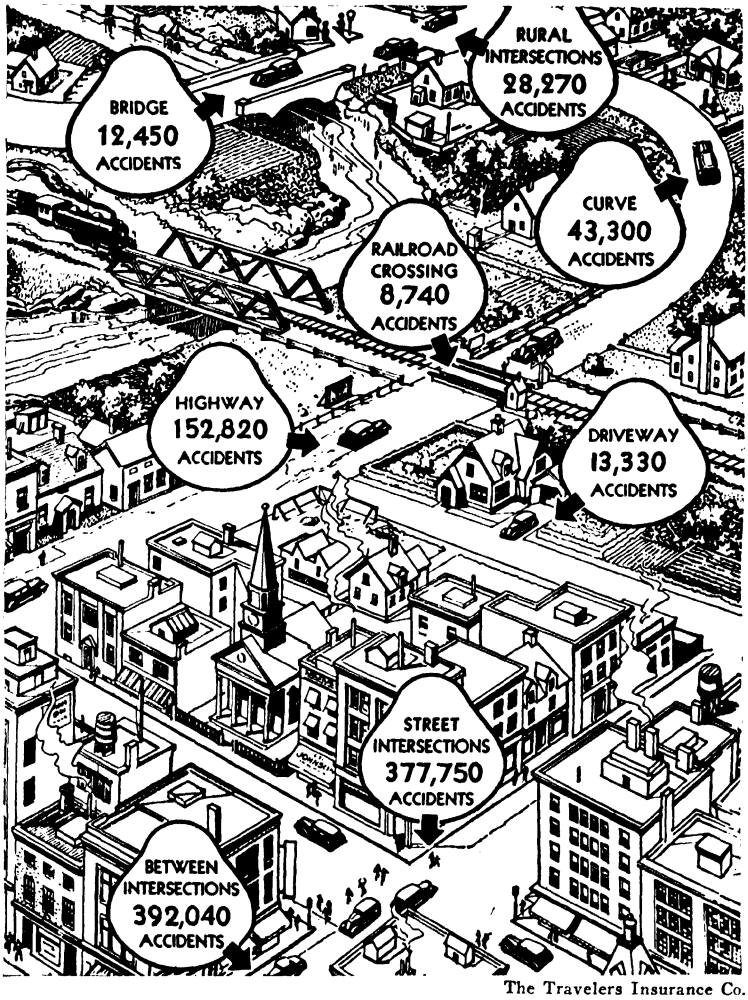
or group hospitalization. Group insurance is also afforded members of associations, such as teachers' groups and medical societies, and to units of federal, state and municipal employees. A few companies also supply group accident insurance on athletic teams in high schools and colleges.

Deferred Payment Policy. A special form of accident and health insurance has been devised to protect the purchaser of real estate, automobiles, furniture and other commodities bought on the installment plan. The policy provides for the continuance of the payments on such purchases if the purchaser becomes sick or disabled. Similar insurance is available for members of credit unions to insure repayment of loans.

Railroad Travel Policy. This is a well-known form of accident insurance which one can purchase at railroad, steamboat, bus and air-line ticket stations upon the payment of a small sum. Insurance is for a short period of time, a day, a week or a month.

Hospital Policy. The most popular form of accident and health insurance at the present time is the hospital policy. The hospital insurance policy provides a daily payment for a given number of days while the policyholder is confined to a hospital. The hospital policy also may include additional payments for the use of operating room, cost of anesthesia, X-rays, laboratory fees, ambulance charges and other expenses. Many of these policies also include benefits for the payment of specified amounts for operations. Some companies at the present time are issuing a policy whereby stated amounts will be paid for visits by a physician.

Generally speaking, there is no standard form of accident and health policy similar to the fire-insurance policy. The contract itself varies as to the policy provisions, amount of indemnity payable, length of time payable, and various other benefits. Most policies may be divided into three parts: (a) Indemnity for specific or stated losses, such as accidental loss of life, loss of hands, limbs, or sight; (b) Indemnity for



The Travelers Insurance Co.

The places where accidents occur most often out-of-doors. The figures, for one year, indicate that crossing in the middle of the block is most dangerous.

SAFETY RULES FOR HOME AND FACTORY

Pictograph Corporation

How to avoid accidents at home and in the factory. By following these common-sense rules, our time, health and money are saved.

Metropolitan Life Insurance Co.

Many accidents are caused by stupidity and carelessness. Never put a loose rug on a stairway.

loss of time; and (c) Indemnity for other expense, such as hospital, nurse, medical and similar expense.

Indemnity for loss of time from accident is usually paid on a weekly or monthly basis for a stated period of time, although some policies will pay for life. These loss-of-time benefits from accidents are paid if the insured person is totally disabled and unable to engage in his usual occupation; partial or reduced indemnity is paid for shorter periods of time if the insured person is only partially disabled.

Persons receiving income from sources other than employment (that is, from real estate stocks and bonds, annuities, etc.) are not usually insured by accident disability policies.

The insurance companies supplying (or writing, as they call it) accident and health insurance in the United States in a recent year insured approximately 14,000,000 persons and collected a total of $223,000,000 in premiums. Over 2,500,000 persons were paid claims for either accidents or sickness during the same year. If all these people were gathered together in a single city, it would rank among the largest in the world.

You will have noticed that we mention several kinds of insurance that cover the cost of medical care. However, only a small proportion of the people are insured in this way. Many other people can not afford it. Experience in the war, when the draft boards had to reject more than one-quarter of the young men called up for service, showed that there is a very great need for more extensive health care.

In recent years there has been a growing movement for what is called compulsory health insurance. In general, under such a plan the wage earner would contribute to a central insurance fund by having a certain per cent of his pay deducted. Different versions of the plan also call for contributions by employers and, in some cases, by the government. It would work something like Social Security in the United States. Some form of compulsory health insurance has, in fact been adopted by a number of countries.

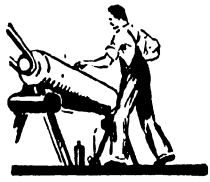
One advantage of such a plan to the health of the country as a whole is that, under it, no worker would fear to visit a doctor because of the possible expense. In this way, many of the most dreaded illnesses could be caught in the early stage when they are curable.

Whether or not compulsory health insurance itself is adopted in our country, it is highly probable that in the next few years there will be a great increase in various kinds of medical insurance. And it will cover the cost not only of curing illness, but of preventing it.

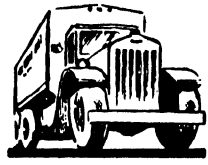
THE NEXT STORY OF OUR OWN LIFE IS ON PAGE 3305.

HANDLING OBJECTS
24% of the cases
15% of the compensation

FALLS
18% of the cases
23% of the compensation



MACHINERY
12% of the cases
15% of the compensation



VEHICLES
9% of the cases
14% of the compensation

HAND TOOLS
8% of the cases
4% of the compensation

FALLING OBJECTS
10% of the cases
12% of the compensation

STEPPING ON OR STRIKING AGAINST
8% of the cases
3% of the compensation

OTHERS
11% of the cases
14% of the compensation

National Safety Council

VERY CURIOUS-LOOKING TREES

West African grass tree.

Pandanus.

Courtesy, Australian News and Information Bureau
Curtain fig tree of Australia.

Cannon-ball tree.

N.Y. Botanical Garden

A banyan tree, showing how shoots hang down from branches, take root and grow into trunks.

QUEER PLANTS

AS in the animal kingdom there are strange creatures that strike the imagination on account of their great size or grotesque form, so in the vegetable kingdom there are many plants that attract attention wherever they may be seen.

There are, for example, a number of trees that grow to enormous sizes, some in girth, some in height and some in thickness of stem or diameter of leaf or blossom. Among these the banyan, or Indian fig, stands foremost. It is a relative of the common fig tree and produces a multitude of little figs that grow in pairs, are scarlet in color and about the size of a cherry.

But it is the banyan's amazing way of life that makes it so interesting. The trunk throws out branches, and as they grow they put out hanging roots which increase in length till they reach the ground and there take root and develop into new stems. In this way the tree spreads farther and farther all around the original trunk, with an ever growing number of stems that become as thick as the trunk itself, and at last the banyan looks more like a grove or small forest than a single tree. This is clearly shown in the picture above.

The centre trunk may decay and die, but the tree lives on, supported by the many root-stems it throws down and drawing nourishment from the ground by their means. A banyan may have as many as 350 of these stems, each as thick as the trunk of an oak, and, in addition, there may be two or three thousand more stems of lesser girth. Such a tree will cover an enormous area, and seven or eight thousand people can take shelter under its branches.

Hundreds of bats, birds and monkeys will make a banyan tree their home. The monkeys eat not only the fruits but also the leaves, which are heart-shaped and grow about five or six inches long. Though there is so much stem, the wood of the banyan is too light and porous to be of value as timber; yet the tree is not lacking in commercial value for it yields both lac (from which lacquer is made) and caoutchouc (from which we get rubber), and its bark is used by the Hindus as a

medicine for various kinds of illness.

The banyan is much venerated by the Hindus, who plant it near their temples; if a village possesses no stone temple the banyan tree itself is used as a temple. The tree, with its widely outstretched arms, is regarded as an emblem of the Creator of all things. As a shelter from the hot Eastern sun the tree has no equal.

A very near relative of the banyan is the bo tree, or sacred fig tree, of India and Ceylon, which is looked upon as a holy plant by the Buddhists. It is said that the sites of ancient temples can always be identified as Brahmin or Buddhist according to whether there is growing near them the banyan or the bo tree. In general appearance the two are much alike except that the bo tree sends down, not rootlets, but true branches which, as soon as they reach the ground, take root and become thick stems.

Courtesy, Australian News and Information Bureau

An Australian bottle tree. The swollen stem is good to eat; it also contains a supply of water.

The bo tree lives to a great age. One growing at the ruined city of Anuradhapura, about eighty miles north of Kandy, in Ceylon, is said to have been planted in 288 B.C., and to have been started from a branch of the tree under which Buddha sat and meditated. In 1887 the main stem broke off during a storm. The Buddhist priest reverently gathered the fragment and cremated it with great ceremony.

THE SHORT, THICK BAOBAB, OR MONKEY'S BREAD TREE

The baobab is the largest tree as far as girth of trunk is concerned. It is a relative of that familiar plant, the common mallow, and it is often called monkey's bread, because of the liking monkeys have for its fruit. It is a native of West Africa but has been introduced into the East and West Indies. Though it does not reach a height of more than sixty or seventy feet, it has a girth of nearly a hundred feet, and its branches, sixty feet long, often grow as thick as the trunk of an oak. The crown which they form at the top of the tree may be as much as five hundred feet in circumference.

The juicy, acid fruit forms a refreshing drink and is in size and shape very much like a cucumber. It is much sought after in case of fever. The leaves also have a medicinal value, and the bark yields a strong fibre.

Attempts have been made to employ the fibre as a substitute for silk and cotton. The natives of West Africa remove the fibre while the tree is still living. They come again and again to the same tree till the baobab is completely stripped of its bark on the lower portion of the trunk. Instead of dying, as one might expect, the tree grows a fresh supply of bark. Its vitality, indeed, is amazing. Often when the trunk is hollow so that twenty or thirty men can stand inside, the tree goes on flourishing; and even if it is cut or blown down, it continues to form layers of fresh wood as it lies on the ground.

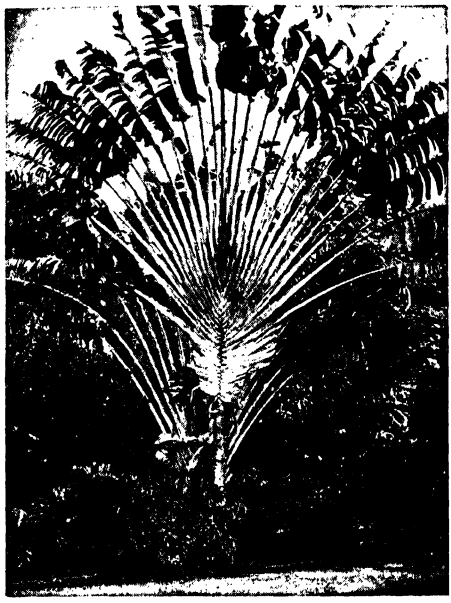
THE TALLEST TREES IN THE WORLD ARE FOUND IN AUSTRALIA

The tallest trees in the world are the giant sequoia trees of California and the eucalyptus trees of Australia, exceptionally large specimens of which tower higher than a tall church spire. The Australian trees are rather taller than the American ones. A giant eucalyptus, seen by Dr. Alfred Russel Wallace after it had fallen, was 500 feet high. These trees have bluish green leaves, leathery in texture, which turn vertically with their edges, and not their faces, to the sun. On this account they throw little shadow.

The giant sequoia trees of California, though on the average not quite so tall as the Australian eucalyptus, are much more impressive. There is a grove of about a hundred of them in Calaveras County, California, which contains some amazing trees.

One of these huge giants, known as the Mother of the Forest, is 327 feet high and 75 feet round its base. It is now dead, death

QUEER MEMBERS OF THE BIG PLANT FAMILY



The traveler's tree contains water for the wayfarer.

Pan Pacific Press

Sausage tree of Hawaii. The fruit is not edible.

De Cou from Ewing Galloway, N.Y.

The leaves of the Victoria Regia, a South American lily, sometimes measure forty feet around.

having been caused by the removal of the bark, which was eighteen inches thick, for a distance of over a hundred feet up the trunk. A fallen monster called the Father of the Forest must have been 400 feet high at the time of its fall, and its trunk is over one hundred feet round at the base. The age of these mammoth trees has been estimated at between two and three thousand years. They are probably the oldest forest trees alive.

Vast as are the sequoia and eucalyptus trees, they are not the tallest plants in the world. Giant seaweeds have been growing which were at least 600 feet from the root to the top. One of these is pictured on page 880.

THE TRAVELER'S TREE OF MADAGASCAR AND THE CANDLE TREE OF PANAMA

A somewhat strange-looking tree is the traveler's tree of Madagascar, a close relative of the banana. This rises as a succulent stem from the ground and sends out leaves on two opposite sides. The leaves are five or six feet long and grow on the ends of stalks seven or eight feet long, giving the tree the general appearance of a gigantic fan. As the stem grows up, the lower leaves decay and fall off, so that the fan-like appearance is preserved.

The plant gets its name from the fact that the large cup-like sheaths of the leaf stalks contain considerable stores of good water, which travelers are able to tap by simply cutting the sheath at the base. The leaves are used for thatching by the people of Madagascar, and the stalks for walls and partitions.

Another queer tree is the candle tree, a native of the Isthmus of Panama, which produces its fruit in the form of what appear to be candles about four feet long. They are the color of yellow wax and look for all the world like bunches of old-fashioned tallow candles. But the resemblance to a candle is not confined to the appearance. The fruits contain far more than half their weight of fat, and a lamp-oil is prepared from this.

THE DRUMSTICK GRASS TREE AND THE BLACK BOY

A strange-looking tree in Australia is the so-called grass tree, a member of the lily family. On a stout stem as thick as an oak trunk, rising to fifteen or twenty feet, there grows a mass of grass-like foliage; and on the top a number of flower stalks appear with blossoms that make them look like drumsticks, hence the familiar name of the plant—the drumstick grass tree. Another kind, called the arborescent grass tree, grows branches at the top; and another and smaller species at a distance has the general appearance of a native holding a spear and is in consequence called by Australians the black boy, the local name for a native.

A member of the myrtle family growing in tropical America is known as the cannon-ball tree, because of the resemblance of its large, hard fruits to the old-fashioned cannon-ball. The tree produces large white or rosy flowers which spring from the trunk and branches, and these are succeeded by the round fruits, which have woody shells.

THE MANGROVE, WHOSE TANGLED ROOTS CHOKE THE MOUTHS OF RIVERS

A very strange plant is the mangrove, many species of which are found in South America, the East and West Indies, China and northern Australia. The mangrove grows on the seacoast, especially round about the mouths of rivers. Sending down roots from the branches it spreads rapidly and forms the familiar mangrove swamps. The tangle of roots closely interlaced retains the mud and other solid matter brought down by the river or washed up by the waves, and gradually the area of the land is extended. The fruit of the mangrove is sweet and juicy and pleasant to the taste, and the bark yields a useful tannin.

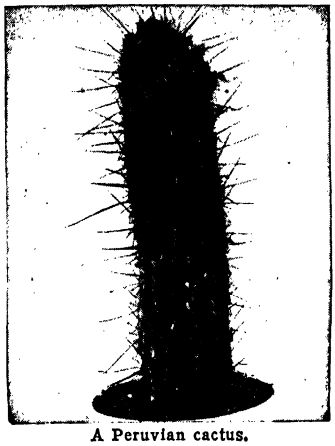
THE LARGEST OF ALL KNOWN FLOWERS HAS NEITHER STEM NOR LEAVES

The largest of all known flowers is the *Rafflesia Arnoldi* of Sumatra, a parasite plant that consists of a flower without stem or leaves. This giant blossom, three feet in diameter, is flesh-colored and has a most disagreeable odor. It often weighs ten pounds, and its bowl-like centre is capable of holding two gallons of fluid. It was first discovered, in 1818, by Dr. Arnold and Sir Stamford Raffles, after whom it is named. The petals are in some parts three-quarters of an inch thick. While still unopened the plant is in form something like a cabbage. It takes a month to attain its full size and, after opening, remains only for a day or two before it begins to decay.

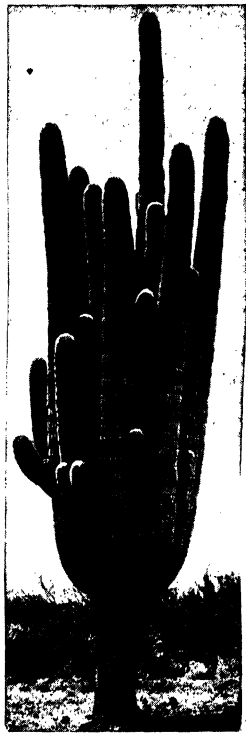
Another plant, the *Victoria regia*, a lily of South America, has the most gigantic leaf. This sometimes measures nearly forty feet round. It is named after Queen Victoria.

A thick rootstock in the bottom of the river throws up leaf buds to the surface of the water, where they expand into what look like round green trays, with an edge all round turned up to a height of three or four inches. The back of the leaf is made up of a network of veins, giving it the appearance of

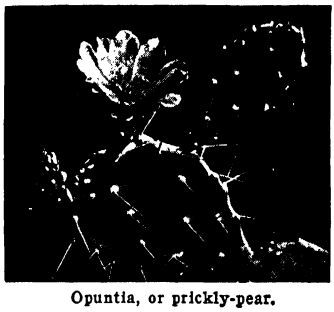
HEDGEHOGS OF THE VEGETABLE WORLD



A Peruvian cactus.

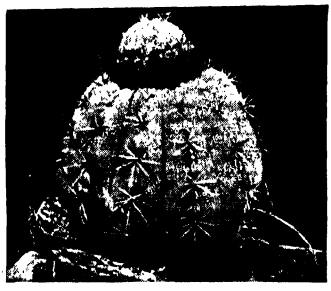


A West Indian cactus.

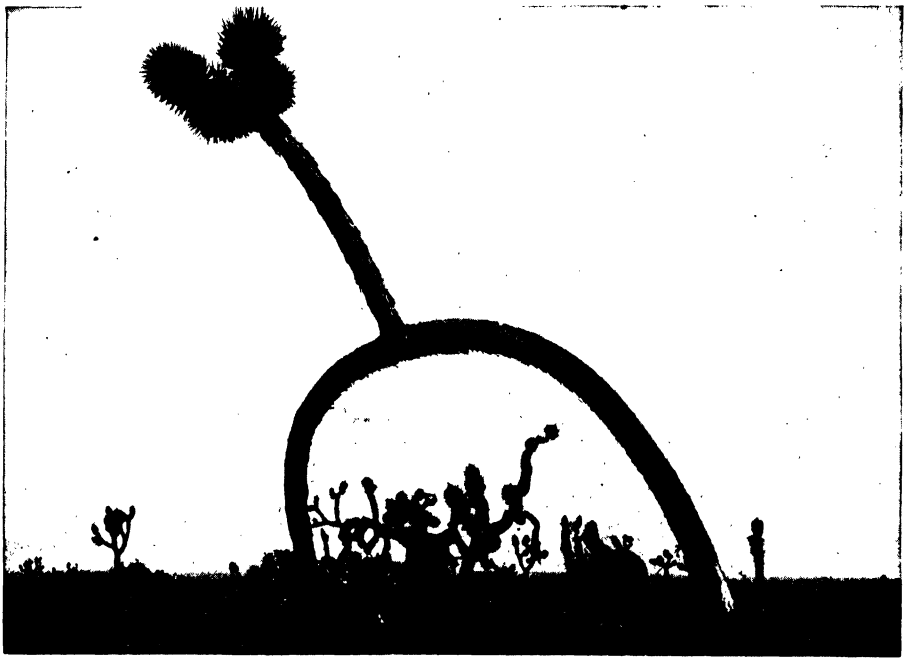


Opuntia, or prickly-pear.

Cactus in Arizona.



Cactus in Trinidad.



A huge spur-like cactus in the Arizona desert, blown into this shape by the wind.

wickerwork. This underside is crimson.

The beautiful flowers, white outside and rose-colored inside, rising among the giant leaves, are a yard or more in circumference and develop into fruits about the size of a man's head, full of starch seeds which form a nourishing and agreeable food. It is because of these seeds that the plant is sometimes called the water-maize.

A very strange family of plants are the cactuses. The plants are very interesting because they are a striking instance of adaptation to environment. They are natives of the more arid districts of America, and their form and structure enable them to take up and retain water when it falls in the form of rain.

THE STRANGE LEAVES OF CACTUSES WHICH GROW IN VERY DRY CLIMATES

The cactuses have long roots that branch out extensively in the arid soil where they grow and seize on every drop of moisture that is available. Then, in order to reduce the rate of evaporation to a minimum, the cactus does not produce leaves of the ordinary kind, which present an extensive surface to the sun and air. Instead the whole plant is in a more or less globular or cylindrical form, so that the very minimum of surface is presented.

The cells of the plant have thick walls, and these still further delay evaporation. To show how well a cactus retains its moisture, it may be mentioned that a giant cactus needed nearly two years to dry up when deprived of all water. It did not lose the whole of its water-content for 576 days.

There is another interesting fact about many members of the cactus family. The fact that they will grow in arid regions and retain much moisture makes them desirable as food for the herbivorous (plant-eating) animals that live in the desert regions. The poor cactus, therefore, after adapting its form to hard conditions of life, would have to face the still greater danger of being snapped up as food and thus exterminated.

But the plant has proved equal to the emergency. In the course of ages it has done a wonderful thing in the way of self-defense. Instead of giving up its leaves altogether, it has changed their form and grown them in the shape of thorns and prickles and sharp spines. These effectively protect the cactus from all enemies but man, who, using his brain, has found various ways of overcoming the defense.

Sometimes he burns off the spines of the cactus and uses the plant as food for his cattle; but, as this is a long and tedious and costly process, he has done better and has found a way of making the cactus grow without producing spines at all.

THE CACTUSES THAT ARE CALLED HEDGEHOGS OF THE VEGETABLE KINGDOM

The prickles and spines are very marked in some cactuses, and it is not without reason that they are called the hedgehogs of the vegetable kingdom. Some of them, like the prickly-pear, are often planted round a house to form a barrier to animals and robbers. This particular plant, also called the Indian fig, is a native of both Americas, but it now grows in the Mediterranean countries, and in Australia it has flourished so well that it has become a menace to the farmers. It will grow on bare rock and spreads very rapidly. Its yellow fruit, about the size of a hen's egg, is very juicy and pleasant to the taste and is used largely as a food.

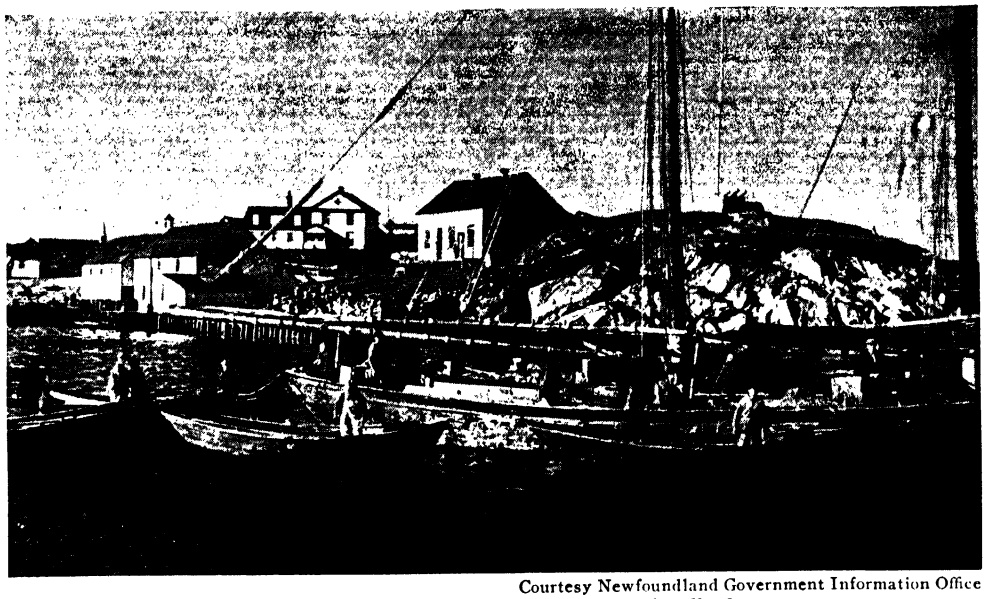
Altogether there are about a thousand different kinds of cactuses. Some, like the prickly-pear, have thick flattened stems, others look like pillars and columns, others like sponges, and others like hedgehogs or woolly bears. One, the torch-thistle, which grows to a great height, is like a gigantic club studded with nails. Another, the Turk's cap cactus, has what appears to be a fez crowning it; and another, Wislizen's cactus, has spines that are nearly as tough as steel needles. Many of them produce very beautiful flowers, and some will grow in the open air farther north than their original home.

SPANISH MOSS, WHICH HANGS FROM TREES IN SOUTHERN UNITED STATES

One other queer plant is a native of southern United States. It goes variously by the name of Spanish moss, long moss and black moss, though it is not Spanish or black or a moss. It is what is known as epiphyte, that is, a plant which grows on another plant but does not draw its nourishment from its host like a parasite. The long "moss," which is a flowering plant, is a relative of the pineapple. It has long silvery thread-like stems and leaves, which attach themselves to the branches of trees by suckers and hang in dense tufts which sometimes almost hide the foliage of the trees and give a very beautiful appearance to the forests.

The plant is often gathered and steeped in water till the outer tissues can be washed off; and the dried fibrous remainder is used as a substitute for horsehair in stuffing mattresses and cushions.

THE NEXT STORY OF PLANT LIFE IS ON PAGE 3519.



Courtesy Newfoundland Government Information Office

A hamlet on the rocky southwest coast of Newfoundland.

THE PROVINCE OF NEWFOUNDLAND

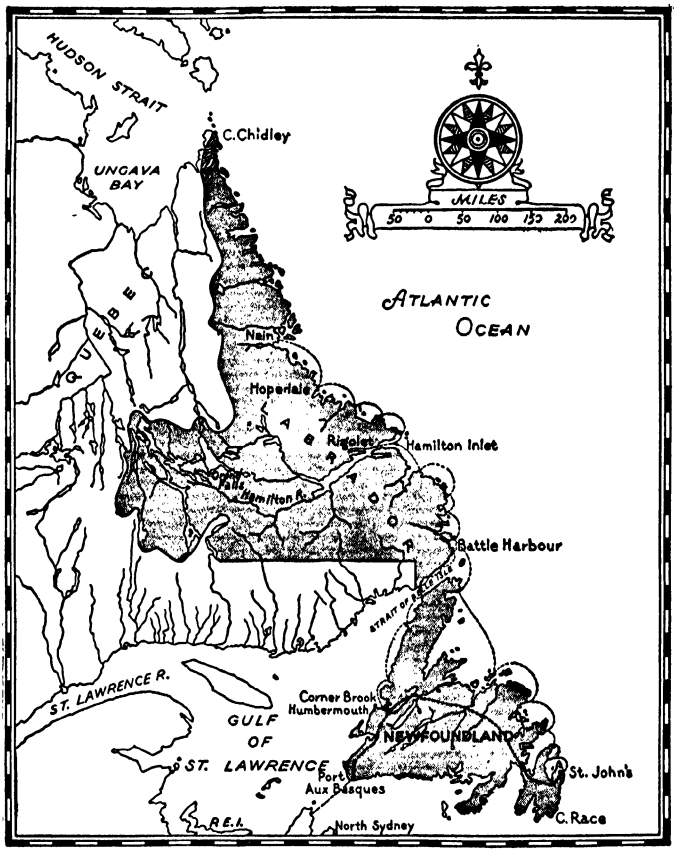
THE island of Newfoundland, which was once a dominion of the British Empire, is now one of the ten provinces of the Dominion of Canada. In this article we shall tell you about this fascinating island and its dependency, Labrador, on the mainland.

The island itself stretches across the entrance of the Gulf of St. Lawrence, from the Strait of Belle Isle on the north, 9 miles wide at the narrowest part, to Cabot Strait on the southwest, more than 90 miles wide. It covers an area of some 42,000 square miles, which is about half the area of Great Britain and slightly less than that of New York State. It forms an irregular triangle, whose points are Cape Race on the southeast, Cape Ray on the southwest and Cape Bauld on the north. The coastline is much indented with many deep bays and harbors, most of which are studded with small islands.

Inland, the country is sprinkled with lakes, the largest of which, Grand Lake, is 50 miles long, and has an area of about 200 square miles. There are several fine rivers, the Exploits, on the east coast, being 200 miles long, and the Humber, which flows into the Bay of Islands, on the west coast, about 80 miles long. There are plenty of hills, but few high enough to deserve the name of mountain. A range of high land, called The Long Range, runs parallel to the west coast, forming the backbone of the island.

Perhaps the most important geographical fact about Newfoundland is that it is the nearest part to Europe of the North American continent. The distance from St. John's, the capital of Newfoundland, to Valencia, in Ireland, is a little more than 1,600 miles. Because it is so close to Europe the island has been for centuries a sort of stepping-stone between the Old World and the New. The southeastern corner of Newfoundland, the Avalon Peninsula, was the first part of North America to be thoroughly explored; its harbors were well known to seamen from Europe when as yet the rest of the continent was *terra incognita* (unknown land) on their maps; it was the first part of the world to be colonized by Englishmen. In fact, Newfoundland is the foundation-stone of the British Empire.

In later years this nearness to the Old World has caused Newfoundland to play a most important part in the development of transoceanic telegraph and wireless sys-



The shaded part of this map shows the island of Newfoundland and its dependency, the strip on the mainland called the Coast of Labrador.

tems. The first successful Atlantic telegraph cable was landed at Heart's Content in July, 1866, by the largest vessel afloat in those days, the Great Eastern. On December 12, 1901, Guglielmo Marconi received the first wireless signals ever transmitted across the Atlantic, at Cabot Tower on Signal Hill, near St. John's.

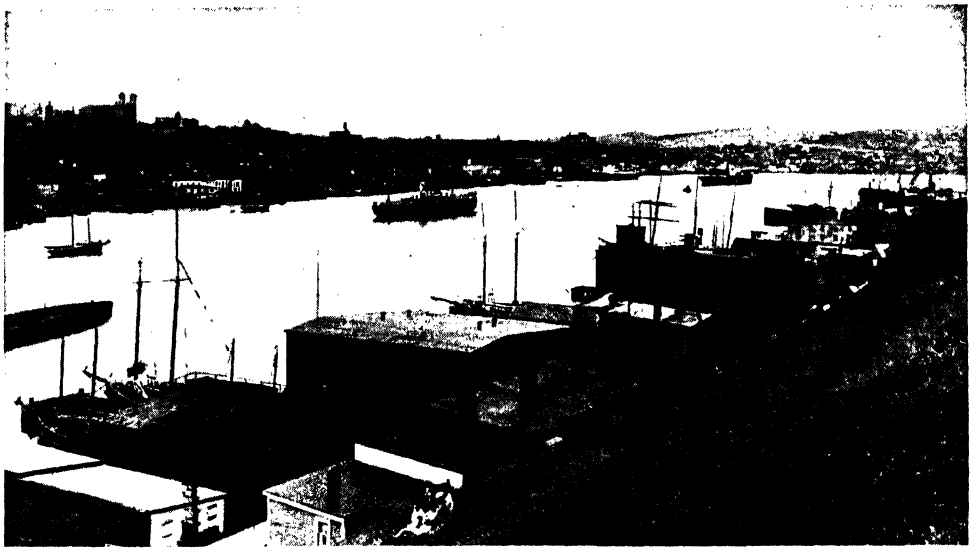
Newfoundland was discovered, or rediscovered, by John Cabot, in June, 1497. He is generally supposed to have first sighted land, after crossing the Atlantic from Bristol, England, at Cape Bonavista (the name means Happy Sight). This cape is still called "Cabot's landfall" by the inhabitants.

It is altogether likely, however, that the first Europeans to set eyes on Newfoundland were the Viking rovers, Norsemen who had settled in Greenland in the tenth century and shortly thereafter pursued their adventurous rovings along the coasts of Labrador and Newfoundland. No permanent settlements were made by them, however, and by the time of Cabot's voyage all traces of the Norsemen's discovery had been lost.

The discovery by Cabot opened up for England a vast wealth. Since the demand for fish was very great in countries like Spain and Italy, as well as in England itself, a great export trade was built up. Money was made also by building fishing boats and ships for carrying the cargoes of fish.

During most of the sixteenth century the shores of Newfoundland were a sort of "everyman's land," where French, Spanish, Portuguese and English fished side by side or in their own special harbors. In 1583 Sir Humphrey Gilbert, representing Queen Elizabeth, formally took possession of Newfoundland for the English crown and called upon all foreigners fishing there to pay tribute in recognition of English rule.

Quebec was founded by Champlain in 1608 as a French colony. The French established themselves within the Gulf of St. Lawrence and soon were fast extending their hold on that part of the continent we now call Canada. Before long they realized that they might safeguard their position on the mainland if they possessed a part of the Newfoundland coast. The English king, Charles II, wished to gain the favor of King Louis XIV of France, and so Charles agreed to a treaty, signed in 1662, whereby the French were allowed to take possession of a portion of the south coast to hold and fortify. The harbor of Placentia, in the bay of the same name, became the French capital in Newfoundland and was strongly fortified. During the latter part of Louis XIV's reign, the French attempted to seize the rest of the island, and in fact they destroyed most of the English settlements; but by the Treaty of



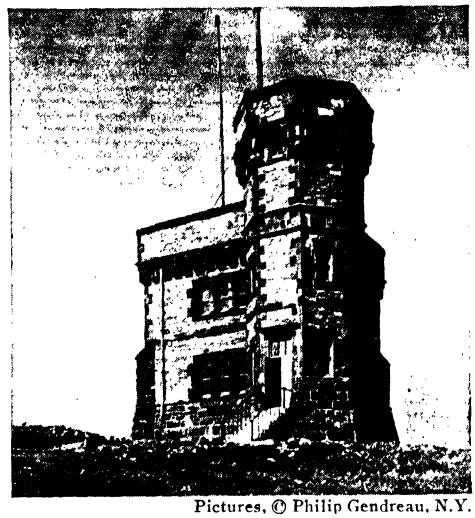
Newfoundland's capital, St. John's, and its harbor. Since 1497 it has been the centre of the cod-fishing industry, and at one time hunting for seals was very profitable. The city is situated on the crest of a hill; and along the water front are warehouses and factories for receiving and treating cod, whale and seal oil.

Utrecht, in 1713, they were forced to give up their hold on the island, including the town of Placentia. They were still allowed, however, to exercise special fishing rights on a part of the coast, and it was known for two centuries after as the "French shore." These fishing rights led to almost constant disputes with the English settlers on the coast until, in 1904, the agreement was ended. France was given certain rights in Africa to pay for the loss of her rights in Newfoundland.

Since 1713 Newfoundland has belonged entirely to Britain. For a long time settlement on the island was discouraged by the English authorities, as it was intended that Newfoundland should serve merely as a convenience for the use of fishermen who came from the west coast of England in the spring and returned in the fall. It was thought that permanent settlement of the colony might interfere with this rich trade.

Various attempts at colonization were made, however, in particular by Lord Baltimore, who later founded Maryland, and by John Guy and others. These first small groups formed the bud of a colonial population which grew gradually in spite of the efforts of the English government to prevent increase. Laws were passed to restrict settlement; settlers were not permitted to acquire permanent title to land, or to build permanent houses, or to make roads or to live within a certain distance of the sea. Indeed, it was not until the beginning of the nineteenth century that the last of these restrictions was done away with.

The population of Newfoundland is made up almost entirely of persons of English, Scotch and Irish descent; it numbers about 315,000. St. John's, the capital and the chief city, has a population of over 62,000. Increase has been slow, mainly because many young people of Newfoundland moved to Canada and the United States. The number of Newfoundlanders living in these two coun-



Pictures, © Philip Gendreau, N.Y.

This tower at the entrance to St. John's harbor is a memorial to John Cabot who discovered the island.

tries probably equals the number of those in the homeland.

Settlement is mostly along the coast, as is natural in a country originally devoted to ocean fishing. Many of the fishing villages are on small islands. Houses are built as close as possible to the sea, sometimes even on the very edges of high rock overlooking the ocean.

During the last half-century, however, Newfoundland has undergone a gradual but steady change. New industries have sprung up such as logging, mining, pulp- and paper-making and farming. As a result, new towns have been built in the interior, which had never before been developed. These towns have little in common with the older settlements along the coast. The older towns, such as Harbour Grace, Carbonear, Twillingate and Bonavista, tend to give way in importance to the newer industrial towns of Grand Falls, Corner Brook, Buchans and Millertown.

For more than three centuries after the discovery by Cabot, fishing, especially for cod, was practically the only industry. The cod was vastly superior in number and importance to all other fish, and even to-day to a Newfoundlander, the word "fish" means "cod." All other fish are referred to under the specialized name: herring, salmon, halibut, etc.; only cod is "fish." Gradually these other fisheries have developed and play a considerable part in the general livelihood. There are also "lobster-fishing" and "seal-fishing," as they are called, although neither the lobster nor the seal is a fish. Both these latter industries have declined in the present century. The sealing industry, which was particularly flourishing, once gave employment to several thousands of men during the two months of March and April. Nowadays less than a thousand men are engaged in this industry.

Even the cod-fishing has lost some of its former importance. International relations have had much to do with this state of affairs; wars and depressions have greatly injured the long-established markets for cod. The Newfoundlanders have sought new markets to replace those that have been lost; they have also introduced new methods of preparing cod for foreign trade. Will Newfoundland's cod fisheries regain their former supremacy? Only time will tell. Fortunately for the islanders, the newer industries, especially mining and pulp- and paper-making, have been developing steadily.

© Philip Gendreau, N.Y.

A farm scene near St. John's. Fishing, mining and lumber industries, including pulp and paper, are much more important than agriculture. The growing season is short, and much of the island is rocky, or covered with bog. However, there are thousands of acres suitable for farming and the government encourages the production of crops requiring only a short growing period. Sheep, cattle and goats are raised, also poultry and some pigs.

Pictures, courtesy, Newfoundland Government Information Bureau

Not far from St. John's is Pouch Cove, where hundreds of fishing boats put in to land their catch of cod. The fish are quickly cleaned, salted and spread on flakes (high wooden platforms) to dry until they are stiff.

Mining provides about one-fifth of the island's export trade, the total value of mineral exports in 1947 being about $14,000,000. The principal minerals are iron, lead, zinc, copper, limestone and fluorspar. Iron is found chiefly at Bell Island, in Conception Bay. The ore lies deep under the surface, and much of the mining is done far below the level of the sea. Lead and zinc ores are mined at Buchans, in the interior of the island. Fluorspar, which is important for the aluminum and steel industries of Canada and the United States, is found at St. Lawrence in Placentia Bay. Traces of many other minerals have been found, and exploration still continues, both in Newfoundland itself and in Labrador, which shows signs of possessing great mining possibilites.

Pulp- and paper-making form one of the newest industries in Newfoundland. The first mills were opened at Grand Falls, on the Exploits River, in 1909. These mills can now

produce 500 tons of paper a day. There is also a pulp mill at Bishop's Falls, about 11 miles from Grand Falls. The produce of all these mills, as well as the lead and zinc ores from Buchans, are shipped through the port of Botwood, a large harbor near the mouth of the Exploits River.

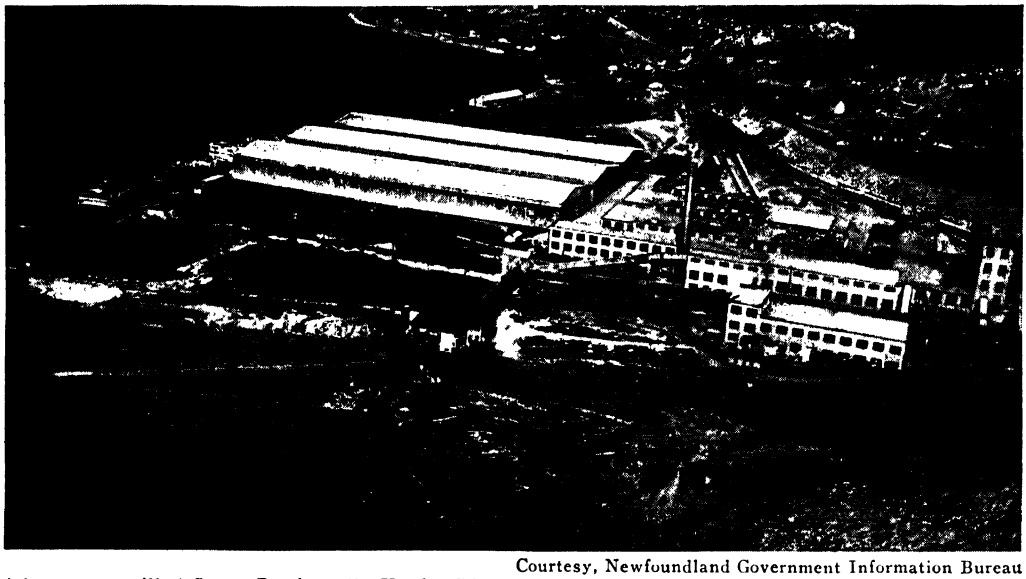
At Corner Brook, near the mouth of the Humber River, is a newsprint mill. (Newsprint is the paper on which daily newspapers are printed.) Corner Brook is one of the most picturesque spots in the island. It is on the largest arm of the beautiful Bay of Islands, and an excellent motor highway connects it with Deer Lake, a town near the lake of the same name, where there are the hydroelectric plants which supply light and power to the region. Twenty years ago this part of Newfoundland was very sparsely settled. It is now one of the most populous and progressive parts of the country.

Farming in Newfoundland has not yet been undertaken on any great scale. The growing season is short, and in many parts of the island the soil is not favorable. There are large sections of bog or bare rock. It must be remembered that Newfoundland began as a fishing community; people looked to the sea for centuries as the chief means of livelihood. Settlements were established along the fringe of the coast, at spots considered most suitable for the fishery. Between periods of fishing, the fisherman tended his little garden. Often, indeed, the very soil would be lacking, and then the enterprising fisherman would fetch by cart or wheelbarrow enough soil to cover a portion of the rocky ground, so that his family might have vegetables for the table.

However, there are many parts of the island where good soil is available in sufficient amount for farming on a modest scale. On the Avalon Peninsula, in the valleys of the Exploits and other rivers, on the west coast and in the interior, there is land suitable for cultivation. The season, though short, is favorable to rapid growth, and most of the common vegetables are produced. Much more might be done, as the total area at present under cultivation probably does not exceed 200,000 acres, while the total land area of the island is 24,000,000 acres. Even when one deducts for bog, forest and rock, there still remain many thousands of acres of good soil unused.

In recent years, the government has attempted to stimulate interest in farming by establishing farming settlements and encouraging the men to follow a combination of farming and fishing. Markland, on the Avalon Peninsula, Midland, near Deer Lake, Lourdes, on the west coast, and Brown's Arm, on the east coast, are the principal settlements of this kind.

Newfoundland has often been called the sportsman's paradise because of the opportunities it provides for hunting and sport-fishing. Besides the larger rivers, there are many smaller streams in which fine trout and salmon may be caught. One of the best is



Courtesy, Newfoundland Government Information Bureau

A large paper-mill at Corner Brook, on the Humber River. Newfoundland has goodly forests of spruce, pine and other woods from which pulp and paper are manufactured. Almost all the paper manufactured is exported.

Salmonier River, not far from the capital.

Not many years ago vast herds of caribou roamed the interior, but these have been greatly reduced and restrictions have been made on the hunting of caribou. There are signs that the herds are once more increasing. Moose have been introduced into the island from Canada, and these too are fast increasing in numbers. There is also a plentiful supply of wild-bird game such as partridge, duck, geese, plover, snipe and curlew, not to speak of the hosts of sea birds which swarm along the shores in autumn and are killed in thousands by the fisherman for food. Fishing for the giant tuna is a sport recently introduced.

Courtesy, Newfoundland Government Information Bureau

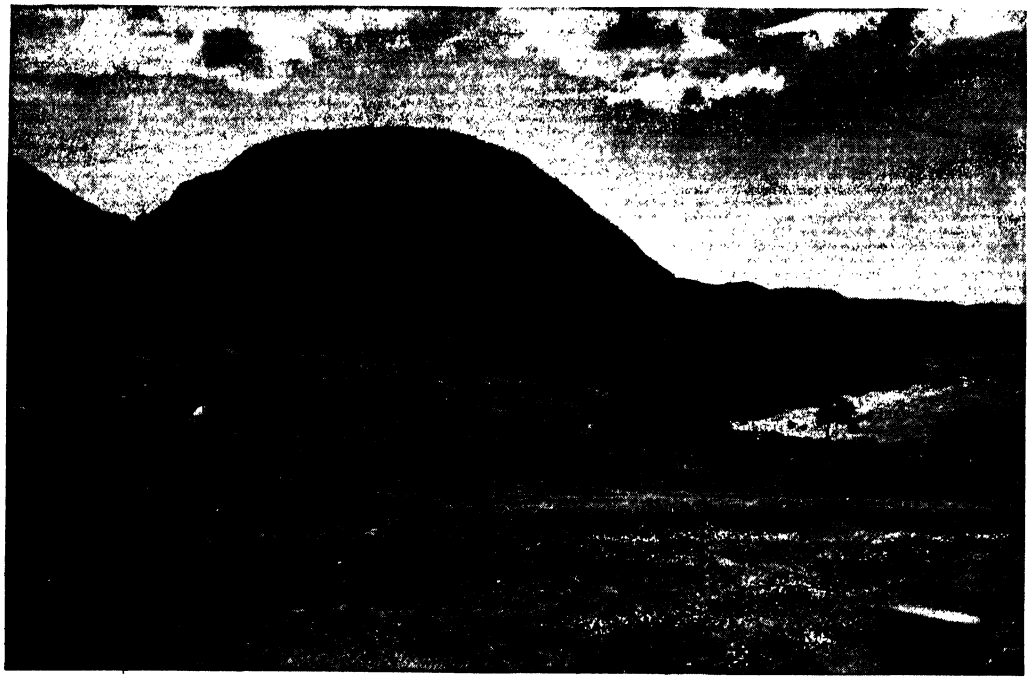
The piece of land which looks like a crumpled square hanging by a thread from the southeastern corner of the island is called the Avalon Peninsula. There is good agricultural land on the peninsula, as you can see from this haymaking scene near St. John's. There are many other regions where farming is, or could be, profitable; and there are in addition thousands of acres of pasture, and grazing lands, especially suited to sheep raising.

The island has played a notable part in the development of aviation. Here again, nearness to the continent of Europe has been the most important factor. In the early days of experimental crossings of the Atlantic by airplane, the airfields of Harbour Grace and St. John's were popular "take-off" points in the Western Hemisphere. In May, 1919, three United States Navy planes set out from Newfoundland for the Azores, and one of them successfully completed the journey. A month later Alcock and Brown made their famous flight to Ireland. This was the first time the Atlantic was actually crossed by airplane. In the following years such well-known pioneers in long-distance flying as Charles Lindbergh, Amelia Earhart, Charles Levine, Post and Gatty, Richard Byrd and James and Amy Mollison, made use of the airfields of Newfoundland.

A few years before the outbreak of the second World War, a great modern airport, said to be the largest in the British Empire, was constructed at Gander, near the river of that name, about fifty miles inland. It was built for the British Imperial Airways—as one of the chief links in a proposed round-the-world service. In World War II this airport was entirely devoted to war purposes. Giant bombers on their way to Britain from the factories in the United States and Canada paused there to re-fuel. Other planes from Gander patrolled the coasts and the neighboring waters in search of enemy or hostile aircraft. On page 3276 we speak of Goose Airport, in the interior of Labrador, which is a sort of sister airfield to Gander. Goose Airport was built after the outbreak of World War II.

At Botwood there is a seaplane base which is a regular port of call for great flying-boats which fly to and from England and America. Air connection with the mainland is obtained through Trans-Canada Airlines. The journey from St. John's to Moncton, in New Brunswick, the first port of call, is made by plane in a little over four hours. This journey, by train and steamboat, formerly took two or three days.

Newfoundland's situation at the entrance to the Gulf of St. Lawrence—the front door of Canada—together with her exposed position in the Atlantic and her nearness to Europe, gave the island important duties in the second World War. The capture of Newfoundland by an enemy country would have exposed the whole eastern seaboard of the American continent to the danger of attack by air. Therefore the island was strongly fortified. Watchers were constantly



Courtesy, Newfoundland Government Information Bureau

Mount Moriah looks out upon the Bay of Islands, on the west coast of Newfoundland. The western coast has a milder climate than the eastern shore, which is chilled by the Labrador Current.

stationed at posts along the whole 6,000 miles of coastline, and planes continually hovered overhead.

Permission was granted to the United States for the building of American air and naval bases on the island. In one case the entire population of a town on the southeast coast (Argentia) was moved to a new site, and the place transformed into a naval base. American forces were also stationed at Fort Pepperell, near St. John's and at Stephenville, on the west coast. All these bases were leased to the United States for a period of ninety-nine years. Canada, also, had troops stationed on the island, and Canadian, American and Newfoundland soldiers, sailors and airmen stood together on guard.

Increased contact with the outside world caused great changes. The Newfoundlander now had a sense of being at the center of world events, instead of on the outer rim. Was it not in a harbor of Newfoundland that President Roosevelt and Prime Minister Churchill met to draft the Atlantic Charter in 1941? The coming and going of high-ranking officers and statesmen from Britain and America, on their way to conferences of historic importance, were ordinary events in World War II. Newfoundland was now not a lonely outpost but a station on a great international highway of the air. Aviation and the war so transformed the island that it hardly recognized itself.

The earliest governors of Newfoundland were the so-called "fishing admirals." King Charles I, in 1633, ordered that the captain of the fishing vessel which first arrived from England each spring should be judge and governor in and over the territory for that season. It often happened that the "governor" was a man who could neither read nor write, but he usually managed to dispense a kind of rough and ready justice which suited the circumstances.

The first resident governor, Captain Henry Osborne of the Royal Navy, was appointed in 1729. By this time the English knew that Newfoundland was important as a bulwark of defense against the French in Canada. By this time, also, the number of settlers had largely increased, in spite of the efforts of the English authorities to prevent it. Therefore the government in London admitted that Newfoundland should be given a proper organization and government.

The governors were sole rulers of the island until 1825, when it was ordered that a council should assist the governor in the work of administration. In 1832 Newfoundlanders were given permission to elect

representatives to an Assembly. The representatives could assist in the making of laws but not in the actual administration of them, which was entirely in the hands of the governor and council.

Quarrels between the elected Assembly and the council soon interfered with the carrying-on of public business, and attempts were made to break the deadlock by joining the two bodies into one. This scheme was abandoned, after a four years' trial, in 1847.

The English government in London sent Lord Durham to the British North American colonies after the rebellions in 1837. Lord Durham's task was to inquire into the state of affairs in the colonies and make a report to London on what he found. His report recommended that the colonies be given a wider measure of "responsible government," that is, that the people be made more responsible for their own governments through elected bodies. After the Durham Report had been published, the Newfoundlanders pushed hard for responsible government.

In 1855 this was granted to them. From then until 1934 Newfoundland was a self-governing unit of the British Empire, with power to make and administer its own laws in all matters except those relating to foreign affairs. In its relations with foreign countries, Newfoundland—like other parts of the Empire until recently—was represented by Great Britain. Shortly after the first World War, and partly in recognition of the heroic part played by her soldiers and sailors on many a battlefield and on every ocean, the island was granted the status of Dominion. Newfoundland was thus placed on terms of equality with Canada, Australia, New Zealand and South Africa.

In 1934, however, largely for financial reasons, the legislature decided to surrender its power temporarily. A commission of government was appointed by the British Government. This commission, which governed the island until 1949, consisted of the governor and six commissioners, three of whom had to be resident Newfoundlanders, the other three being chosen from the British Civil Service. This state of affairs was intended to last until Newfoundland could become self-supporting again.

Though the second World War had the effect of restoring prosperity to the island, it nevertheless interfered with the return of responsible government. At the same time there was a growing feeling among the Newfoundlanders that it would be to their advantage to join the Dominion of Canada, in spite of the fact that the island voted against union with Canada in 1869, and in 1895 refused to accept the terms then offered by Canada. Finally, in July 1948, a majority of the island people voted to join Canada. The transfer was arranged with the United Kingdom and approved by the Canadian Parliament; and Newfoundland became the tenth province of Canada in 1949.

LABRADOR

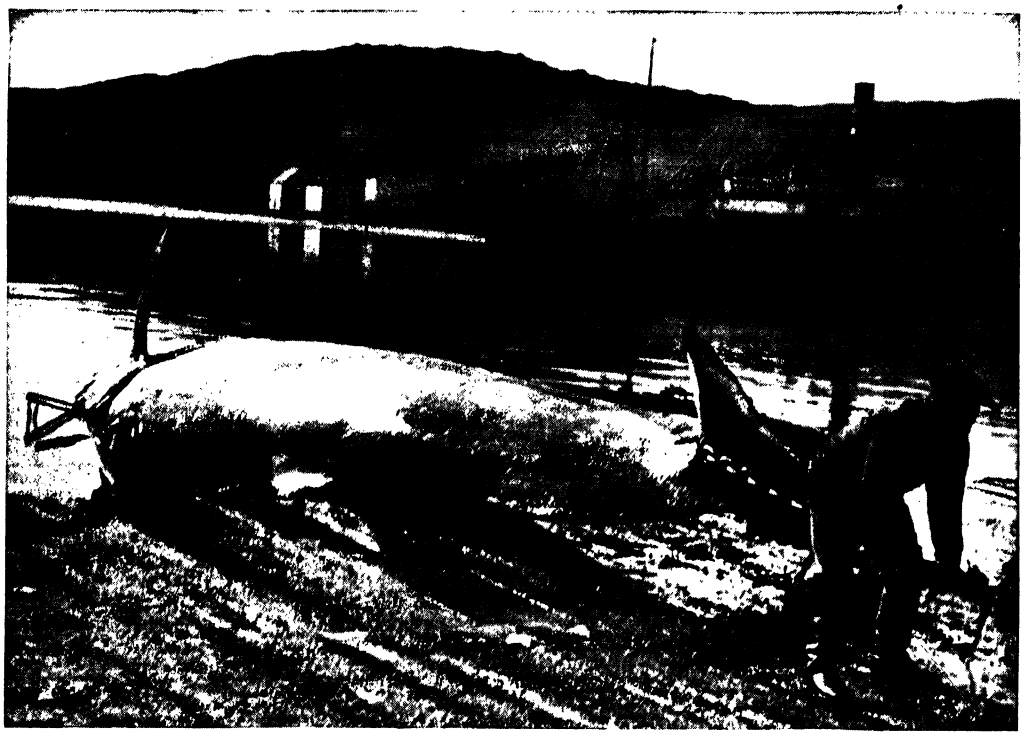
Labrador consists of a large peninsula on the mainland of North America, extending from Cape Chidley, at the entrance to Hudson Strait, to the Strait of Belle Isle, a distance of about 1,100 miles. Formerly divided between Canada and Newfoundland, the whole territory became a part of Canada in 1949.

Like Newfoundland itself in its early days, Labrador has been for centuries used chiefly as a convenience for transient fishermen. These sail from Newfoundland in the months of May and June to the harbors of Labrador and live on board ship or in huts on shore while they pursue their calling. In the fall they return to Newfoundland with their catch of cod, which has been well salted or partially dried. The drying, or "curing," is completed in Newfoundland.

Labrador is rich in other wealth besides that of the sea. It has vast quantities of water power, extensive forests and many kinds of minerals, all awaiting development. The famous Grand Falls, on the Hamilton River, are 315 feet high, or more than twice the height of Niagara Falls. The resident population is about 5,000, of whom about one-quarter are Eskimos. In summer, however, the population is increased by several thousands.

The word Labrador is the Portuguese word for laborer, workman or slave. It is said to have been applied by a king of Portugal to certain natives brought to Portugal from this territory by the explorer Corte-Real in 1500. These natives were fine, big, strong-looking men and therefore quite suitable as workers, or *labradores*. They were probably Indians, not Eskimos, for Eskimos are short men. The southern part of Labrador, by the way, is called on the maps of the sixteenth century Terra de Cortereal (Land of Cortereal).

John Cabot, the discoverer of Newfoundland, also discovered Labrador. His son Sebastian explored the coastline and was first of



© Captain Bartlett from Gendreau

Hawkes Harbor on the coast of Labrador. A fine catch is being landed—a finback whale. Whaling has been carried on in the North Atlantic since very remote times. The "fishery," as it was called, grew steadily through the sixteenth to nineteenth centuries, then declined. Whaling is still carried on to a limited extent.

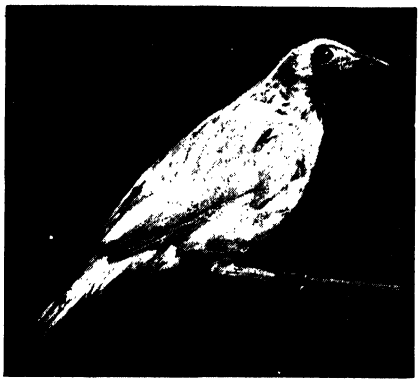
thousands of fishermen—English, French, Portuguese and Spanish—who visited these shores for the next two centuries.

Until 1763 the French regarded Labrador as their possession; but when Canada became British, Labrador was annexed to the Government of Newfoundland. Restored to Canada in 1783, it was again transferred to Newfoundland in 1809. The exact boundary line between Newfoundland-Labrador and the Canadian province of Quebec was a subject of dispute for many years and was finally settled in 1927 by a decision of the Privy Council of Great Britain. Newfoundland received all that part of the Labrador peninsula lying between the sea and the inland watershed (the "height of land") and bounded on the south by the fifty-second parallel. It is marked on many modern maps as Coast of Labrador. The area thus acquired by Newfoundland is roughly 120,000 square miles.

The inhabitants consist of Eskimos, Indians (Naskopis and Montagnais) and "liveyeres." The latter are white people, of English descent, who have either come north from Newfoundland to settle on this barren shore or whose ancestors came from England to work for the trading and fishing companies established along the coast. The word "liveyere" means "live here." They are people who live there permanently, as distinct from those who only come for the summer fishing and who are known as "floaters" or "stationers."

The Hudson Bay Company has several trading posts in Labrador. An important one is at Cartwright, in Sandwich Bay. Missionaries of the sect known as Moravian Brethren have established settlements among the Eskimos, where they combine trading with preaching the gospel. The remarkable work of the well-known missionary-doctor, Sir Wilfred Grenfell, has made the name of Labrador known to hosts of people throughout the English-speaking world.

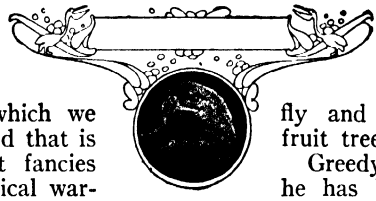
Aviation and World War II brought great changes to Labrador, just as they did to Newfoundland. A vast airport was built in the interior; it was known as Goose Airport, since it was a sort of "sister" to the Gander Airport in Newfoundland. Today Goose Airport serves in peace as effectively as it did in wartime; and this portion of the Labrador wilderness has become highly modernized.



The Naked-throated Bell Bird.

The Sulphur Tyrant.

WARBLERS, BABBLERS AND CHATTERERS



IT is a cold heart that does not thrill in the presence of this group of singing birds to which we come now; a dull mind that is not fired by pleasant fancies as one watches a typical warbler, the Whitethroat. This European bird crosses the continent, goes over the Mediterranean into Africa and back. When he sets up housekeeping in the garden he bullies the owner like a little pickpocket.

There is no note in the gamut of human song sweeter than his warble; but when he scolds, he has a sound which suggests a young frog just come to manhood who is getting his croak into operation for the first time and is not quite sure of the true frog note.

That little war-cry is the whitethroat's endeavor to scare us, not only from his nest, but from the beat of territory which he considers his own.

The slender beak is so perky; the head of ashy gray and brown so knowing; the white throat so swollen with happy melody; the white breast tinged with so delicate a rose, as if flushed with the triumph won, that the whitethroat is irresistible. The Great Whitethroat is the common species. The Lesser Whitethroat, for some reason, is scarcer. Slightly smaller and more sober in color, it is very shy. Only from necessity it comes to shady gardens to clean up the greenfly and caterpillar from the fruit trees and bushes.

Greedy people complain that he has been seen to fill his handsome little beak with a raspberry or two, but for how many raspberries and other fruits have not he and the larger whitethroats prepared a safe way, by gobbling up the insects that spoil the harvest!

Other warblers are: the Alpine, which does not belong to the Alps alone, but is found in Northern Africa and the Mediterranean countries of Europe, as well as in the Canary Islands; the Spectacled Warbler, a timid neighbor of the Alpine, though not accompanying it throughout its range; and the Sardinian Warbler, whose sweet note has a magical beauty in the clear, sunny air of the Riviera, where it thrives abundantly.

It is easily mistaken for the Blackcap, whose sable head it mimics. This warbler is supposed to confine itself to pine woods, in the main; but one has seen it bold and daring, week after week, in a sunny Riviera garden. It sings when other birds are silent, when the amazing high chorus of the cricket and the incredible bass of millions of frogs are the chief elements of melody.

Another warbler is the Orpheus, well

described as a larger blackcap, bigger of build, louder of song, but not so sweet. The Barred Warbler leaves its African quarters late in the spring to make its nest in Europe, but Orpheus has to begin his quest for nursing sites earlier. His mate demands Baltic conditions for her preparations.

THE SWEET NOTES OF A MODEST LITTLE SONGSTER

Matching the lesser whitethroat in size, the Garden Warbler is grayish brown, with an olive tinge above, and has the throat white and the under-parts very light gray or white, with a suspicion of reddish hue along the sides. Timidity has not paid this bird, one fancies; for, though it is an ancient summer visitor to England, it is nowhere common, nowhere plentiful. Would it were, for it has the most charming of songs, which it utters as it lurks in hiding among the foliage.

But the Blackcap makes up by his boldness for the shortcomings of many reluctant members of his order. Audacity pays in his case, at any rate. He and his mate have no sooner arrived in April than they set up housekeeping forthwith; the eggs are laid and the babies hatched. Their feathers grow like magic, and in an astonishingly short time the youngsters are out of the nest, seeing the world for themselves.

A BEAUTIFUL ENGLISH BIRD THAT IS RAPIDLY DYING OUT

One of the rarest of the European warblers is the Dartford Warbler, which someone with a homely fancy has called the Furze Wren. The second name is useful as indicating clues by which we may identify this sprightly little acrobat and singer of the gorse bushes.

One doubts there being any Dartford warblers on the heath which gives the birds their name. Dartford has grown out to the heath, and bird-catchers have villainously thinned out the live stock of the place. Someone who has made a close study of these birds says there are not more than ten pairs in England today, and certainly these little treasures are among the scarcest birds, though their territory used to be fairly widespread in southern England.

Here we are face to face with another of the problems with which Nature has to deal. A few years ago millions of swallows, flying back from Africa, found their path in the air barred by a great snowstorm. They were too conservative, too wedded to an instinctively followed flight-line to go round, but continued straight on to destruction. There have not been large numbers of swallows in England since, nor, as letters from Africa show us, has the Dark Continent been so favored.

HOW WE CAN SAVE RARE BIRDS FROM PASSING OUT OF LIFE

That is how we suffer from the natural perils of migration. But the English Dartford warbler is a native of England and stays there all the year round as fixedly as the sparrow. In the early Eighties they were affected by a snowstorm as disastrous as that which slew the swallows in Europe. That one storm nearly exterminated the stock. The rarity of the survivors made them more and more valuable to snarers for private cages, and so they have never regained their original numbers.

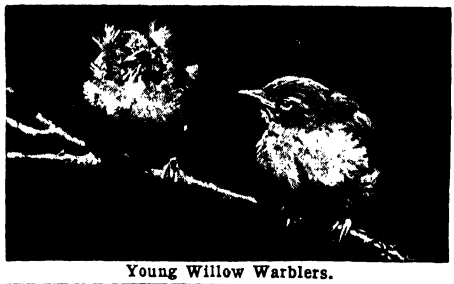
It is all sad and perplexing, but it leads us to a decision in which there can be no error—that the only hope of minimizing the dangers to which birds are exposed is to defend them rigorously when they are with us, to preserve their nesting-places, to guard their eggs and young, and to give the adults the same freedom from capture that we guarantee to lovely rare wild things that grow in our parks and private woods. Then we have done our duty and our best, and Nature must do the rest.

There are some wrens that come in here. The Wood Wrens are warblers, as is the lovely Golden-crested Wren, which we placed with the rest of the wrens. The wood wrens, jolly little singers to whom a coppice is a forest, a thick hedge as a vast plantation, include the cheerful Chiffchaff, the neat Willow Wren and the Yellow-browed Warbler. This bird is found in the summer in the far north of Siberia. Tree warblers, and warblers of the reeds and of the sedges, lead us on to the Grasshopper Warbler group of perhaps half a score of species. No birds are more difficult to find, for they secrete themselves in heath and moor, and on the margins of thick woods, even straying into dry reeds. And there they utter an unbirdlike chirp, or rapid succession of chirps, which have been likened to the clicks made by the cogs of a wheel as we wind up a clock.

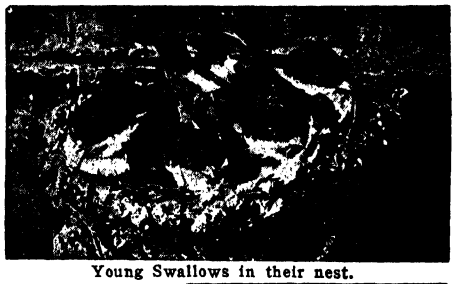
The fine song of the River Warbler

has been likened to the chirping of the grasshopper; a cry like that of a tree frog is uttered by the Savi's Warbler, common in Holland; a tail like that of a miniature young fan-tailed pigeon naturally gives its name to the Fan-tailed Warbler; and Australians have as logically called a strange warbler of theirs the Pheasant-tailed, in reference to the remarkable development of tail which this little wonder has accomplished.

Their habits vary also. The Water Thrushes (which are true warblers in spite of the name) live in the swamps, as do the Canadian Warbler and Wilson's Warbler. The Pine Warbler and the Bay-breasted Warbler live in the forests. Others like low bushes, and some are often found in the ground. Some are creepers, and some catch flies on the wing. The American Redstart is one of the most beautiful of all, with its mingled plumage of orange, black and white. It is often seen in woodland and shrubbery.



Young Willow Warblers.



Young Swallows in their nest.

The Sand Martin.

Reed Warblers and their young.

Young Goldcrests.

Garden Warbler.

Sedge Warbler.

The Goldcrest of Europe has its rivals in the lovely Firecrest and in the gorgeous Rubycrest of South America, a land to which warblers in general have not made their way.

THE AMERICAN WARBLERS ARE A DISTINCT FAMILY

As mentioned above, the Old World warblers do not visit North America, but this continent has its own warblers, which belong to a different family. There are over a hundred species of them, nearly all more brightly colored than the European, though few sing so well.

THE FLYCATCHERS OF THE OLD WORLD AND THE NEW

Formerly many widely differing birds were classed as Flycatchers. In fact, almost every bird that catches flies on the wing was called a flycatcher. Now, however, the number of birds so classed has been much reduced. The true flycatchers are confined to the Old World.

Why many species of birds have found their way across the Atlantic to the New World, while others equally competent

have failed to do so, is one of the mysteries of ornithology. We may wonder and wonder without getting any nearer a satisfactory answer.

We know that forms of world-wide distribution did not originate separately in each land. They originated in a common centre, and the Old World types which reached the land of Columbus must have come here æons in advance of him, in days when land bridges linked the north of Europe with America. That suggests how the travelers came, but not why the others did not.

The flycatchers are all weak on foot, though strong on the wing. That is to say, while they perch securely, and spend the greater part of their time on lookout twigs, they are feeble on a level surface. Two species come regularly to England for the summer months, the Spotted, or Gray, and the Pied Flycatchers.

THE QUIET BUT GOOD WORK THE FLYCATCHERS DO FOR MANKIND

The first is a common bird. He is a dull-coated little fellow five and a half inches long, the upper part of the body a uniform brown, with dark pencilings along the centre of the feathers that crown the head, and with the sides of the poll and under-parts of the body a dull white, with grayish feathers mingling in the color scheme of the breast.

"I have never seen a flycatcher," many people say; yet numbers of these busy birds may be seen in parks, in thousands of gardens, wherever, indeed, evil-working flies congregate. But the stillness of the sober little wonder-worker perched upon his bough renders him so inconspicuous that his image does not live in the mind.

There he rests, mute and inglorious, like a rigid statue of himself, and one would think he had not a pinch of activity in him. But he is all conserved force. He is like a little motor car whose engine is stopped, like a deer which is browsing with mincing gait in safe pastures.

Touch a button and the engine is a thing of power and immense activity; startle a deer and it is transformed into a cyclone on four dainty feet; reveal a fly and the little bird is a flash of sombre feathers launched like a projectile through the air, and there is another fly the less.

These birds are of priceless worth, for they live entirely on insects which are wholly injurious to the human family. They haunt the spots where flies abound, and with great good sense they put away fear, and come close up to the houses where flies flit to and from open doorways and windows.

THE HANDSOME COUSINS OF THE PLAIN LITTLE FLYCATCHERS

Life is a succession of perchings and pounces for the flycatchers. At every pounce an insect demon of mischief goes to his destiny, and the bird returns to his spray. He makes a little song about it, then relapses into deep contemplation, from which another flying insect, unseen by us, rouses him to lightning activity. The habits of the American flycatchers are similar.

There are beauties in the flycatcher's family: the Red-breasted of Eastern Europe; the Paradise Flycatcher of Asia, whose name denotes its splendor; and Fan-tailed Flycatchers of various species, some white-browed, some white-throated, some entirely black—half a hundred species of these alone. The lovely Blue Wren, so called, of Australia, is really a flycatcher; so is the handsome Gray Warbler of the same region. This bird is the especial victim of the two species of cuckoo found in New Zealand, which leave their eggs to the care of this much-enduring bird.

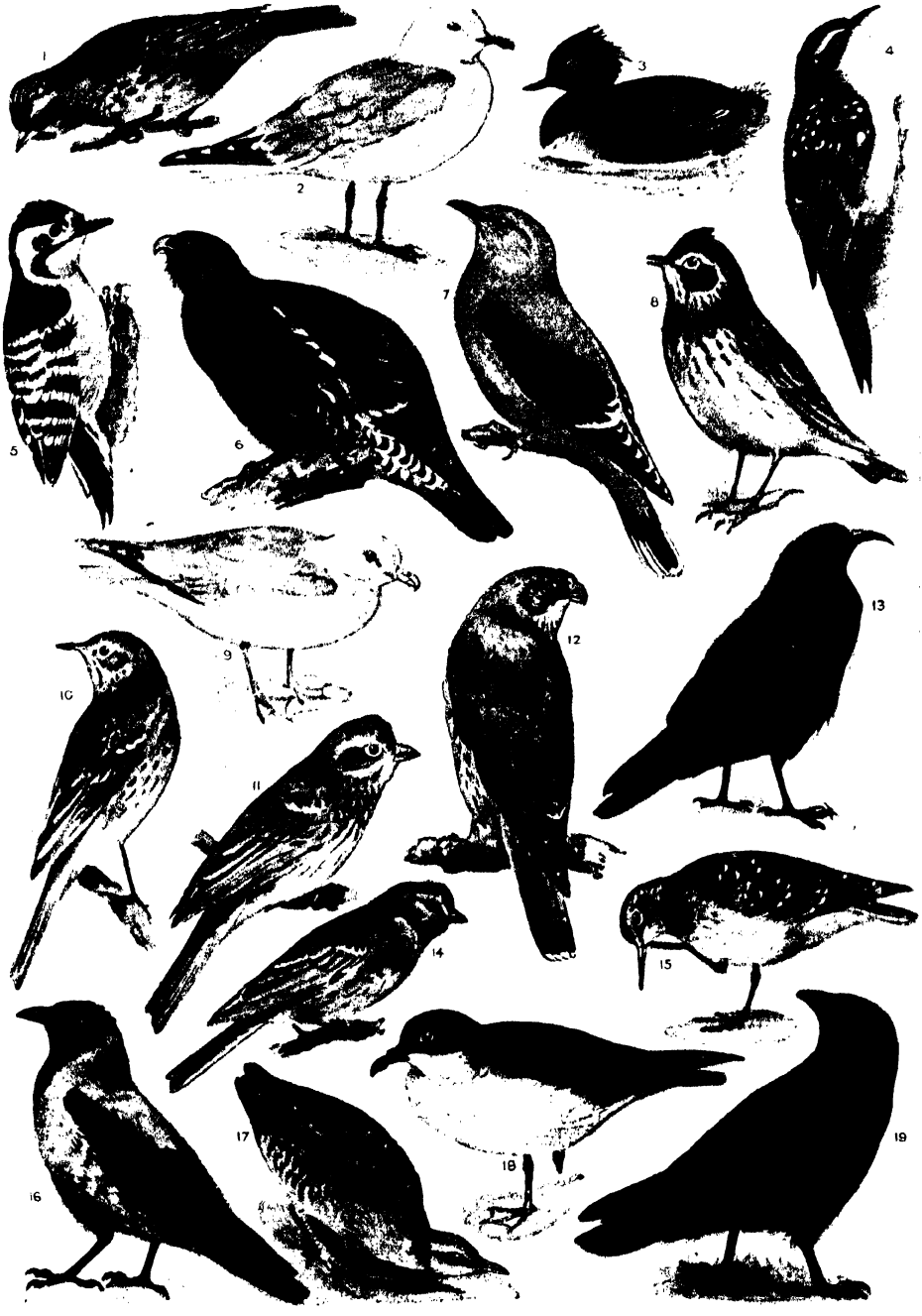
THE SWALLOW THAT HAS COME IN FROM THE WILD TO LIVE WITH MAN

The weakness of foot which characterizes the flycatchers is still more pronounced in the Swallows, their next of kin. Here the feet are excessively small and weak, well adapted for clinging but not for walking on a level surface. But for the fact that these delightful birds must cling to build and enter their nests, we should imagine their feet to be following the wings of the penguins and the ostriches into the limbo of disuse.

Yet, unlike the flycatchers, they go pretty well everywhere. Even the forbidding Arctic Circle has its summer swallows. That fact alone, if brave men had not been there to see for themselves, would be evidence enough of the existence of insects in the frigid lands. Swallows, needless to say, eat only insects. How could they do otherwise when their business is carried on solely in the air?

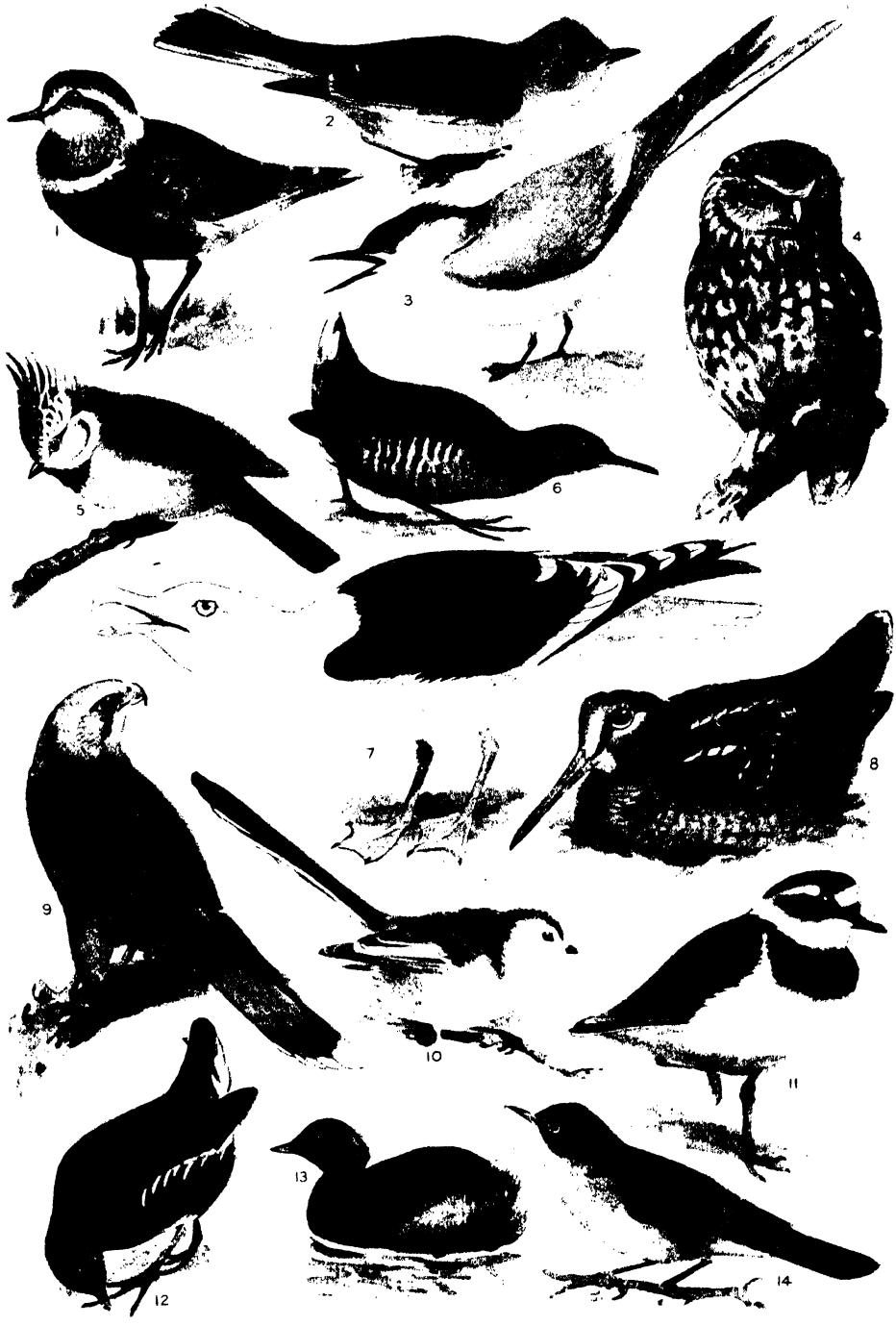
The commonest European swallow—Chimney Swallow, as it is named—is a purplish brown above, the forehead and throat chestnut, the breast black with a deep violet sheen, the lower parts mingled

BIRDS OF THE NORTHERN HEMISPHERE (III)

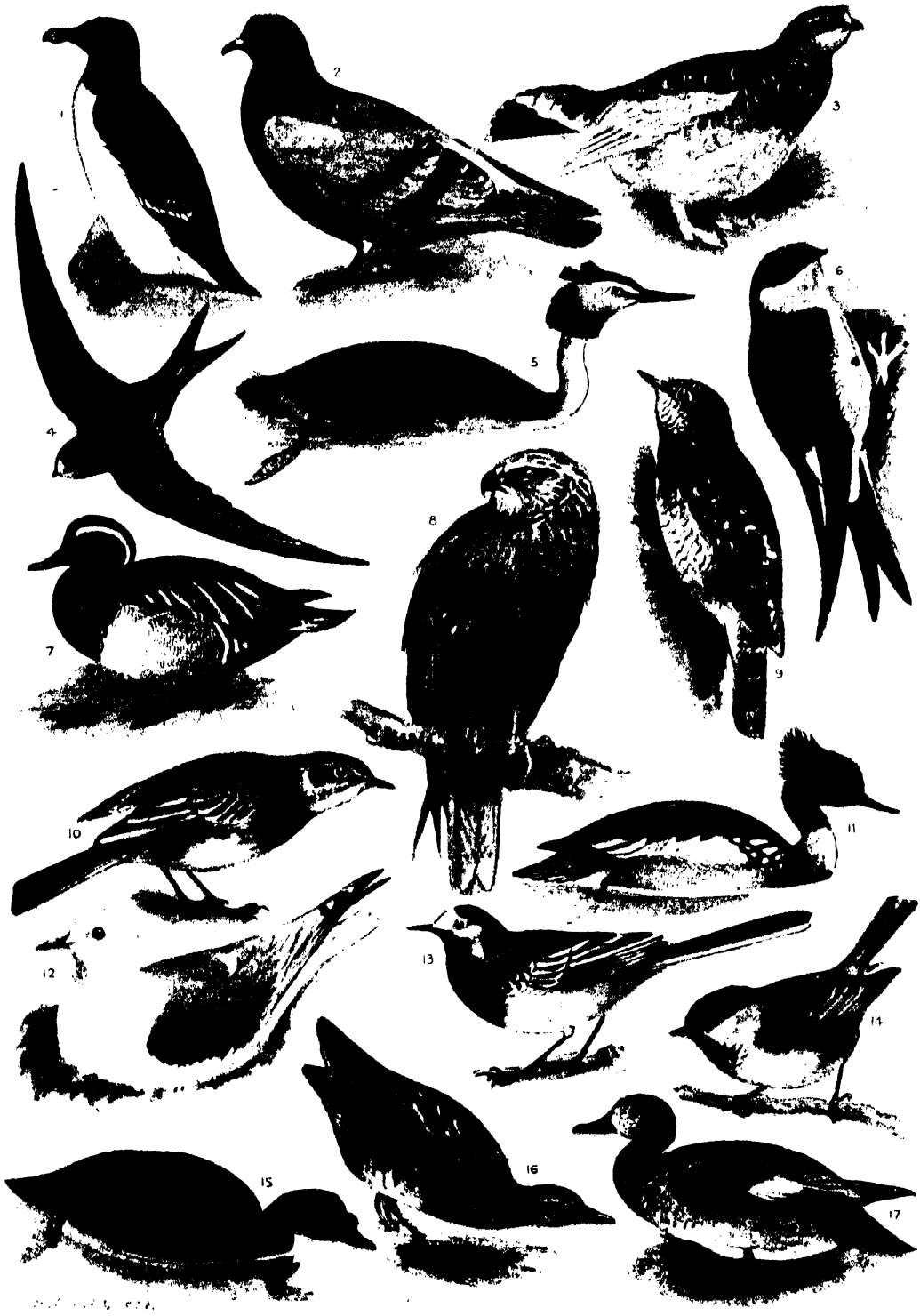


1. Redpoll. 2. European Gull. 3. Black-necked, or Eared, Grebe. 4. Tree Creeper. 5. Lesser Spotted Woodpecker. 6. Capercaillie. 7. European Golden Oriole. 8. Woodlark. 9. Fulmar. 10. Tree Pipit. 11. Corn Bunting. 12. Merlin. 13. Chough. 14. Cirl Bunting. 15. Common Sandpiper. 16. European Hooded Crow. 17. Landrail. 18. Manx Shearwater. 19. European Carrion Crow.

1. Crossbill. 2. Herring Gull. 3. Osprey. 4. Gannet. 5. Phalarope. 6. Montagu's Harrier. 7. Wilson's Tern. 8. Hobby. 9. Sandwich Tern. 10. Lesser Black-backed Gull. 11. Yellow Wagtail. 12. Sheldrake. 13. Honey Buzzard. 14. Raven. 15. Red-backed Shrike. 16. Pintail Duck.



1. Dotterel. 2. Whitethroat. 3. Arctic Tern. 4. European Little Owl. 5. Crested Tit. 6. Water Rail 7. Great Black-backed Gull. 8. Woodcock. 9. Kestrel. 10. Longtailed Tit. 11. Ring Plover. 12. Florida Gallinule. 13. European Little Grebe, or Dabchick. 14. Reed Warbler.



1. Razorbill. 2. European Rock Dove. 3. Ptarmigan. 4. Swift. 5. Great Crested Grebe. 6. European House Martin. 7. Garganey. 8. Marsh Harrier. 9. Wryneck. 10. Rock Pipit. 11. Red-Breasted Merganser. 12. Kittiwake. 13. Pied Wagtail. 14. Marsh Tit. 15. Scoter. 16. Spotted Crake. 17. Gadwall Duck.

white and red, the tail long and forked, the wings sharply pointed. Civilization has done well for swallows, let us thankfully note. Originally the bird had his lodging among cliffs and savage rocks, but houses and outbuildings are the foundations of his latter-day home.

He comes north to make his nest on the outer side of the wall, behind which lies baby's cradle. It is with a thrill of delight that we note how fearlessly he comes inland, right into the towns and villages, from his great African journey. He sets up housekeeping beneath the eaves, certain of his welcome, certain of his security, unless some atrocious sparrow has robbed him of his nesting site. What is called a chimney swallow in America is a swift. It really makes its nest in an unused chimney.

How are we to distinguish a true chimney swallow from the equally loved House Martin? From tip to tail the swallow is a good seven and a half inches; the martin is two inches shorter, has the head black, the lower part of the back and the under-side of the body pure white, and the feet and legs feathered like some of the pigeons.

It resembles the swallow, with whom it flies and hunts in joyous company, but we may detect the difference in the slightly inferior flight of the martin; it is not so much a master of wheeling and speed, of direct rush and turning movement. But if it were not compared with its rival, we should rank it a wonder as a flier. Both species are glorious little builders, forming the outer shell of the nest of mud and clay, and lining the interior with soft material, wool and grass.

THE BIRD MINER THAT MAKES ITS HOME IN THE CLIFFS

Sand Martins, or Bank Swallows, are general throughout the greater part of the world. They have never taken to us as the others have, but have clung to the ancient habit of mining homes in the sides of banks and cliffs of sandstones, weak clay and earth. Their works in these forbidding materials are marvels of cumulative force. There can be little strength in the single blow from a sand martin's beak; but blow upon blow, directed with skill and endurance, a few specks, a few grains at a time, they excavate a tunnel from four to six feet and more in the hill-face or the railway-cutting, and that is nursery and sure refuge.

WHY THE EGGS OF THE TREE SWALLOW ARE PURE WHITE

Not all swallows make their nests of clay. The Tree Swallows make their nests of dried grass and feathers in holes in tree-trunks. It is interesting to note that the eggs of the tree swallows conform to the common rule. Birds whose eggs are laid in the open must be colored to harmonize with surroundings so as to be inconspicuous. On the other hand, these birds have eggs which are pure white, like those of the owl and other haunters of holes. They do not need protective coloring, but they must be easily seen in the darkness of the nest. They are white, and therefore instantly seen by the bird returning to its sheltered home.

Our next group comprises the various Babblers, so named from their chattering, babbling song-language. They are all Old World birds. They include thrush-like forms which seem so gay in their language that we call them Laughing Thrushes. There are the Sober-coated Babblers of Abyssinia, whose strange chatter and labored flight from one low-growing bush to its fellow was one of the strange features which awaited James Bruce when he made his great journey into Abyssinia.

THE BEAUTIFUL BULBULS AND THEIR HISTORIC HOMES IN THE NEAR EAST

It is a little perplexing to young students to find green bulbuls, hill-robins, straight-claws and a genus of crow-tits brigaded as merely genera of babblers, and then to be introduced to the true bulbuls as a separate family. At this point relationships are hard to define clearly, and we have space here only to indicate the difficulty. Explanation must be sought in textbooks.

The true Bulbuls are Eastern beauties in which both sexes are alike. They differ in that respect from the Green Bulbuls, where the male is a brilliant bird of predominating lustrous green. The hen is a sober, retiring little bird, difficult to detect among the foliage from which she collects her daily food of insects.

Syria gives its name to a bulbul which thrives also in Arabia, Cyprus, Rhodes and the Cyclades. The White-vented Bulbul warbles over the cradle-site of Cleopatra and stays to-day in the Fayum province of Egypt. This district is a cemetery for the bones of multitudes of

animals now extinct, which have taught us many secrets of past life which would have been otherwise unknown. This bulbul sang over the heads of the men who labored beneath the scorching sun in Fayum. They were trying to piece together from relics there the amazing story of how the elephant got his tusks and trunk, and changed the shape of his head during the age-long process.

If the birds of the Near East could speak a language known to men, what marvels of the past they could tell us! There are so many wonders which we now piece together, a fraction at a time, with infinite pain and labor.

THE SPLENDID COURAGE OF THE TYRANT BIRDS OF AMERICA

Though we said a little while ago that America has no true flycatchers, we have birds quite different in type which we call flycatchers, because they catch all manner of winged insects. Science adopts the name, but corrects itself by giving a subtitle of Tyrant Birds, in allusion to the courage and fighting habits of the tribe. This courage is revealed in the magnificent bravery with which these comparatively small birds unite to attack and drive off birds of prey. They need no man with a gun to help them in their task. They manage the matter so ably themselves that they flourish like the green bay tree, numbering some four hundred species, and myriads of individuals.

Even though we adopt the name of flycatchers, we must remember that they are different birds from the true flycatchers. They are so different that their voice-boxes are entirely distinct from all the perching birds which we have yet considered. We have dealt with birds whose voices are controlled by a complex mechanism, but now we reach birds whose vocal organs are very simple and primitive.

Best known among the tyrant birds is the Kingbird, the supreme challenger of hawks and a glutton for insects. It occasionally takes a bee, and so is hated by some farmers who forget how enormous is this bird's intake of other insects ruinous to crops. The Scissor-tailed Flycatcher has scarlet patches on its sides. The quarrelsome Crested Flycatcher sometimes uses snakeskins in building its nest. There are many other interesting American flycatchers, but we must hasten on to the Chatterers, a gorgeous family of South American birds, of which one of the most bizarre is the Umbrella Bird, so styled from its crest of straight, elevated feathers, the tips of which gracefully turn to splendid drooping plumes.

A QUAINT LITTLE BIRD WITH ITS SPLENDID PARASOL

The whole crest can be expanded at will, and forms a noble parasol. Yet the sides of the neck are naked, and, as if to compensate, there descends from the throat a gorgeous lappet of feathers. Next come the Bell Birds, of several species, some of them grotesquely feathered. The notes they utter, one sharp, short note at a time, some sixty to the minute, have been likened to the clear, ringing note struck by a blacksmith upon a mellow-toned anvil.

It is a fact that when there was a bell bird at the London Zoo many thought the sound of its voice was the product of the anvil; and the superintendent of the gardens, worried by the unusual sound, sent with some annoyance to the Zoo blacksmith to know why on earth he was making noise.

The Cotingas, brilliant of hue, solitary of habit high in the tree-tops of the great Brazilian forests, are the nearest allies of the bell bird, and link up with the cock of the rock, a striking resident of Guiana and the Amazon countries. There are allied species in possession of Peru and Ecuador. Brilliant orange red is the dominant note of the feathers, and a wonderful crest surmounts the head and extends to the tip of the beak, overhanging it, but of course not growing upon it.

THE COCK OF THE ROCK, AND WHAT HE SEEMS TO SAY

All handsome birds love to display their fine feathers, and the Cock of the Rock is desirous that others shall be witness of his splendors. So in an open glade he mounts a rock and dances and prances, with proud swayings of the head, and jaunty leaps and struts, and curious cries, as if to say, "See how fine a fellow am I!"

Equal gorgeousness, but a very different outline, marks the Manakins, another South American family. They are handsome, bright little birds, small of beak, small and weak of feet, and with this curiosity, that the two middle toes are united for part of their distance. We cannot say how such a modification has

SOME VERY ATTRACTIVE BIRDS

Scissor-tailed flycatcher.

White-collared flycatcher.

Brazilian sicklebill.

White-headed bell bird.

Common manakin.

Sumatran broadbill.

The red-billed hill-robin.

Pictures, copyright, Warne, Bickerton, Chislett, Crook, Symonds, Taylor and others.

come about, nor for what purpose. The feature must have arisen as a freak in the manakin family, and have persisted through the supreme vigor of the line in which it first appeared.

THE POWERFUL SAW-LIKE BEAK OF THE PLANT-CUTTERS

Central America has another curiosity in the Plant-cutters. They are birds with thick beaks with sharp cutting edges, notched in the manner of a saw. This beak is rather a terror to cultivators, for it does not merely cut leaves: it cuts down an entire plant as effectively as a wood-louse in a greenhouse cuts down the baby tomato plant when it is thin and weak, or as a garden slug deals with seedling plants.

An equally remarkable beak is found in Eastern birds, the Broadbills, common to hottest India, Sumatra and Malaya. Their name is well bestowed, for in some species the bill is actually broader than the head! In the Pittas of the Old World we get back to another thrush-like form. They are exquisitely colored birds of the Malay Archipelago. Their habits of life and general outline earn them the popular name of Ant-thrushes.

THE WONDERFUL FORTRESS OF THE OVENBIRDS OF SOUTH AMERICA

Another family awaits to introduce us to the remarkable Ovenbirds of South America. They are among the master-builders of the world. Their home is a fortress of mud, a foot and more in diameter, built with an outer surrounding wall with a narrow entrance, but with one end of the wall turning inward as a defense. Within there is an inner room, to which a small opening gives access from the outer defenses.

Many weeks may go to the making of these nests, for the birds cannot work except when moisture and mud are available, and that is not always the case in tropical America. It is interesting that these fortress-builders like the company of men and choose human habitations for their sites when possible.

When they build in the open country, they take up their positions by the side of a road and make the entrance face the highway. There must be a long history of native kindness behind these habits. What we call an ovenbird in North America is a warbler.

Spinetails are so named from the rigid, pointed tips of the tail feathers. This and the Sicklebill, a bird with a bill long and curved like a reaper's implement, lead us to the extraordinary Lyre Birds of Australia. They have developed in a unique manner, in the great island continent, and stand alone in the grace and splendor of their tails.

Extravagant grace could scarcely go farther than in this family. The feathers of the tail take the most beautiful outline, differing in varying species, yet all with the general shape of the lyre. Here, again, we find gay birds gay in habit. They are capital songsters, and as they sing they dance. They seem to display a real greed of admiration. But they have good hearts as well as giddy brains. No bird shows greater devotion to its young than the frivolous lyre bird.

Nothing but fatal illness will make the parents desert eggs or babies. Even if the little ones are carried away, the parents will follow, if possible, and continue their duty to the chicks in another place. When young ones have been taken away, and are afterward restored to the nest, the mother welcomes back her lost ones with lavish affection. And that is more than the great wise mother elephant will do to a strayed baby of hers that finds its way back home.

THE IMPORTANCE OF BIRDS TO THE PROSPERITY OF THE WORLD

What a list of birds we have now run through together in this story! Except the plant-cutter, there is not an enemy in the whole vast company. But there are friends beyond price on every page. It is only when we take such a survey that we gather any estimate of worth as to the real value and importance of birds to the prosperity of the world.

Some time ago a scientist estimated that one-fifth of our crops is destroyed by insects, and warned us that man is fighting a losing battle with these small enemies. The best aid in the fight is the great company of birds. If we destroy our allies, the battle is likely to go against us, and we shall have for our own use a smaller part of the crops.

Strike out this group of birds of which we now take farewell, and life would be harder for mankind in many places, and apart from economic values, it might even be said to be shorn of half its beauties and half its joys.

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 3365.

An imaginary picture of "life on Mars." Any life on that planet would be very different from ours.

THE TERRESTRIAL PLANETS

MERCURY, VENUS, MARS and PLUTO

THE sun is the shining lordly center of the solar system. Countless bodies—planets, minor planets, comets, meteors, moons—move steadily in their orbits around the great ball of brilliance. Of these thousands of millions of bodies, nine attract our attention particularly, for they are the planets, and included in their number is the planet earth on which we live. Until 1930 it was generally believed that there were only eight planets, but in that year Pluto was discovered, moving at a snail's pace in its wide path farthest from the sun.

This brought the known total up to nine; but there is some reason to believe that there may be other planets beyond Pluto yet to be discovered. In the early days of astronomy the Greeks listed seven planetary bodies—the five which could be seen with the naked eye, Mercury, Venus, Mars, Jupiter and Saturn, and also, erroneously, the sun and the moon.

Mercury, Venus, Mars and Pluto are often referred to as the "terrestrial" planets because in many ways they resemble the earth (*terra*).

Planets differ from stars in very definite ways. The planets have no light of their own, but, like the moon, shine by reflected sunlight. The stars, on the other hand, are enormous balls of incandescent gas which give out light and heat of their own. The planets show a much more obvious movement than the stars, because they are closer to us. The Greeks called these bodies "planets," a word which means "wanderers." The planets, as they move eastward around the sun, can be seen to change their position against the background of the stars. We speak of the stars as fixed, in spite of the fact that, like our sun, they are not fixed at all, but are actually moving rapidly through space. Because of their vast distances from us, we do not observe their motion except over very long periods of time.

The planets, in their motion around the sun, always travel within a narrow belt of stars known as the zodiac, the center of which is the ecliptic, or the apparent path of the sun eastward around the sky during the year. The identification of the planets is made easier by the fact that they stay within this narrow band of stars—not much more than 18 degrees wide. The zodiac is in the central region of the sky, not far from the celestial equator. Eclipses of the sun and moon are seen along this belt. That is how it came to be called the ecliptic.

Mercury is the smallest of the planets, with a diameter of about 3,100 miles. It is the nearest to the sun, and because of its nearness it is never seen more than 28 degrees away from that body. (To understand how much one degree is, remember that a whole circle is 360 degrees. From the east point of the horizon through the zenith, the top point of the heavens, and down to the west point is 180 degrees. From the horizon to the zenith, directly overhead, is 90 degrees.)

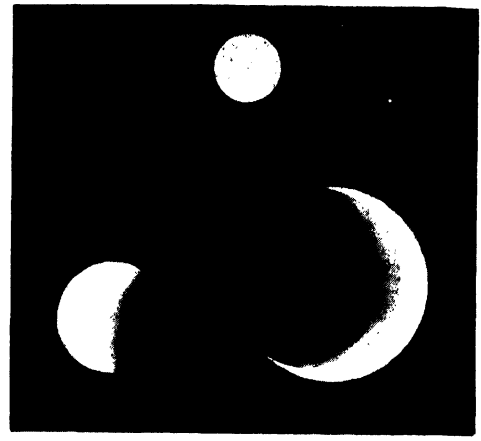
Mercury at its brightest is about as bright as the star Sirius, which outshines every other star in the sky. Most observers have never seen Mercury unless they have looked for it very particularly, because of its nearness to the sun. It is always seen, in northern latitudes, in the twilight of the evening or the morning sky, rising just before the sun, or setting just after the sun goes down.

Many celestial objects can be seen to much greater advantage when viewed through a pair of opera glasses or binoculars, and while Mercury is not a very satisfactory object for observation, it can be seen more clearly with glasses. The planets, when observed with optical aid, show definite discs, or diameters, while the stars (no matter how large they are) appear only as tiny points of light, because of their great distance. The most favorable times for the observation of Mercury, although some years are better than others, are in March and April before sunrise, and in August and September after sunset.

MERCURY, NEAREST THE SUN, IS THE SPEEDIEST OF THE PLANETS

All the planets were named after gods of ancient Greek and Roman mythology. Mercury was the messenger of the gods; he traveled with miraculous speed, and the planet Mercury, being closest to the sun, travels faster than any of the others. The speed of the planets decreases as we travel farther from the sun; Pluto moves at the slowest rate of all. Mercury's speed in its path around the sun ranges from 23 to 36 miles a second! Our own planet speeds around the sun at a rate of about 18 miles a second. Mercury's orbit is elliptical and not circular; when closest to the sun, Mercury is about 28,500,000 miles away from that body, and when it is most remote the distance is about 43,500,000.

So far as we are able to tell, there is no atmosphere or air surrounding this tiny planet. Its surface seems in many ways to



Phases of Mercury. At the top, Mercury's full face—when it is farthest from us. Right, when it is almost at its nearest point. Left, at a middle point.

resemble that of our moon, which also has no atmosphere. To the average person looking through a telescope the markings on Mercury would be almost impossible to see. However, it is believed that there are definite markings. The period of rotation on its axis is about the same as its period of revolution around the sun, eighty-eight days, making the day exactly the same length as the year. Consequently, the same side of Mercury is always turned toward the sun. That side is extremely hot, with a calculated temperature of about 770 degrees F., higher than the melting point of tin and lead. The side which is always turned away from the sun is forever dark and cold, with a temperature approaching absolute zero.

This little planet is fairly dense, and it is believed that it is composed of stone or iron much like the earth. Probably it once had an atmosphere which has since escaped from it. Bodies of small mass like Mercury lose their atmospheres quickly, for a molecule of gas need travel only at the very moderate speed of 2.3 miles per second to escape from the gravitational pull of such a tiny body.

Because of the lack of atmosphere, and also because of the extremes of temperature, we can be very sure that there is no life on Mercury—at least, no life of any kind that we can imagine.

Venus is, of all planets, the most beautiful, a fact which undoubtedly accounts for the choice of its name, for Venus was the goddess of love and beauty. When it is at its brightest, Venus is brighter than any other object in the sky except the sun and

the moon, so brilliant that it can at times be seen in broad daylight when the sun is shining, if one knows where to look. Its great radiance is accounted for by the fact that it is surrounded by heavy white clouds which reflect the light of the sun.

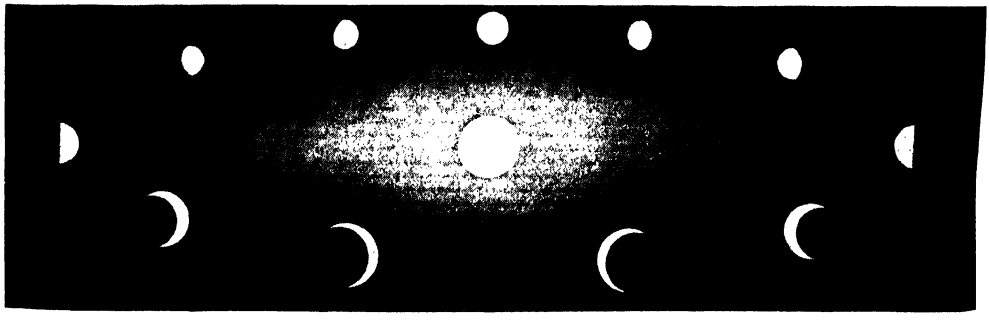
Of all the planets, Venus is nearest the earth. Venus is sometimes called the twin sister of the earth, for it is of about the same size—its diameter is only 400 miles less. Its year is much shorter than ours—225 days long—but much longer than that of Mercury. As we investigate planets farther from the sun we shall discover that the years increase in length. Not only do the planets actually move more slowly, but their paths become longer, quite naturally, as they are located farther from the solar system's center. At one time it was thought that Venus' day was equal to her year, but now it is generally believed that Venus' period of rotation must be somewhere in the neighborhood of 30 days, though that can not be proved because of the heavy clouds. It is impossible because of these clouds to observe any fixed spot on the surface and watch its rate of rotation.

No one knows what the clouds of Venus are composed of. It seems improbable that they can be of water, for no trace of water vapor has yet been found in the analysis of light reflected from them. One modern authority, Wildt, has suggested that they may be composed of formaldehyde, which would give Venus plastic clouds! Below the clouds which we can see the atmosphere of Venus may be quite different. Because of this uncertainty about the lower atmosphere we can not rule out the possibility of life there.

The temperature of the dark side of Venus has been measured at about —9 degrees F., not nearly so cold as the dark side of Mercury. On the other hand, it is not always the same side of Venus that is turned away from the sun. The sunlit side of Venus, so far as we can tell, is between 120 and 140 degrees F., which is not excessively hot, judged by the heat of deserts on our own earth.

If there were creatures living on Venus, they would probably never have seen the sun or the stars, but would live perpetually in a cloudy world, in twilight almost, beneath that heavy layer of atmosphere.

Venus and Mercury are the only two planets which pass through an entire cycle of phases as does our moon. When either one of them is between us and the sun, as it must be once during each one of its years, we can not see the planet at all, for the sunlit side is turned from us and it would be lost in the direct light of the sun. Then, as the planet moves around the sun in its elliptical path, we see a thin crescent, a tiny sliver of the lighted half of the planet. That sliver grows until we see a quarter planet, when it is at greatest elongation. Then the planet moves on until it is on the other side of the sun from the earth, when we see the entire lighted side, but in appearance very small because it is so much farther away. The diameter of Venus at its closest approach to the earth appears to be six times greater than its diameter when it is on the other side of the sun from us, or at superior conjunction. When between the earth and the sun the position of either Mercury or Venus is referred to as inferior conjunction.



Phases of Venus, in her journey round the sun. The earth's orbit is outside that of Venus. When Venus is directly between us and the sun, we can not see her. When she is at the opposite point of her orbit we can see her full face, lighted by the sun. She is then at her farthest point from the earth and looks small.

Sometimes Mercury or Venus will pass exactly between us and the sun at inferior conjunction. This position is called transit. Usually this does not happen; usually the planet appears either above or below the sun. But fairly frequently we see Mercury

in transit, as a tiny black speck against the bright disc of the sun. Transits of Venus are infrequent, the last one occurring in 1882, and the next scheduled for 2004.

At its greatest elongation Venus is 47 degrees east or west of the sun. This means that Venus never sets more than three hours after the sun, or rises more than three hours before the sun comes up. Between greatest eastern elongation, when Venus is a bright "evening star," and greatest western elongation when it precedes the sun into the sky as a "morning star," 144 days elapse. Then a long period of more than a year passes before Venus is again seen as an "evening star."

If you have never observed Venus with a pair of binoculars or a telescope, or even with opera glasses, take the first opportunity to do so, particularly when it is at crescent phase. It is a sight you will never forget.

RUDDY MARS, THE EARTH'S OTHER NEAR NEIGHBOR

The earth is flanked on one side by her beautiful and brilliant neighbor Venus, and on the other by the ruddy and warlike Mars. Of all the planets in our solar system, Mars is to the average person the most interesting. It has long been the "best seller" among planets because decades ago some astronomers came to the conclusion that there might conceivably be life there. That is a fascinating thought; but let us see first what Mars looks like and what its physical characteristics are, before we examine this question of life.

Mars in itself is an interesting planet, even omitting the possibility of life there. We can observe it more easily than any other planet because of its nearness to the earth (only Venus among the planets comes closer) and because of its very thin atmosphere which produces no heavy clouds to hide the surface from our curious gaze.

It was undoubtedly because of Mars's red color that the ancient astronomers gave it the name of the god of war, for red is a color associated with battles and bloodshed. This red color is caused by the oxidation of iron on the surface of the planet—in other words, Mars has rusted. Some day in the far future, it is probable that the surface of the earth will for this same reason take on a similar reddish tint.

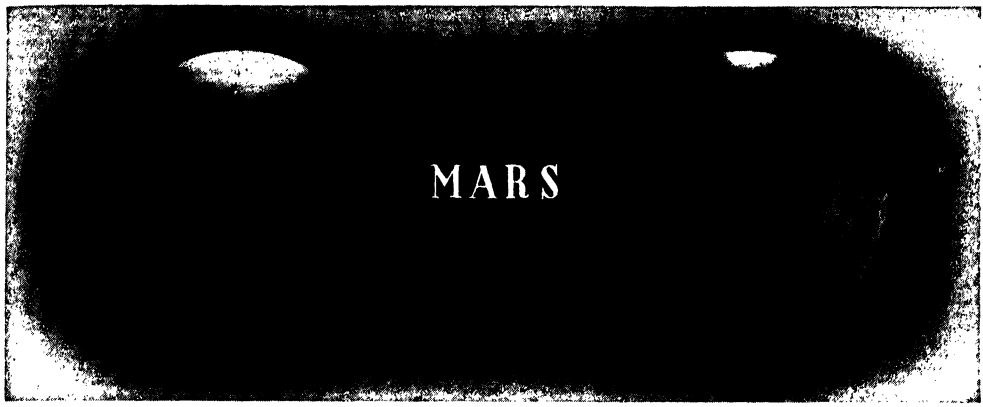
Mars is slightly more than half the diameter of the earth, and is so much less massive than our planet that your weight there would be much less than it is on the earth. The day is just 37 minutes and 22.58 seconds longer than our day on the earth. Mars has two moons revolving around it very rapidly. Phobos, the nearer moon, with a diameter of about 15 miles, travels around Mars in 7 hours and 39 minutes. Deimos, the outer and smaller of the two, takes 30 hours and 18 minutes to complete its circuit. (Neither Venus nor Mercury has any moons.) Phobos travels so much more rapidly than Mars itself rotates that an observer on Mars would see this tiny moon rise and set several times a day; and Phobos would rise in the west and set in the east because of this rapid revolution.

One of the most interesting features of Mars is the presence of the two polar caps, white patches which occur at the planet's north and south poles. These polar caps vary in size with the changes of the Martian seasons which are approximately twice as long as ours. In winter the polar caps are extensive, sometimes reaching more than halfway to the equator. (Of course the same thing is often true on the earth in the winter time.) Then, when the Martian spring and summer come, these polar caps begin to shrink in size until sometimes they almost entirely disappear. Naturally, astronomers have wondered if the caps are not composed of snow and ice like our own terrestrial polar caps. Although we are not sure, it seems most probable that this is true.

PERCIVAL LOWELL'S IDEAS ABOUT LIFE ON MARS

Toward the end of the last century an American astronomer, Percival Lowell, began a study of Mars and its peculiar surface markings which was to occupy him for the rest of his lifetime and to make him one of the greatest students of Mars. Lowell believed that the peculiar dark lines on the surface were actually artificial waterways or canals, built by intelligent beings to carry water from the melting polar caps to the more arid and desert-like sections of the planet. Very few astronomers would agree today with Lowell's belief. At such a great distance (at its closest approach Mars is about 35,000,000 miles from the earth) it is impossible to determine whether the dark lines are straight or whether the appearance of straightness is merely an illusion caused by distance.

The presence of living creatures on Mars seems unlikely because there is an infinitesimally small amount of oxygen in the atmosphere, something like $\frac{1}{10}$ of one per



Right—In summer on Mars' northern hemisphere, the ice around her North Pole melts. Left—In early spring the icecap is larger. Of course we can only guess that these white caps are ice.

cent ($\frac{1}{1000}$) as much per unit of volume as in the air of the earth. The Martian atmosphere is probably only about 60 miles in depth, as compared to the 500- or 600-mile depth of the earth's envelope of air.

We can not say definitely that there can be no animal life on Mars because, as some authorities suggest, Mars probably once had a much heavier atmosphere than it has today. If beings existed there at that time, they might have gradually adapted themselves physically to the slow loss of oxygen from the atmosphere, or even have built themselves cities with artificial atmospheres under cover. But this is in the realm of wildest speculation, and nothing whatever is known definitely about life on Mars.

While this great doubt exists as to the presence of animal life on Mars, many astronomers believe that plants may grow there. Certain seasonal changes in color, green areas appearing in the spring and summer, seem to indicate that vegetation is coming to life at those times on Mars, as it does on the earth in the spring. If plants do exist there, we might expect that they would be of the same general type as terrestrial plants found in deserts and at high altitudes.

Mars as a whole is a much colder planet than the earth. Temperatures in some of the green areas have been found to be as high as 86 degrees F. at noon, while in the early Martian evening the temperature falls to about 10 degrees F. At midnight it must be very cold indeed, far below zero.

While we have given to various dark areas on the red planet the names of lakes, bays, channels and seas, there are in reality probably no large bodies of water there. Any large area of water would reflect sunlight so conspicuously that it would be observable with our telescopes, and no such reflection has ever been seen.

It is interesting, in comparing our two closest neighbors among the planets, to note that some astronomers think Venus is in an earlier stage of development than the earth, perhaps as the earth was millions of years ago. Mars, on the other hand, shows all the evidences of a slowly dying planet, presenting perhaps a picture of the earth as it may be ages from now.

Of the most recently discovered planet, Pluto, not much is known. Because of its vast distance from the sun (on an average about 4,000,000,000 miles) it must be extremely cold and dark. It is about ¾ the size of our earth. Because of its distance from the sun, Pluto's year is long, about 248 of our years in length.

Pluto's discovery was the result of years of work carried on in the Lowell Observatory at Flagstaff, Arizona. Percival Lowell, the student of Mars, felt certain that there must be a planet beyond Neptune. He thought so because of certain unexplained peculiarities in the motion of Uranus, which might be attributed to the gravitational pull of a planet beyond Neptune. He called the unfound body Planet X. When such a planet was found in 1930, by Clyde W. Tombaugh, long after Lowell's death, it was discovered in the position which he had indicated. Its name Pluto is not only that of the god of the underworld, but also a reminder of Lowell's work, for his initials are the first two letters of the planet's name.

By MARIAN LOCKWOOD.

THE NEXT STORY OF THE EARTH IS ON PAGE 3409.

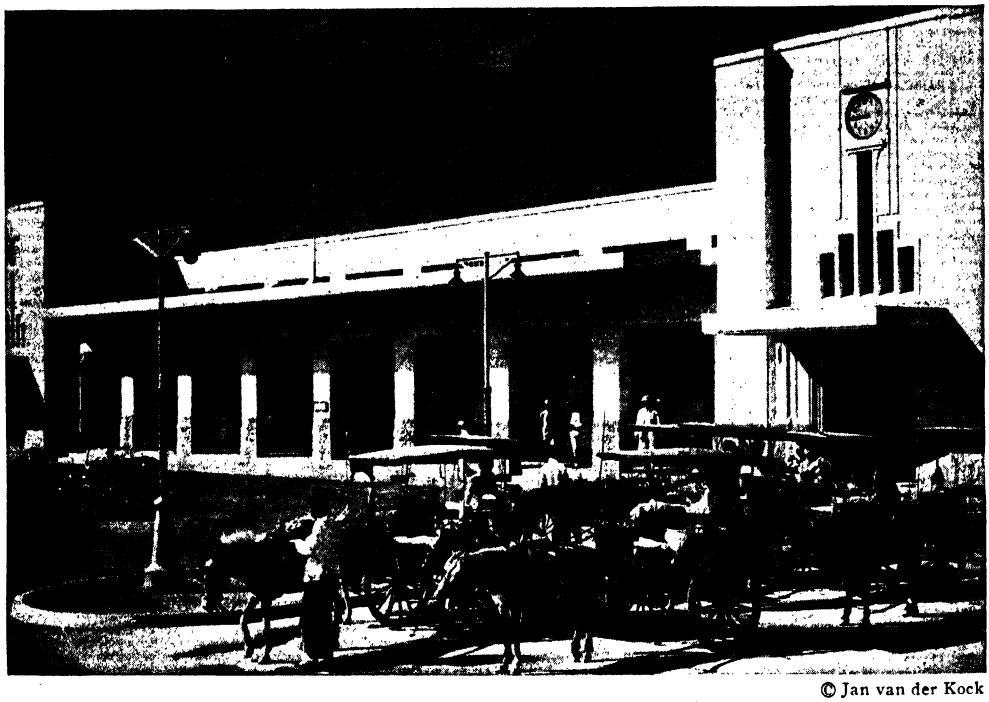
THE SOUTH SEA ISLANDS

SPRINKLED in clusters over the vast distances of the Pacific Ocean are thousands and thousands of islands. Some of them are quite large; but most appear only as dots on the map, though World War II made many of their names familiar. As you know, the Japanese occupied many of these islands and were driven out only after a bitter struggle. But that is a part of the story of the war, which we tell elsewhere in our book. Here we shall talk about the islands as they are in peacetime.

Generally speaking, the South Seas is that part of the Pacific Ocean within the tropical zone, between the Tropic of Cancer, on the north, and the Tropic of Capricorn, on the south. (The island-continent of Australia, New Zealand and Japan are discussed elsewhere.) There are three kinds of tropical Pacific islands: the volcanic peak or range, surrounded entirely or in part by a coral reef; the coral mass; and the atoll, which is a circular coral reef, enclosing a lagoon, a quiet bay.

The volcanic islands are usually mountainous, and on some of them the volcanoes are still active. The coral islands, reefs and atolls have been formed—and the process still goes on—of the countless millions of skeletons of tiny sea creatures. Such skeletons, delicate pink or orange-red, are what we call coral. Usually there are several breaks in an atoll, providing passage between the lagoon and the outer sea. Reefs may extend outward from coral islands, often just under the surface of the water, and many a ship has come to grief on them.

In the course of ages, sand and soil, blown by the wind from other lands, covered both the volcanic and coral islands. Then trees and plants began to grow. Volcanic soil is usually fertile, and in the thickets of such islands are sandalwood, ebony, coconut palms, tree ferns, sago palms, and the yam,



© Jan van der Kock

Sados, pony-drawn "taxicabs," wait outside the spick-and-span railroad station in Weltevreden, the modern section of Batavia, where most Europeans reside. Batavia is the center of the extensive railway system on Java.

© Publishers Photo Service
Polynesians are tall and well built. Their skin is light brown.

© Ewing Galloway, N. Y.
Micronesians have darker brown skin, and straight black hair.

© Ewing Galloway, N. Y.
Melanesians, or Papuans, have dark skins, broad noses and fuzzy hair.

breadfruit, pineapple, guava, banana, mango and taro. (The roots of the taro are ground to form the paste known as poi—the flour of the South Seas.) On the coral islands the soil is usually shallow. Nevertheless coconut palms and bananas, cotton and sugar-cane thrive on them.

There are few land animals on the islands, only rats and bats and pigs. But the islands are alive with birds, especially pigeons and doves. There are lizards, some snakes, and crocodiles in the swamps; and there are insects. The worst insect-pest is the malaria-carrying mosquito.

The waters of the South Seas teem with fish. Sharks are an ever present danger to swimmers. Off some of the islands are large pearl-oyster beds. An odd sea creature, the trepang, or sea cucumber, is used for food.

Some of the islands have extremely valuable mineral deposits: New Caledonia has nickel; Nauru, phosphate; Louisiades, gold; New Hebrides, sulfur.

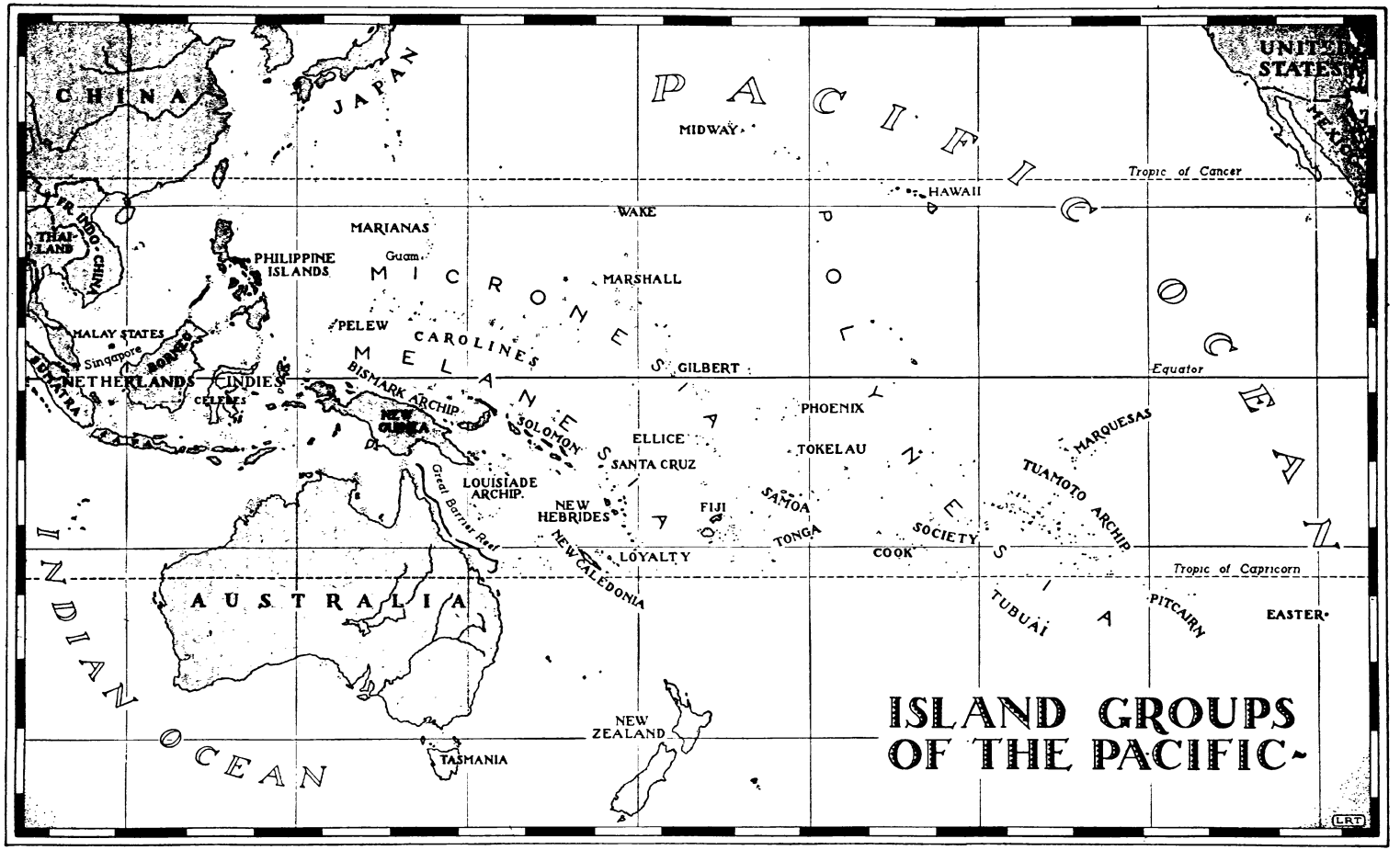
The history of the South Sea islands before the Europeans came is shrouded in mystery. Where did the island-dwellers come from, and how did they get to the islands? Probably from Malaya and India, some perhaps even as far as Africa, in frail canoes. It is also possible that boats from the west coast of South America may have been carried by currents to the easternmost islands. No one knows for sure.

Ferdinand Magellan was the first European to reach the South Sea islands, in 1521. He discovered the Marianas and probably sighted a number of others. The Portuguese and Spanish did most of the exploring in the sixteenth century. In 1642-43 a Dutchman, Abel Janssen Tasman, discovered the Fiji group and other islands. French and English navigators came in the eighteenth century, among them Louis Antoine de Bougainville and Captain James Cook. Missionaries, traders and finally scientists followed the explorers. Until the nineteenth century Spain and Portugal controlled a number of the islands. Others became possessions of Great Britain, the United States, France, Holland and Germany; but Germany lost its South Seas territory after World War I.

The islands of the South Seas form five main divisions. Traveling eastward from the southeast tip of Asia, the Malay Peninsula, they are: Indonesia (East Indies), which begins close to the Malay Peninsula,

© Ewing Galloway, N. Y.
The coconut-palm gives food, shelter and clothing.

THE PACIFIC AREA, NORTH AND SOUTH OF THE EQUATOR



Courtesy K. P. M. Lines
The shopping district of Macassar, Celebes seaport.

and then spreads out to the east; the Philippine Islands, north of Indonesia; Melanesia, which includes New Guinea and the first arc of islands to the east; Micronesia, the next arc of islands swinging out into the Pacific; and Polynesia, the islands in the center and eastern part of the South Seas.

INDONESIA

The chief islands of Indonesia are Sumatra, Java, Celebes and Borneo. The first three, part of Borneo and other near-by islands have been Dutch territory since early in the seventeenth century, the Netherlands East Indies. However, under the Japanese occupation of these islands during World War II, the native movement for independence was encouraged. At the war's end the Indonesians declared themselves a republic, and considerable fighting with the Dutch resulted. Eventually, in March 1947, representatives of the Netherlands Government and of the Indonesian Republic signed an agreement which recognized the republic and provides for the formation of an independent nation by January 1, 1949, to be known as the United States of Indonesia. It will include chiefly Sumatra and Java; the rest of the Netherlands Indies are to remain under Dutch control. The United States of Indonesia will become an equal partner with the Kingdom of the Netherlands in a Netherlands-Indonesian Union.

The capital of these islands is Batavia, and the second most important town is Surabaya, both on Java. Most of the people are Malays, chiefly Mohammedan in religion.

Java is by far the most fertile and highly developed island of Indonesia. Rice, sugar, cinchona (for quinine), coffee, tobacco, tea and indigo all thrive. The production of petroleum and of plantation rubber are both extremely important.

The long, rather narrow island of Sumatra has a spine of thickly timbered mountains, and the coastal lowlands are covered with jungle. However, tobacco, palm oil, rubber, tea, sisal and coffee are produced; and the island has mineral wealth, especially petroleum, coal and tin.

Celebes and the group of islands around it (including the enchanting isle of Bali) are the original Spice Islands. Even before the Roman Empire came to an end, spices from these islands were reaching Europe by way of India. The spice trade is one of the most ancient in the world. Later, as stories of the actual islands traveled to Europe and they were discovered eventually by the Portuguese, the group came to be known as the Spice Islands. Today ships still carry away cargoes of nutmeg, mace and cloves. Celebes itself is almost all mountains, and in the dense forests are valuable woods. It produces copra and coffee, and is rich in gold, silver, copper, manganese, nickel, coal and natural asphalt.

Borneo, the largest of the islands of Indonesia, is mostly jungle, threaded with many rivers. Mountain chains ridge it from north

Netherlands Information Bureau
Houses on Sumatra seem to be leaning into the wind.

© Fenno Jacobs from Three Lions
A bountiful rice crop on Negros Island, Philippines.

© M. Mihaldo from Black Star
Signs familiar to Western eyes along a Manila street.

to south. In addition to Malays there are tribes of Dyaks, the original "wild men" of Borneo, and large numbers of Chinese. Rice is the chief crop, and the island is rich in petroleum. But jungle and mountain have hindered development of Borneo's resources.

In the north of Borneo are two British colonies—North Borneo and Sarawak—and the British protectorate of Brunei. North Borneo, once ruled by the British North Borneo Company, became a colony in 1946. The chief products of this area are timber, dried fish, rice, coconuts, rubber, tobacco and sago.

Tiny Brunei is southwest of North Borneo. The natives build boats, weave cloth and manufacture brass and silver articles. Crude oil, rubber and sago are exported.

For more than a hundred years Sarawak was ruled by a British family named Brooke. The head of the family had the title of rajah. However, in 1945 the last rajah, Sir Charles Vyner Brooke, turned the area over to Great Britain. Sarawak has both coal and oil, but only the oil fields have been developed to any extent.

THE PHILIPPINE ISLANDS

There are more than seven thousand islands in the Philippine group, but many of them are hardly more than points of rock jutting above the surface of the sea. Two of the islands, Luzon and Mindanao, account for two-thirds of the total area. Manila, the capital, is on Luzon.

Mountain peaks loom from the larger islands, and there are about fifty volcanoes, twenty of them still active. Earthquakes are frequent.

The soil is rich, and there are great forests, which yield valuable woods. Many kinds are so hard that they can not be cut by ordinary saws. Sugar, from sugar-cane, is the most valuable export. Manila hemp is famous. Coconut oil, copra, coffee, cocoa, tobacco, Indian corn, rice and sweet potatoes all add to the stream of wealth from the soil. Gold is the most important mineral, and the Philippines have silver, iron, lead, zinc, copper, sulfur, petroleum, salt, marble and asbestos as well.

There are several different races in the islands. The first inhabitants were black, and from them the Negritos are descended. The Malays then invaded the islands, and after a time other Malay invasions drove the first invaders into the hills. Among the various pagan tribes descended from the first Malay invasion are the famous head-hunters, the Igorrotes. Some of the second wave of Malay invaders eventually became Christians, and their descendants are called Filipinos. Then a third and later Malay invasion arrived, but this time it was the Mohammedan Malays, and from them are descended the fierce Moros.

The Moros probably would have conquered the islands if the Spanish had not taken possession, in 1565. The Spaniards held the islands until the Spanish-American

© Todd Webb from Black Star
A Filipino lass—shy smile and tight braids.

War, in 1898; and the United States kept the islands after that war, but paid Spain $20,000,000. The Filipinos had been fighting for their freedom from Spain, and after the war they also revolted against the United States. The rebellion was put down; but the United States promised independence some day. Gradually the Filipinos were granted more self-government; and in 1934 the United States permitted the establishment of the Commonwealth of the Philippines. July 4, 1946, was set as the date for complete independence. The old promise was kept, and there is now a completely free Philippine Republic.

MELANESIA

Melanesia means the Islands of the Blacks. Most of the people on these isles have dark skins and frizzy hair. They belong to the Papuan branch of the black race.

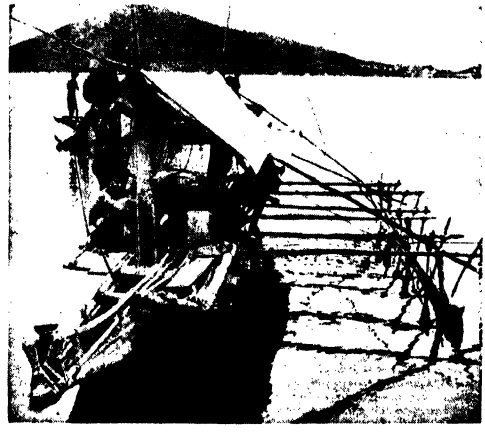
New Guinea is the only really large island in the group. It actually does have the shape of a guinea, a bird, the peninsula in the northwest the head, the peninsula in the southeast the tail. There are lofty mountains in these peninsulas, and much of the island is covered with thick forests. Here one may catch a glimpse of the gorgeous birds of paradise. Copra, cocoa, shells and gold are New Guinea's chief contributions to trade. The gold industry, on the east coast, is unusual. Here the mountains "stand on edge" and the jungle can hardly be penetrated. The only transportation to and from the gold field is by airplane.

The western half of the island is Dutch territory (usually included in the Netherlands East Indies). Between the two world wars Australia governed the eastern half, in turn divided into the Territory of Papua (much the larger part, in the southeast) and Northeastern New Guinea. The Territory of Papua is still under the control of Australia. But Northeastern New Guinea, which was a League of Nations mandate, now is administered by the Trusteeship Council of the United Nations.

The Bismarck Archipelago is a necklace of islands northeast of New Guinea. Of these the most important are New Britain, New Ireland, Lavongai and the Admiralty Islands. Crescent-shaped New Britain, the largest, is mountainous with several active volcanoes. It is largely undeveloped, but has several good harbors, especially Rabaul. The next largest isle is New Ireland, also mountainous, but a large part of it is cultivated. Copra, coffee and cocoa are produced. The group is a United Nations trusteeship.

Included in the Australian Territory of Papua (the New Guinea mainland) is the Louisiade Archipelago, a group of about eighty tiny islands southeast of New Guinea. These, too, are mountainous, and gold has been discovered on some of them.

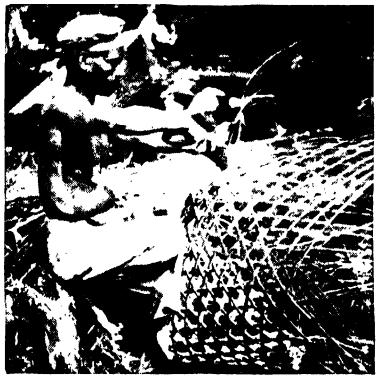
About seven hundred miles east of New Guinea are the Solomon Islands. Here are numerous extinct volcanoes and several active ones. Coral reefs glimmer in the surrounding waters. Coconut palms, sweet potatoes, pineapples and bananas thrive; and copra, shells, ivory nuts and timber are exported.



© Ewing Galloway, N. Y.
A Papuan outrigger canoe for travel and fishing. It has a canvas canopy to keep off the sun's glare.

Australian News and Information Bureau

A queer Papuan village. Homes on stilts in the Purari River, on the island of New Guinea.



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Two ways of fishing in the South Seas. Left, a man of New Guinea weaving a fish trap of rattan. Right, a native boy of New Caledonia catching fish with a bow and spear.

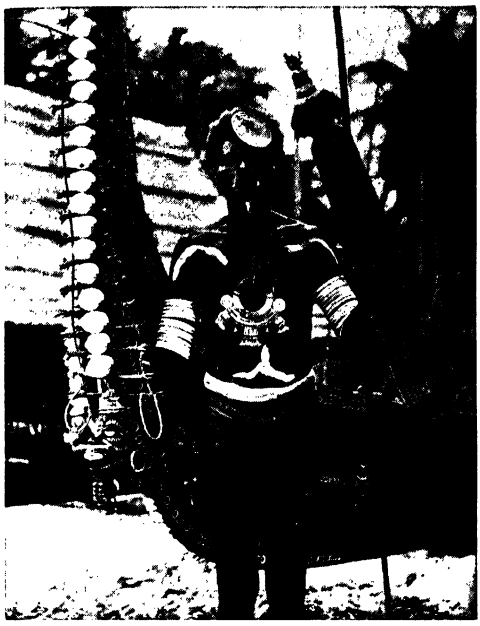
The southern Solomons, including Guadalcanal, Malaita, Santa Isabel, San Cristoval, New Georgia and Choiseul, are a British protectorate. The northern Solomons, including Bougainville and Buka, are a United Nations trusteeship.

Northeast of the Solomons, only a few miles south of the equator, is the tiny isle of Nauru, which contains valuable phosphates. The island was a British Empire mandate before World War II. It is now a United Nations trusteeship, administered by Great Britain, Australia and New Zealand.

One of the largest and most valuable of all the islands in Melanesia is New Caledonia, a French possession. The capital is Nouméa. The island lies more than a thousand miles east of the northern part of Australia. In its mountain chain are enormous mineral resources. The nickel ores are unusually valuable, and there are chrome, iron, manganese, cobalt, copper, coal and mercury as well. Many varieties of timber grow in the forests; and the fertile soil yields coconuts, coffee, cotton, manioc, corn, bananas, tobacco and pineapples.

A number of near-by islands are governed from New Caledonia as French dependencies. Among them are the Isle of Pines, the Wallis Archipelago, Futuna, Alofi and the Loyalty Islands.

The French and British have joint control over the New Hebrides Islands, a group about 250 miles northeast of New Caledonia. Espiritu Santo, Malekula, Epi, Ambrym and Efate are the chief isles of this cluster. They



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A head-hunter of the Solomons, and his decorated boat. Human heads are taken as a religious act.

are rich in sulfur; and bananas, sugar-cane, oranges, yams, coconuts, millet and corn are grown.

The Fiji Islands are the principal British possession in Melanesia. They lie about eight hundred miles east of the New Hebrides. The Fijis are rich and beautiful, and have a delightful climate. There are about 250 of them, but only 80 are inhabited. Viti Levu and Vanua Levu are the most important. The capital, Suva, is on Viti Levu. There are valuable hard and soft woods in the thick forests; and coconuts, bananas, sugar-cane, rice, pineapples and cotton flourish.

MICRONESIA

The name for this area—Micronesia, meaning Little Islands—is a good one, for indeed most of the islands in it are extremely small. Some of them are mere reefs that scarcely rise above the surface of the sea. The Micronesians seem to be a mixture of stocks; there are Malay, Mongolian and Polynesian strains among the people. They are generally brown-skinned, with straight black hair. Some of them have slanting Mongolian eyes.

The little coral-builders have been very busy in Micronesia. There are more atolls here than in any other group of islands in the world. The principal islands of the area are the Carolines, Marianas (or Ladrones), Marshalls and Gilberts. The Carolines are about a thousand miles northeast of New Guinea; the Marianas, about another thousand miles north of the Carolines. The Marshalls are northeast of the Carolines; and the Gilberts, on the equator, southeast of the Marshalls.

Spain held the Carolines and the Marianas from early in the sixteenth century until 1899. In that year they were sold to Germany (with the exception of Guam, one of the Marianas, which was ceded by Spain to the United States in 1898). In the meantime the Marshalls had become a German possession. After World War I, Japan ruled the Carolines, Marianas (except Guam) and Marshalls as a mandate from the League of Nations, and fortified some of them secretly. One result of this was that they became battle areas in World War II, and the Japanese eventually were driven out by United States forces. The islands have now become trusteeships of the United Nations under the sole control of the United States.

No scientific exploration of the islands could be made under the Japanese; and little accurate information about them seeped through to the outside world after 1910. In 1947, however, a broad study was begun by a number of scientific institutions working together. Several expeditions are visiting the islands to study their life and resources.

The Caroline Islands are made up of about 550 tiny islets. Though the soil is rather poor, coconut palms, breadfruit and bananas thrive. There is trade in copra and tortoise

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A village street in Tarawa, in the Gilbert Islands.

shells. This group includes the Palau Islands, Truk, Yap and Ponapé. Yap is famous for its massive stone money. It is in the form of discs which may measure anywhere from six inches to twelve feet in diameter. The natives use this strange money in barter. From their viewpoint part of its value lies in the very difficulty of carrying it about!

The Marshalls are all coral islands; nowhere do they rise more than a few feet above the sea. The chief island is Jaluit.

Not including Guam, there are fourteen islands in the Marianas group, and of these Saipan is the most important. Guam, the largest of the Marianas, is mountainous, much of it covered with pathless jungle. The seat of government is at Agana.

The Gilbert Islands are a British possession and form part of the Gilbert and Ellice Islands Colony. The Gilberts are made up of sixteen atolls. Coconut palms and pandanus fruit grow; the most valuable mineral is phosphate.

POLYNESIA

The name Polynesia means Many Islands. The Polynesians, or Kanakas, as they are sometimes called, are tall and well built, with light-brown skin and wavy brown or black hair.

Among the most pleasant islands in the whole area are the Tonga, or Friendly, Islands, southwest of the Fijis. There are about two hundred islets in the Tongas group, which is a British protectorate. Some are volcanic and mountainous, others coral. The hospitality of the Tongans to the first European arrivals won the islands the name of Friendly. Nukualofa, on Tongatabu Island, is the capital. Copra, fruits, mats and sponges are articles of trade.

North of the Tongas are the Samoan Islands. There are fourteen of them, all volcanic. Coconut palms, cotton, sugar-cane, coffee, oranges, bananas and mangoes flourish. Eastern Samoa, including Tutuila, Tau and several other islands, is United States territory. The harbor of Pago Pago, on Tutuila, is one of the finest in the Pacific, and is an important naval base. Western Samoa, including Savaii and Upolu, was a League of Nations mandate administered by New Zealand. It is now a United Nations trusteeship. Savaii is largely unexplored; but Upolu has an important port, Apia.

The part of the Gilbert and Ellice Islands Colony, north of Samoa, which is in Polynesia includes Ocean Island, Christmas Island, the Ellice Islands, Phoenix Islands, Fanning Island and Washington Island. Ocean Island is the center of government. There is trade in copra.

North, east and southeast of Samoa, spread out over a vast area, are several clusters of islands governed by New Zealand: the Cook Islands, Union (Tokelau) Islands and the Kermadec Islands. The last group is south of the Tropic of Capricorn. Fruits and vegetables are the chief crops.

Out in the middle of the Pacific, hovering just north of the Tropic of Capricorn, is

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Native fishing canoe off the island of Tahiti. Fishnets are drying on a tree.

the best-known French possession in Polynesia, the Society Islands. The largest of the group, Tahiti, is famous. Sharp peaks rise from the interior of many of these islands, and coral reefs circle them. These are indeed the isles of the romantic tales of the South Seas, "where every prospect pleases." Papeete, on Tahiti, is the capital and has a fine harbor. All kinds of tropical crops thrive. Copra and phosphates are traded, and there are pearl fisheries.

North and east of the Society Islands are the Marquesas, the Leewards, the Tuamotu group, and Austral, Gambier and Rapa islands—all French possessions. The Marquesas are the most important of these clusters, fertile and lovely. But, sadly, most of the native population has died out as a result of diseases brought by the white man.

Lonely Pitcairn Island, south of the Tropic of Capricorn, is a British possession. This barren islet is famous as the refuge of mutineers from the ship Bounty, in 1789.

The easternmost island of Polynesia is Easter Island, which belongs to Chile. It, too, is south of the Tropic of Capricorn. There are strange stone-walls and statues here. Who the sculptor-builders were is a mystery, though the remains are similar to ancient stone work found in Peru. The island is only ten hours from Chile by air, and it may become a way station on a proposed air route between Chile and Australia.

The chief possession of the United States in all the South Seas is the Hawaiian Islands. It is possible that before very long this territory will become a state of the Union. Of the eight principal islands of this group, Hawaii was the first to become known to the white man and gave its name to all.

Northwest of the Hawaiian Islands is another United States possession, the Midway Islands. They are halfway between Asia and North America. Before World War II they were important as a way station on the transpacific air route.

More than a thousand miles southwest of Midway lies another United States possession, bleak Wake, a coral island only a mile square. It fell to the Japanese in December 1941, and was not recovered until the end of the war, in September 1945. It, too, was a stop on the air route to China.

THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 3415.

THE CHIEF ISLANDS OF THE SOUTH SEAS

Figures for both areas and populations are not available in all cases. However, where area is not given, it may be assumed that the island is very small. Population figures are estimates in many cases as no accurate census of some areas has ever been taken. Not all of the islands of a particular group are listed, but only those which have some importance.

	Area in square miles	*Population*
Philippine Islands (total)	115,600	13,513,000
BOHOL	1,492	449,549
CEBU	1,707	947,309
LEYTE	2,785	915,853
LUZON	40,420	7,374,798
MASBATE	1,262	145,065
MINDANAO	36,537	1,828,071
MINDORO	3,759	116,988
PALAWAN	4,550	43,813
NEGROS	4,905	1,218,710
PANAY	4,446	1,291,548
SAMAR	5,050	470,678
Indonesia		
BORNEO (total)	290,012	3,191,223
Brunei	2,226	30,000
North Borneo	29,500	270,223
Sarawak	50,000	491,000
Dutch Borneo	208,286	2,400,000
CELEBES	38,786	4,600,000
JAVA (including Madura)	51,032	46,000,000
SUMATRA	163,048	9,000,000
Melanesia		
ALOFI AND FUTUNA	50	2,000
BISMARCK ARCHIPELAGO (total)	19,200	140,759
Admiralty Islands	663	14,000
Lavongi	460	?
New Britain	14,600	90,349
New Ireland	2,800	39,000
FIGI ISLANDS (total)	7,083	240,641
Vanua Levu	2,130	32,086
Viti Levu	4,053	129,829
ISLE OF PINES	58	570

	Area in square miles	*Population*
LOUISIADE ARCHIPELAGO	200	?
LOYALTY ISLANDS	800	11,100
NAURU	5,263 *acres*	2,672
NEW CALEDONIA	8,548	53,245
NEW GUINEA (total)	330,000	1,312,013
Dutch New Guinea	172,514	539,013
Northeastern New Guinea	69,700	433,000
Territory Papua	87,786	340,000
NEW HEBRIDES ISLANDS (total)	5,700	40,000
Ambrym	300	3,000
Efate	300	1,700
Espiritu Santo	2,000	4,000
Malekula	800	7,000
SOLOMON ISLANDS (total)	12,400	94,000
Bougainville	3,500	49,067
Choiseul	1,500	4,051
Guadalcanal	2,500	14,300
Malaita	2,000	40,000
Santa Isabel	1,800	5,768
WALLIS ARCHIPELAGO	40	4,243
Micronesia		
CAROLINE ISLANDS (total)	860	42,000
Palau Islands	?	11,467
Parao Island	?	12,798
Ponapé Island	?	10,000
Truk Island	?	16,000
Yap Island	?	6,650
GILBERT ISLANDS	166	26,000
MARIANAS ISLANDS (total)	452	63,000
All except Guam	246	40,000
Guam	206	23,000
MARSHALL ISLANDS	800	10,000
Polynesia		
COOK ISLANDS	99	12,246
EASTER ISLAND	60	650
ELLICE ISLANDS GROUP		
Christmas Island	60,000 *acres*	11
Ellice Islands	14	4,600
Fanning Island	15	250
Ocean Island	1,500 *acres*	2,700
Phoenix Islands	16	850
Washington Island	6	100
HAWAIIAN ISLANDS (8 principal islands)	6,435	492,379
Hawaii	4,021	73,276
Kahoolawe	45	1
Kauai	551	35,636
Lanai	141	3,720
Maui	728	46,919
Molokai	259	5,340
Niihau	72	182
Oahu	589	257,664
KERMADEC ISLANDS	13	20
LEEWARD ISLANDS	?	11,891
MARQUESAS ISLANDS	480	2,699
MIDWAY ISLANDS	28	35
PITCAIRN ISLAND	2	177
SAMOAN ISLANDS		
American Samoa	76	10,000
Tau	14	?
Tutuila	40	13,948
Territory of Western Samoa	?	65,643
Savaii	700	?
Upolu	430	?
SOCIETY ISLANDS		
Moorea	50	2,279
Tahiti	600	23,133
TONGA ISLANDS	250	40,000
TUAMOTU ISLANDS	200,000 *acres*	4,681
UNION (TOKELAU) ISLANDS	4	1,379
WAKE ISLAND	1	?

Interlochen Music Camp

To play the exact notes that produce harmony—on a French horn, flute, any musical instrument—needs keen hearing.

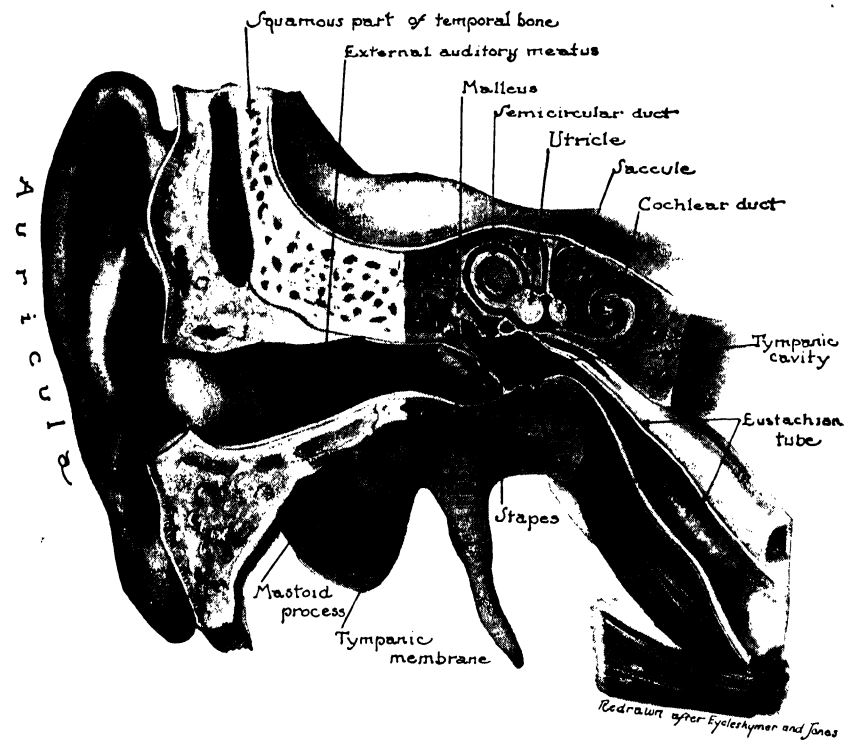
THE EARS AND HEARING

THE world is a very quiet and sometimes frightening place to someone who has lost his hearing. Just think! If you could not hear your mother's voice, if you could not hear music, if you could not hear the approaching car or bus, how would you feel? There are many people—children as well as grownups—who can not hear. Babies learn to talk by imitating the sounds they hear. For this reason, if a child is born deaf or loses his hearing at an early age, he does not learn to talk though his organs of speech may be perfectly normal. Such children are sent to special schools to learn to talk and to read lips. It takes them a long time to get acquainted with many things in the world that you and I take for granted.

Hearing is one of the more important senses. Our ears are very delicate, finely balanced mechanisms that receive sound-waves and transmit them to the brain where they can be recognized. The delicacy of the ear is proven by the ease with which it can be damaged. Constant exposure to loud noise can make one partially or wholly deaf. A very big explosion can rupture the ear-drums. In addition to injury by sound, the ear may be injured by disease, and each year many people become deaf because germs have injured or destroyed the middle ear.

Hearing is perhaps most highly developed in the night-flying mammal, the bat. On the darkest night this animal can fly safely by means of the reflection, or echo, of sound waves from nearby objects. Blind people can tell when they are approaching a wall by the kind of echo their footsteps give. Some people have such a highly developed sense of hearing that they can tell the exact note played on a piano in the next room.

THE PATH OF SOUND THROUGH THE EAR



This drawing shows the right ear, as seen from the front. Let us see what has happened when we say we hear an automobile horn. First of all, blowing the horn sets sound-waves in motion, vibrations of the air. Remember that the rate of these vibrations, for one sound, will remain the same throughout the entire course of their passage through the ear. When the vibrations reach us, they pass from the outer ear, the auricula, into the channel called the external auditory meatus. Up to this point it is air which is vibrating. At the end of the channel, the airwaves hit the eardrum (the tympanic membrane), which is elastic. It begins to move, and in doing so, moves the malleus, or hammer, in the middle ear (the tympanic cavity). This bone is firmly attached to the eardrum. Now the vibrations are set up in the incus, or anvil, and finally in the stapes, or stirrup, because the three bones are jointed together. Thus in the middle ear, the vibrations pass through solid matter, bone. Now the stapes is moving in the oval window, on the inner side of which is the fluid of the inner ear. The fluid immediately picks up the same rate of motion, and from here on the vibrations are transmitted through liquid matter. The waves pass from the vestibule, the "entry" of the inner ear, up into the cochlea, and from there a branch of the auditory nerve carries the message of the vibrations to the brain—and we hear. The whole structure of the ear forms a passage through the temporal bone (side front) of the skull. From the floor of the middle ear, the Eustachian or auditory tube leads down to the throat, into which it opens. The purpose of this tube is to keep the air pressure within the middle ear equal to that of the outside air. The mastoid process is a downward outgrowth of the temporal bone, back and below the ear. There are numerous cavities in the mastoid process, and if they become infected or stopped in any way, extremely serious illness may result.

The ear is the body's mechanism for receiving and transmitting sound. It collects sounds from outside the body, and offers a channel for the sounds to flow inward. From the innermost part of the ear, nerve cells send their messages to the brain where the final step occurs when we hear something. Have you read the article on Sound, in this volume, and the article on Acoustics in Volume 10? If you have not, a little review of these subjects will help you to understand how the ear works.

SOUND-WAVES, THE STIMULI THAT PRODUCE THE SENSATION OF HEARING

To begin with, you must know that air is made of matter. It is a gas, mostly nitrogen and oxygen, with carbon dioxide and other gases present. We say that sound is produced when airwaves are set up. What do we mean? If you strike a piano key and hold it down, you will hear the vibrating piano string. When you release the key, the sound stops, because the felt damper stops the string from vibrating. If you drop a stone into a quiet pond or a large basin of water, you will see the waves begin from the point where the stone falls and spread out until the whole surface of the water is covered. The water waves are like a series of rings spreading from a single center. Sound-waves also move out through the air in the same way from a vibrating object; the waves vibrate in all directions, up and down as well as across. You can hear the piano's note from every corner of the room. You can hear it upstairs or downstairs, for the sound will go through ceiling and floor, unless they are very thick, or especially padded with sound absorbing material.

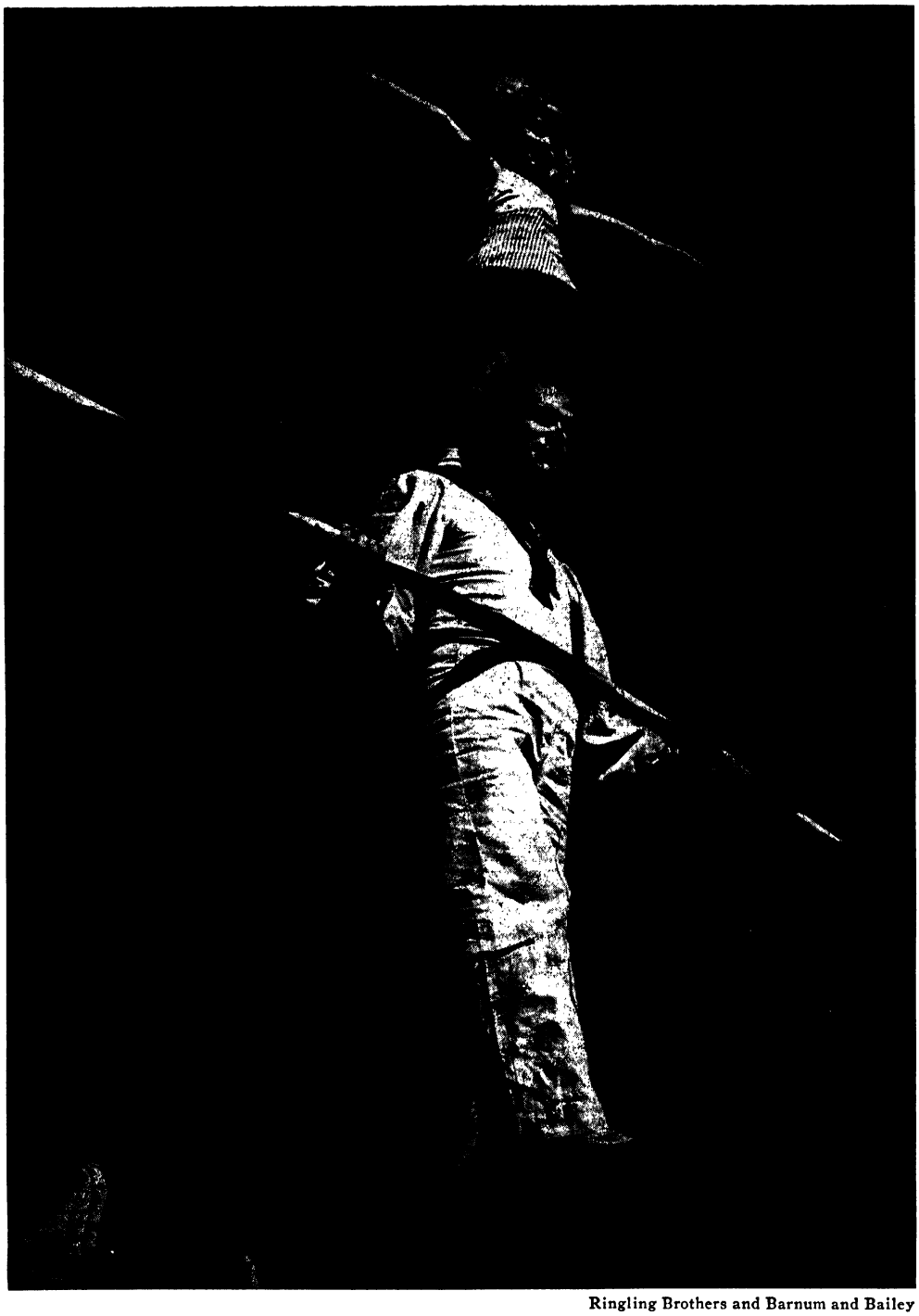
Well, then, vibrations in matter (air or some other substance) reach us, and the vibrations strike our hands, our faces, many parts of the body, but we do not translate them all into sound. Only the vibrations that enter our ears are felt by us as sound.

THE AURICULA, THE OUTER PART OF THE EAR WE CAN SEE

The ear, our organ of hearing, can be divided into three main parts. You can see the external, or outside, ear and touch it. That is the part we ordinarily call "the ear." It has two parts, the sound collector, called the *auricula,* and the tunnel into the skull, the *external auditory meatus.* The auricula is the shell. The auricula of animals can be moved forward and back to collect sound efficiently. Human ears also have muscles for motion, but the movement is so small

The top drawing shows the general shape of the inner ear, or labyrinth. The bottom drawing is an imaginary cross section of the inner ear in the same position, showing how it is imbedded in bone (gray). (In a real cross section, one of the semicircular canals would be missing, and the channels of the cochlea would not be laid out flat.) The bone forms a sort of case (the bony labyrinth) for the whole complicated structure. Inside this case, generally following all the windings of the connected canals and sacs, is a membrane. The space between the case and the membrane is filled with a fluid called perilymph (white). Inside the membrane the space is filled with a fluid called endolymph (black). Any change in the position of the body makes the fluids move. This motion has an important effect in the semicircular canals. Each one of these three channels is at right angles to the other two – that is, one is placed from side to side; the second, up and down; and the third, from front to back. The positions correspond to the three dimensions—width, length and depth. Whenever the fluid moves, it presses against nerve endings. (When you move your head to the right, the fluid is forced to the left, and so on.) Nerves carry the message to the brain of where the fluid is moving, and we have the sense of the direction of our body's movement. In the sacs called the utricle and saccule there are tiny hairs. At the tip of each hair is a tiny bit of horny material—the "ear stones," or otoliths. These stones press down on the hairs according to whatever position the body is in, whether at rest or in motion. Information of where they are pressing passes to the brain, and we have our sense of balance. The cochlea is the part of the inner ear concerned with hearing. Between the middle-ear cavity and the scala tympani of the cochlea is a "round window," covered with membrane. (It is very close to the oval window into which the stapes fits.) Every time the membrane in the oval window is pushed in by the stapes, the membrane of the round window bulges out; and when the oval-window membrane is pulled out, the round-window membrane bulges in. These changes in pressure, caused by sound vibrations, are transmitted from one scala to the other (each filled with perilymph). In doing so, they pass through the endolymph of the cochlear duct, by means of the membranes which separate the duct from the two scalas. From the endolymph the vibrations are picked up by the hair-like cells of the organ of Corti, and then pass by means of the acoustic nerve to the brain. (See also the picture on page 3310.)

BALANCE AND MUSCULAR CO-ORDINATION



Ringling Brothers and Barnum and Bailey

This little girl stands fearless and perfectly balanced on her father's shoulders. Both are members of a famous family of circus high-wire performers, the Wallendas. Their very lives depend on their extraordinary sense of balance.

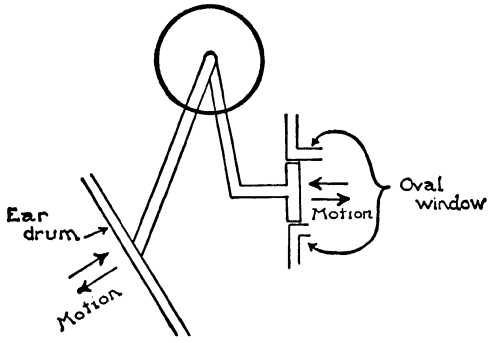
that we have to turn our heads when we want to locate the source of a sound. Sound enters the shell, the auricula, and goes into the little tunnel. This ends at the *tympanic membrane,* generally called the eardrum.

Let us return to the figure of a stone dropped into a pond, and starting waves, or vibrations, on the water. A cork floating on the water will bob up and down when the waves reach it. Just so, the waves reaching the eardrum cause it to bob back and forth, or in other words to vibrate as the sound-waves are vibrating.

On the other side of the eardrum, or tympanic membrane, is the middle ear, or tympanic cavity. The eardrum is like thin skin, and is stretched like a tiny drum head across the external auditory meatus. By closing the tunnel it prevents the entrance of water or solid particles that might otherwise get into the middle ear and cause trouble.

In the middle ear there are three tiny bones, or *ossicles,* that move. These are the connecting links between the eardrum and the inner ear. The first of the three bones is the *malleus* which is attached to the tympanic membrane just below its center. When the eardrum vibrates it moves the malleus which passes on the motion to the *incus,* the second ear bone. The incus in turn moves the *stapes,* the third ear bone. The malleus is shaped like a tiny hammer, the incus is shaped like an anvil, and the stapes is shaped like a stirrup. The foot plate of the stapes, or stirrup, fits into an oval window, and beyond the window is the complex inner ear.

The shape and motion of these bones serves a very important purpose. Together



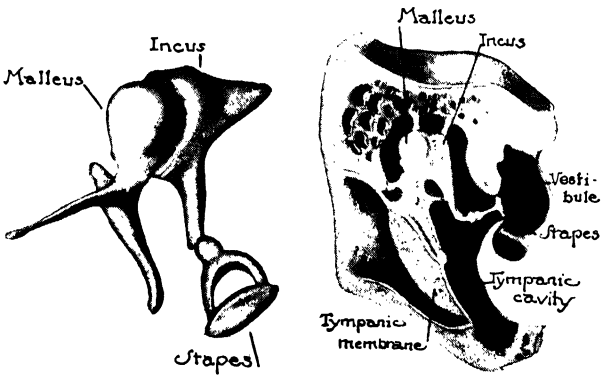
The bones of the middle ear act very much as a bent lever, which has a joint (in the circle). Sound vibrations move the eardrum in aud out. This pulls the malleus in and out. This movement is transferred to the incus and then to the stapes, by means of the joints. The innermost bone, the stapes, is thus made to move in and out in the oval window of the inner ear. As it moves, the stapes, in turn, sets up a vibration in the fluid of the inner ear.

they form a bent lever which can carry the air vibrations to the inner ear. The part of the lever that is connected to the eardrum is longer than the lever arm that moves the stapes. In this way the stapes is given less motion, but with more force than the eardrum exerts.

This increase in force is necessary. The inner ear contains a fluid, and the stapes must push this, causing it to vibrate, and fluid is harder to move than air. As the fluid of the inner ear is set in motion, it stimulates nerve endings. These nerves then send their messages to the brain and we have the sensation of hearing.

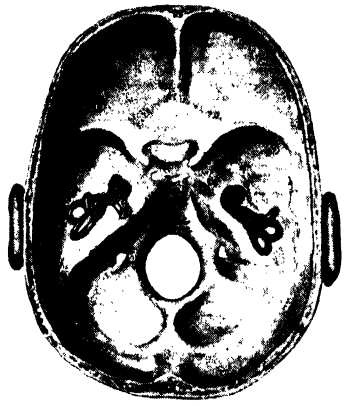
A very ingenious system of ligaments and muscles permits the ear ossicles to act like a bent lever. See diagram on this page. The tiny bones swing back and forth, suspended by ligaments from the roof of the middle ear. The little muscles of the middle ear keep the eardrum under just the right amount of tension for responding to air vibrations.

There is one more important structure to mention; it connects the middle ear with the air passage in the throat. It is called the auditory tube, or the Eustachian tube. If you have ever gone up many stories in a fast elevator, or gone into a tunnel on a



On the left is a drawing of the ossicles, the bones of the middle ear. The other drawing is a diagram of the whole middle ear, showing the location of the ossicles. They are the smallest bones in the body and are named, from the outside in, the malleus (hammer), incus (anvil) and stapes (stirrup). There are joints between the bones; and they are further held in place, but not rigidly, by tiny ligaments (tough bands of tissue) attached to the walls of the middle-ear cavity (the tympanic cavity). In addition, the malleus is firmly fixed to the tympanic membrane (the eardrum); and the stapes fits into the oval window, also covered by a membrane, of the inner ear. The vestibule is the beginning of the inner ear.

train, you must have noticed the peculiar feeling in your ears. Almost automatically you swallowed and the queer feeling left you. This sensation was due to a difference between the air pressure in the middle ear and the pressure in the external auditory meatus. When you go up in an elevator, your eardrum is pushed out, because the outside pressure has become less than the pressure in the middle ear. (The pressure of the atmosphere is less above the earth and the difference is noticeable even if you go up only a few hundred feet.) If some of the air inside the middle ear is released through the auditory tube you have equal pressures once more on both sides of the eardrum. That is what you do when you swallow—you allow some of the air from the middle ear to escape into your throat. Each time you swallow, yawn or sneeze, the throat end of the auditory tube opens. When we have bad colds the Eustachian tube may close by swelling, and our hearing is poor until the doctor gives us nose drops or sprays our throat.



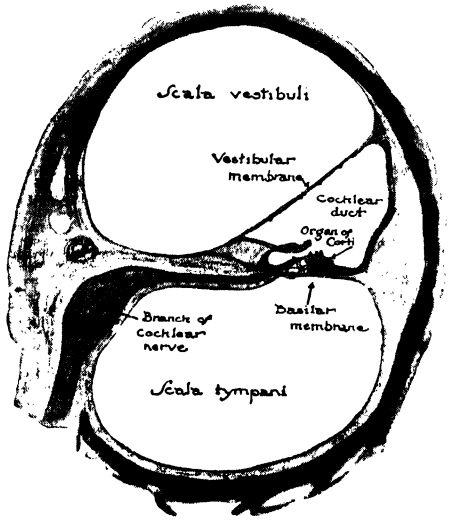
If we could see through the skull and the brain from above, this is where we would find the inner ears. The cochlea is farthest in, lying very near the brain, in a tucked-under position. The acoustic nerve is quite short.

The inner ear is the most important part of our organ of hearing. It is made up of the cochlea, the vestibule, two sacs and the semicircular canals. The cochlea is concerned with hearing, while the sacs and semicircular canals are the sense organs of motion and balance. These structures contain fluids. You will see in the diagram on page 3306—that the inner ear is well protected by being inside the skull bone.

The cochlea is a bit like a snail shell. It is a spiral tunnel in the bone, climbing a total of two and three-quarters circles, like a tube wound around a cone. This long canal has a projecting ledge inside it. This is called the *osseous spiral.*

From the ledge, two thin sheets of membrane divide the cochlea lengthwise into three parts, so that we have three tubes in one. The membranes are called the vestibular and the basilar membranes. See diagram on this page. The *cochlear duct* that you see on one side of the bony canal is enclosed by these two membranes.

On the basilar membrane is the *spiral organ of Corti,* a spiral of nerve cells that can receive vibrations from the endolymph and send the messages to the brain through the nerves in the osseous spiral. Look at the large diagram of the ear on page 3306. You will see that motion of the tympanic membrane, the eardrum, moves the stapes. These vibrations are given to the oval window and passed through the perilymph to the endolymph within the cochlear duct. The vibrating endolymph stimulates the fine hair cells of the organ of Corti. The organ of Corti communicates with the brain through the cochlear branch of the nerve of hearing which we call the acoustic nerve.



A cross section of one of the coils of the cochlea. This shows that there are actually three channels, divided by bone and membrane. The vestibular and basilar membranes are tightly stretched between the bony shelf and the bony case of the cochlea. The organ of Corti bulges out into the cochlear duct, with its hair cells bathed in endolymph. It is through the vestibular and basilar membranes that vibrations pass from the perilymph in the two scalas to the endolymph in the cochlear duct.

The semicircular canals and the two sacs of the inner ear are connected to the brain by a branch of the acoustic nerve. Any motion of the head stimulates these organs so that we can tell our motion and position.

By A. GALE BORDEN, M.D.

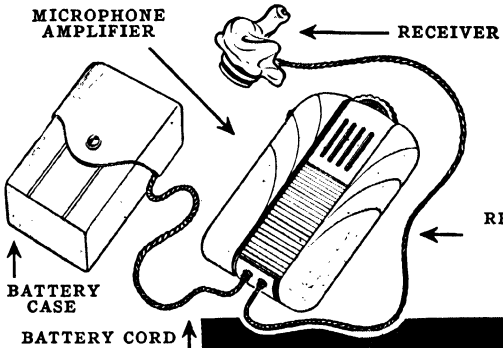
THE NEXT STORY OF OUR OWN LIFE IS ON PAGE 3554.

OVERCOMING FAULTY EARS

The little boy wearing the hearing aid has no trouble keeping up with his playmates who hear normally. He is learning that faulty hearing need not be a great hardship.

All pictures, courtesy New York League for the Hard of Hearing

The old-fashioned hearing "trumpets" were clumsy devices, which had to be held to the ear. They acted as a much extended outer ear, collecting a larger volume of sound.



Most modern hearing aids are electronic devices. They have three parts, connected by longer wires than shown here. The receiver fits the outer ear closely, extending into the channel. The amplifier, worn on the chest, picks up sound-waves and transforms them electrically. Power is supplied by small batteries.

These young men are learning lip-reading, training their eyes to take the place of their ears in conversation. Most speech sounds are formed by the lips, tongue and teeth. So, with practice, the eyes learn to recognize the "shapes" of sounds in a fleeting instant, and the person understands what is said.

THOMAS CARLYLE and JOHN RUSKIN

ABOUT 150 years ago, in England, the first factories were rising. For the first time in history steam-driven machinery was clanging and clattering, and factory smoke was belching from tall chimneys. Things were turned out swiftly by motor power which had formerly been made slowly by hand.

Thousands of farmers' sons and hired men, spinners and weavers, potters and ironworkers—and often their wives and children—went to work in the new factories. But they made goods so fast, with the machines, that there was no work for many thousands more; and the factory workers themselves earned so little money that they could hardly pay for food, clothing and shelter. England, the richest country in the world, could see half of its population sinking into poverty and misery.

Statue of Thomas Carlyle.

The factories covered whole cities, whole valleys, with smoke and soot. They dumped their refuse into the clear rivers. In bringing many workers together, they caused crowded slums to grow up in every industrial town and city. The "green and pleasant land" of England, as one poet called it, began to be ugly.

The factories brought something else with them—a way of thinking called *materialism*. For the men who owned the factories, and the men who sold their products, money profits became terribly important. Many of them believed the way to do business was to pay your workman as little as possible, and sell his product for as much as possible.

It was into such a world that two very important babies were born—Thomas Carlyle, in a poor cottage in a Scottish village; John Ruskin, in a fine, big house in the city of London. Each had very serious-minded, very religious parents; and the mother of each one wanted her baby to become a minister. Neither one did become a real minister in a church; but both, when they grew up, preached far and wide, in books and magazine articles and speeches, fiery sermons about the "condition of England"—its poverty and slums and unemployment and ugliness. Like knights of old, they devoted their lives to destroying the evils in the world around them. These two did more than most other men to make their world aware of those evils. They attacked something more dangerous and more difficult to defeat than a dragon, or a modern army—a point of view.

Thomas Carlyle was born December 4, 1795, in the town of Ecclefechan—hardly more than a double row of grey houses scattered along a dirt road, with green hills rising behind them. Thomas was the eldest of nine children, and his parents were poor—so that young Thomas never had an easy time of it. His father was a stone-mason, a sober, stern man who had to work very hard. He taught his children that man was created to work, and Carlyle never forgot it. Later he wrote that work is a kind of worship, that men are happiest when they are working hard.

Carlyle also picked up his father's earnestness, his sharp temper, his confidence that views different from his own were wrong, and his way of saying things strikingly. His mother, on the other hand, taught him how to joke, and even his most serious books are dotted with bright patches of laughter. From both parents the boy learned that duty and

service to God are important, that a man must follow his own conscience.

Carlyle had an unhappy time at school. His sober family life made him lonely and thoughtful. He was no player of games, and had to take plenty of teasing and bullying from his schoolmates. His mother told him never to fight back, but once, at least, he surprised a tormenter very much by knocking him down.

CARLYLE STRUGGLES FOR A UNIVERSITY EDUCATION

When Carlyle was only thirteen, he set off with a friend, Tom Smail, to walk eighty-five miles to enroll in the University of Edinburgh. At about the age when most boys and girls nowadays are going to high school, he was going to college. He had to study very hard. He lived in a tiny room in a poor section of the city. Every month his mother sent him a box containing butter, eggs and oatmeal. He had to live on that and whatever else he could buy with his small allowance. But he got through the university and came back to his home country as a school teacher, a tall, gaunt, muscular fellow with a ruddy face and long, tangled, black hair.

In the same town there was another schoolmaster, Edward Irving, head of a rival school. These two became close friends, and Carlyle spent many evenings reading in Irving's fine library. He borrowed from Irving a book of essays by David Hume, and Edward Gibbon's great history about the fall of the Roman Empire. These books for a long time made him very unhappy, for they made him doubt the religious faith of his childhood. All that he had valued before seemed worthless. When he went back to Edinburgh a few years later, he was so depressed that life hardly seemed worth while.

WITH NEW CONFIDENCE AND HOPE CARLYLE "FINDS HIMSELF"

But one day he felt a new kind of faith and courage surging into his spirit. He was like a runner who suddenly gets his second wind, and leaps forward refreshed to win a race. Henceforth Carlyle, although by nature gloomy and often sick and weary, never doubted the truth of his ideals. This change of heart led to the books which made him great.

Shortly after this experience Carlyle fell in love with an intelligent, sparkling girl named Jane Welsh, to whom he was teaching German. They were married when he was thirty-one, and went to live in a small town, Craigenputtoch. Here, away from the disturbances of city life, Carlyle wrote his first important book, SARTOR RESARTIS.

The title means The Tailor Re-Tailored. Carlyle wanted to have some fun with his readers, so he put on the title page, in German, that the author was "Diogenes De'il's Dirt," and that the book was published by "Stillness and Company" in the city of "Don't Know Where." Here is a paraphrase of one section:

> . . . Often (he wrote) when I read of formal occasions, Coronations, Royal Drawing Rooms, receptions and so on—how Duke this is presented by Archduke that, and Colonel A by General B, and innumerable Bishops, Admirals and other big wigs are introduced—then I try to imagine what this solemn scene would be like if—on a sudden, as by some enchanter's wand—the Clothes should fly off the whole crowd; and Dukes, Grandees, Bishops, Generals, the Anointed King himself, every mother's son of them, stand straddling there, not a shirt on them; and I know not whether to laugh or weep!

THE REAL MEANING OF THE SATIRE, SARTOR RESARTIS

That is rather an amusing idea, of course. But Carlyle meant to be more than amusing. He was trying to say that most men and women dress up the truth in so many garments that you often can not recognize it. Just so customs and habits and pretending and little fibs cover up reality. We must get rid of the pretenses and the lies, he insisted, if we are to get at the truth of things.

That was a startling idea to the people of England. Many of them did not understand SARTOR, and Carlyle did not become famous until his next book appeared, his exciting story of the French Revolution. A terrible thing occurred during the writing of his history, something which shows what a strong and courageous man Carlyle was. When he had finished writing out the first volume, he lent it to a friend, John Stuart Mill, to read. A careless maid at Mill's house used the papers to light fires with. When Mill told Carlyle, the blow almost overwhelmed the author. But he sat down and wrote it all over—although writing was always very hard for him.

This book brought in a great deal of money, and the Carlyles were never poor again. They lived in London now. Carlyle

wrote another book, HEROES AND HERO-WORSHIP, which shows that other persons besides soldiers can be heroes. A king, a minister, a poet or an essay writer can be a hero, if he leads men to nobler living. Great men move the world forward, he said, and our duty is to pick out the great men and follow them.

Carlyle became known throughout England, Europe and America. The poet Alfred Tennyson, the novelists Charles Dickens and William Thackeray, and the Italian hero Mazzini were among the people who came to visit him and his brilliant wife, Jane.

But Carlyle, in spite of friends and success, could not remain happy with England as it was. When he went into the country to get material for a life of Cromwell, he saw such poverty that he could not continue. Returning to London, he found the poor people there too poor to buy coal for fuel, tearing up and stealing wooden fence-posts at night. Raging at conditions which the factories had brought, Carlyle put aside his Cromwell and wrote PAST AND PRESENT.

The T. F. Healy Collection
The young John Ruskin, when he was a popular art critic.

In it he contrasted modern life with the Middle Ages. Then, he said, men felt more kindly toward one another, and were loyal to wise leadership. They had sense enough, he said, to pick up strong, efficient leaders and then to obey them. Carlyle blamed both democracy and the factory system for the poverty and misery of the people.

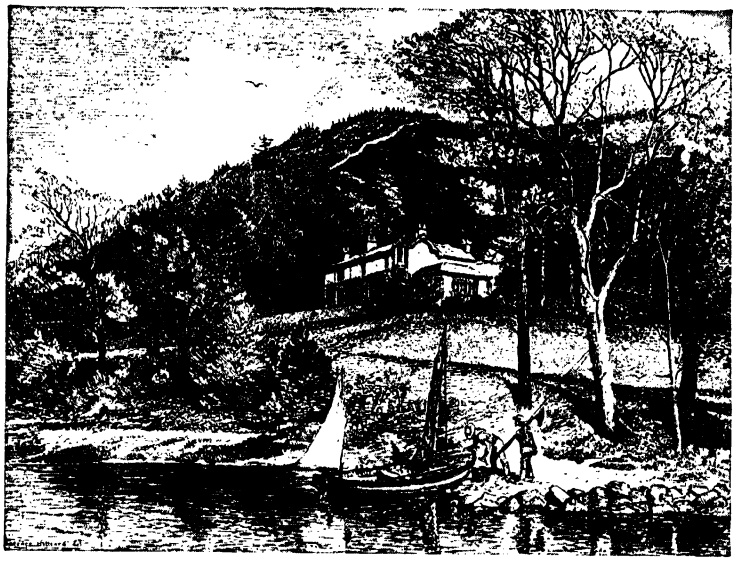
Carlyle wrote one more important book, his life of Frederick the Great of Prussia. The task of writing took fourteen years and filled six volumes. When it was finished, in 1865, Carlyle was exhausted, and an old man; but he was one of the most famous writers in the world. Bismarck, the German military dictator, presented him with a medal for his work on the life of Frederick. In 1866 he was made Lord Rector of Edinburgh University, where he had studied as a poor, unknown boy. It was after this greatest of honors that the worst tragedy of his life befell him, in the death of his wife.

After this, Carlyle accomplished little, except for a kind of biography of his wife, called REMINISCENCES. Fifteen years later, in 1881, he died. His body was put into the earth beside those of his mother and father, in the little burying ground in Ecclefechan.

Carlyle died feeling that his life was a failure, because the miseries of English life were still all around him. But the world held a different view. Most of the leaders of the age acknowledged their debt to his influence. John Ruskin, Dickens and Kingsley owed to him some of the strength of their books on social problems. The famous statesman Disraeli borrowed some of his ideas. In America the essayist Emerson and probably the poet Whitman and the novelist Melville wove into their own books something of the thought and the style of Carlyle. Before his death, young men turned to him for advice and inspiration as if he were the wisest man in the world.

In our own times, workmen all over the world have taken up his cry, "A fair day's work for a fair day's wages," which he called "the everlasting right of man." The whole world is at last seriously trying to solve the basic problem which Carlyle saw so clearly—how can the world's work and the world's goods be justly shared? Yet Carlyle's distrust of democracy, and his belief in dictatorship by strong, able men, helped to prepare the people of Italy and Germany for Mussolini and Hitler, and doubtless helped to plunge those countries into war against the democracies in 1939 and 1940. For good—and for evil, too—Carlyle's stirring ideas have affected the world for more than a century.

John Ruskin's father was a wealthy wine merchant. John's first home was a yellow brick house on a city square, with oil paintings on the walls and fine carpets on the floors. John was an only child, and he never in his life had to worry about money, or clothes, or enough to eat. But that does not mean he could have everything he wanted. Up to the time he was six, he had as toys only a bunch of keys, a little cart, a ball and two boxes of blocks. Once his aunt gave him a beautiful toy Punch and Judy show. His mother, he wrote later, "told me it was not right I should have them, and I never saw them again." As a boy he was never allowed cake or candy.



Ruskin's home at Brantwood, where he was surrounded by the natural beauty he loved.

Every day, from the time he could first understand words, his mother read the Bible with him. They went through the Testaments together, chapter after chapter, and at the end turned back and started again. By the time he was three, Ruskin could recite the 119th Psalm—the longest chapter in the Bible—from memory. As soon as he could read, his mother made him read the verses with her. And every night, he had to sit in a corner while his father read to his mother aloud—DON QUIXOTE, or a novel by Scott, or some poetry. This was quite a burden to the little boy. But it helped him later to produce what has been called the most gorgeous writing ever to come from an English pen.

As the reading helped to make Ruskin a lover of words, so another habit of his parents helped to make him an artist and a lover of beauty. Every year the Ruskins would pack some clothes and books into a carriage and set off on a trip through the country. They went partly to get orders for Mr. Ruskin's wine firm, and partly to enjoy the scenery and to visit old mansions and castles. From these trips John developed an interest in nature, in the structure and shape of buildings, and in fine pictures.

As he grew older, these trips were extended to the continent of Europe, and John saw the old cities and churches of France, and the sky-touching peaks of the Alps Mountains. He loved to draw the buildings and stained-glass windows that he saw. He loved to compare designs, and study the roofs and arches and doorways of buildings. As he grew up, his father bought him several water color pictures by the landscape painter J. M. W. Turner. Ruskin thought Turner the greatest artist in the world; and the painter, by accident, launched Ruskin on the first part of a brilliant career.

It happened in this way. Turner's work was being criticized in the papers and magazines, just after Ruskin left college. Ruskin became so angry at this criticism that he decided to write a book about painting, which would show Turner's greatness. The first volume of the book, called MODERN PAINTERS, appeared in 1843, when Ruskin was only twenty-four. It was an instant success. Charlotte Brontë, Elizabeth Barrett Browning, Alfred Tennyson and William Wordsworth, among others, took pains to get it and read it. Ruskin published four more volumes of MODERN PAINTERS in the next sixteen years. He also wrote two other books about art, THE SEVEN LAMPS OF ARCHITECTURE and THE STONES OF VENICE.

Ruskin's message in these books is something like this: Art should be true to life. A maple tree picture should look like a real maple tree. But art should represent ideal truth as well. In other words, a maple tree would not be worth painting unless it were beautiful and perfect, an ideal tree. A picture of an ugly, evil, or degraded subject—a diseased tree, a dirty street, a mean face—would be bad art. Great art should express great ideas, a noble view of life.

Ruskin also believed that the artists of any period in history express the quality of that period. He said, for instance, that the Gothic cathedrals of the Middle Ages were better art than the temples of ancient Greece, because, in his opinion, men's ideals were higher and their way of living finer in the Middle Ages.

Ruskin's books were accepted as a kind of artistic Bible by great numbers of people. A compliment from his lips was enough to make an artist successful. According to one writer, the appearance of many towns in England and in America can be traced to the influence of his opinions.

RUSKIN TURNS FROM ART TO ATTACK ON SOCIAL PROBLEMS

But Ruskin did not stop there. Great art, he had said, must be the product of great living. Well, he continued, the beginning of great living is getting our country clean and our people beautiful. Now, it seemed for the first time, he took a good look around him at the condition of England. What he saw appalled him. He noticed how the factory smoke was dirtying up the landscape and the cities; he found out what pitiful wages men were getting, and what unpleasant work was necessary in most factory production. He saw how the crowded tenements were destroying health and character.

These things took his mind away from artistic matters. In 1860 he published his first articles on social problems, calling them UNTO THIS LAST. This series was a direct attack on competition and the profit system, what he called "The Gospel of Getting On." The articles wiped out Ruskin's great popularity overnight. The editor of the magazine where they appeared had to stop printing them because of the storm of criticism.

A STORM OF CONTROVERSY IS AROUSED BY RUSKIN'S NEW IDEAS

Ruskin's new opinions, expressed also in his books MUNERA PULVERIS and A CROWN OF WILD OLIVES, were like firecrackers thrown into a quiet schoolroom. He called business competition stupid and inhuman. He denounced the aristocracy for being idle. He called the merchants selfish, and the factory owners barbarous for their treatment of labor. He said the industrial cities, which made England wealthy, should be wiped off the map. He claimed no one could become rich without making someone else poor. The whole profit system should be abolished, he said.

This not only made people angry; it also frightened them. Ruskin was attacking the very sources of wealth and power which made England strong at that time. The abuse which fell on his head would have stopped a smaller man. But Ruskin kept right on writing about the social ideals he had developed. In the old days of his art criticism he had delighted his cultivated readers with long, beautiful, complicated sentences. Now he wrote short sentences, used simple words, said everything as clearly and plainly as possible.

He wanted the working people to understand him. He tried to put some of his theories into practice, also. In an organization called St. George's Guild, he brought together people who were to live together, work for the common good, and try to make their own country more healthful and beautiful. The people were to live on the land they farmed. They were to avoid the use of steam power, which Ruskin thought responsible for the evils of the factory system. They were to take orders from the leader—Ruskin himself—and follow a special set of rules and regulations.

RUSKIN'S COMMUNITY FAILS FOR LACK OF INTEREST

The scheme failed. People were not willing to live that way. Only a few took the St. George's Guild seriously enough to join it. Ruskin had no experience in handling people, and made many mistakes. But today, with the guild largely forgotten, several of its practices are in general use. One modern writer has said that the early communist state in Russia was almost a copy on a grand scale of the experiment which Ruskin tried in the England of the 1870's.

The guild was Ruskin's last ambitious effort to change the world he lived in. He did continue a series of letters to working men that he had been issuing monthly. He lectured at Oxford University on art, and he wrote a beautiful account of his early life called PRAETERITA. But he was growing old. His body and mind were worn out by work and by the strain of living under a shower of criticism. After a long retirement at a pleasant country house in the north of England, he died, in 1900.

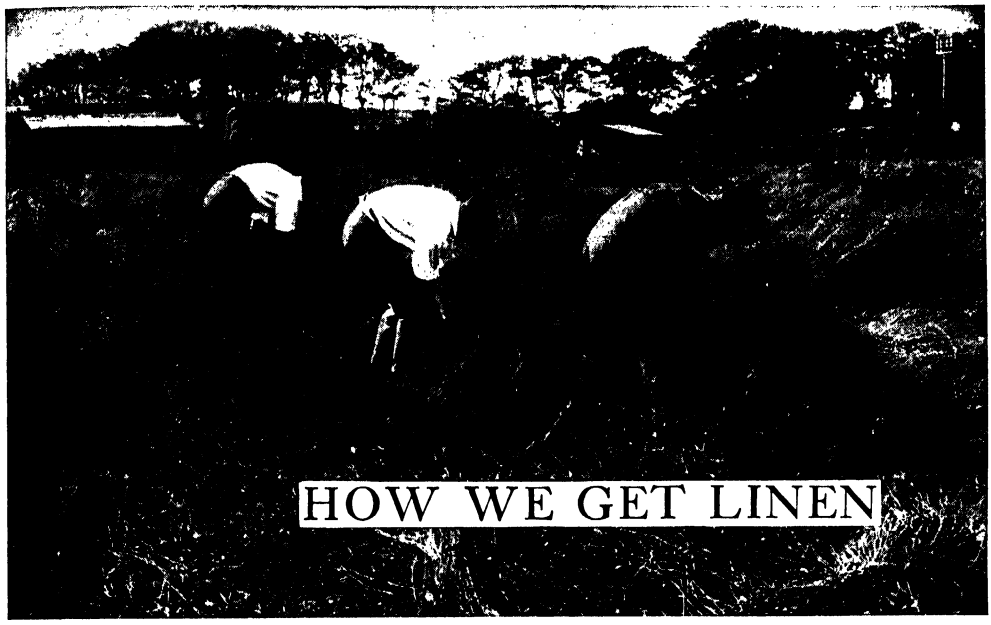
TIME HAS PROVED RUSKIN A GREATER SOCIAL THINKER THAN ART CRITIC

During his lifetime, Ruskin was praised as a great art critic, and reviled when he turned to social reform. Today, few people take his artistic principles seriously; while many of his ideas about society have become part of our life.

Both Carlyle and Ruskin repeated again and again what they considered their most important message. Physical, material things, they said, are not so important as the values of the mind and heart.

By DONALD W. CRAIG.

THE NEXT STORY OF LITERATURE IS ON PAGE 3468.



HOW WE GET LINEN

Pulling flax in County Down, Northern Ireland.

LINEN was the first cloth woven from vegetable fabric, and was one of the earliest products of civilization. Skins of wild animals were man's first garments; then the use of wool was discovered. When the land came under cultivation flax was among the plants grown because of the discovery that its fibre could be woven into cloth. This product was held in high regard by the ancients, and it is frequently mentioned in the Bible as an emblem of purity. But the earliest records come from Egypt, and can be dated at least four thousand years ago. The tomb of Rameses II, who died in 1258 B.C., was opened in 1881; after three thousand years the linen wrappings were in a state of perfect preservation.

The Phoenicians have been given the credit for introducing flax-growing and the making of linen into Ireland, but it was not until many centuries later that definite records of the industry were kept. In 1565 Louis Crommelin, a Huguenot who had fled from France, and who was by trade a weaver of fine linen, settled near Belfast. He improved the methods of weaving. The result of his good work was the forming of the Board of Trustees of the Linen Manufacturers of Ireland in the year 1711. For over a hundred years this body controlled every branch of the linen industry, from the inspecting of the flaxseed to the fixing of the quality of the cloth. To-day Ireland still holds first place in the linen industry.

Flax for fibre is grown chiefly in Russia, Poland and Belgium. (The United States and Argentina, also Russia, grow flax for seed but in this article we are speaking only of flax for linen.) Belgian dressed flax is best, and much is imported by the Irish weavers. Linen is also woven in France, Belgium, Holland and elsewhere in Europe. Some is woven in America from imported yarn.

Flax is gathered just before the seeds are fully ripe. The stalks are pulled by hand because the fibre loses spinning value if cut by a sharp instrument. Cutting leaves square, blunt ends hard to spin into yarn. When the seed is to be saved the flax must be dried after pulling. When dry, the stems are drawn through a ripple, which is an inverted iron comb with teeth spaced to allow the stems but not the seed bolls to pass through.

In Ireland and Belgium no effort is made to save the seed of the regular crop. So, after pulling, the flax is put up in stacks from eight to ten feet long, formed by bundles standing on end and resting one against the

SAMPLES OF VERY OLD LINEN

Egyptian Linen, about 2000 B. C.

Coptic Embroidery, about 400 A. D.

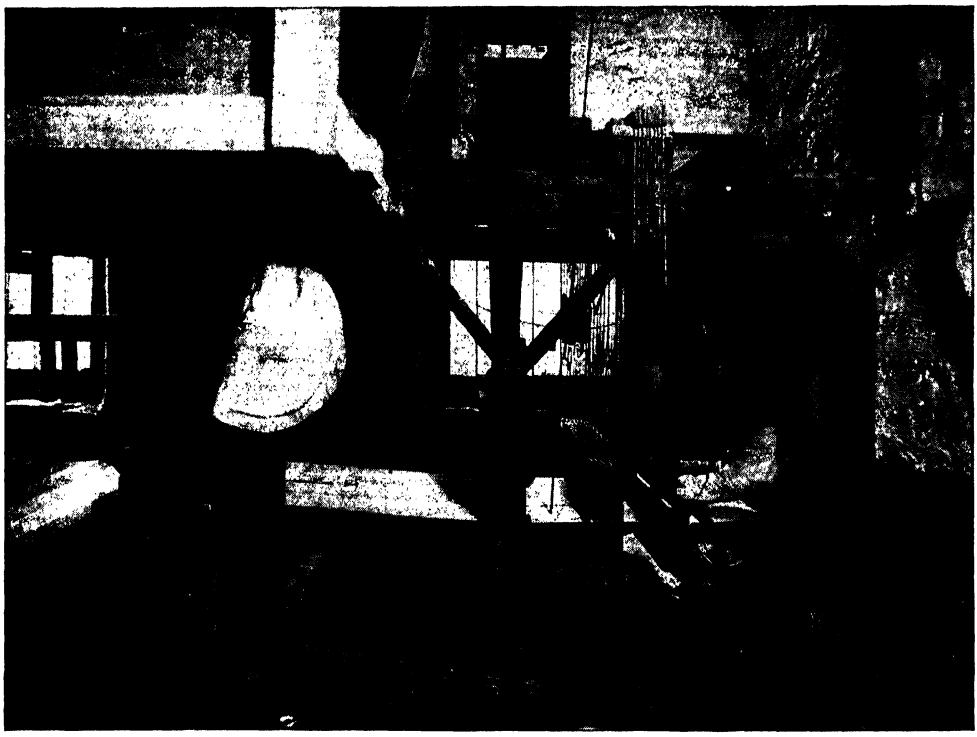
Arabian Embroidery, about 900 A. D.

In the tombs of old Egypt many pieces of linen have been preserved, not only mummy-wrappings but large sheets and other articles. The upper picture at the left shows a fragment of linen from the mummy of an Egyptian princess of the Eleventh Dynasty, who lived in Thebes about four thousand years ago. At the upper right is a bit of Coptic embroidery, on linen, done in the fifth century after Christ by a Christian descendant of the old Egyptians. The lower picture gives a piece of embroidery from Arabia of the tenth century. Photos, courtesy Metropolitan Museum of Art.

NO PLACE FOR MACHINERY

Flax must be handled with gentle care. The plants are pulled by hand, and tied in bundles with even stems. The precious fibres are embedded in the woody core of the stem, and must be loosened by rotting the wood.

The rotting (retting) is done by steeping the bundles under water. Then the bundles are dried. Then comes scutching —the stems are held against whirling wooden paddles which gently break the woody matter from the fibres.



After scutching, the flax fibre goes to the spinners, where it undergoes a number of operations before it has become fine linen yarn for weaving. Here is a hand weaver at his loom. Much linen is now woven by machine.

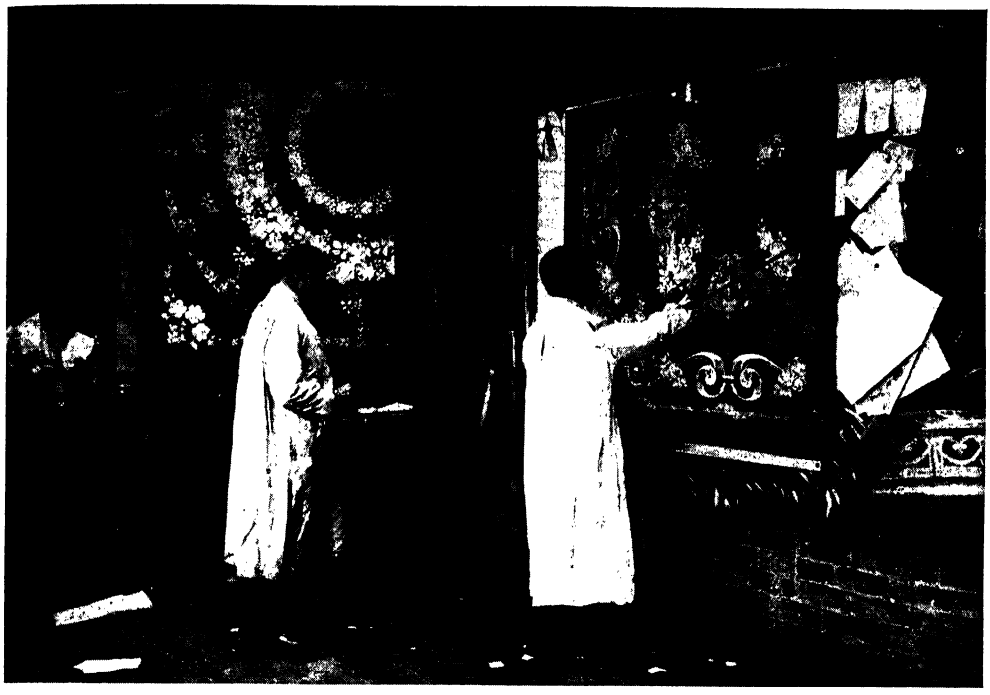
other. It is now ready for rotting (or retting), a process for separating the fibre from the core of the stem with the least possible breakage or loss. There is a gum called pectin found in flax-stems which holds the fibres together. The purpose of retting is to remove this gum. In Ireland the bunches of flax straw are stacked in ponds or dams with mud or sod placed on top, surmounted by heavy stones to prevent the flax from rising to the surface. For at least seven days the bundles remain under water while two species of bacteria fight for control. These bacteria are the *pectinovorum* (pectin-eater), which devours the gum, and the *lactici,* which attacks the fibre. As soon as the *pectinovorum* overcomes the *lactici* the retting is complete and the fibre can be separated from the stem.

The next step is to shake the bundles and spread them out on the grass. The spread flax must be turned often to keep its color. The grass exposure lasts from about seven to fourteen days. Then the flax is stacked for a month before going to the "scutch" mill. Here it first enters a "butting" machine which evens the root ends of the stalks. It goes next through grooved rollers which break up the "boon," or woody matter of the flax-stem, into small pieces. A man, the "scutcher," then holds the stems against revolving wooden blades or beaters which knock off the boon and leave the fibre clean and ready to be sold in bundles to the spinners.

This fibre is called line flax. What was beaten off with the boon is rescutched and spun into yarn, but it would not do for linen-making because of its short fibres. A good flax fibre is from twelve to twenty-four inches in length, and under the microscope its shape is cylindrical. Five tons of flax weighed when taken from the field yield only between 450 and 550 pounds of fibre after retting and scutching are finished.

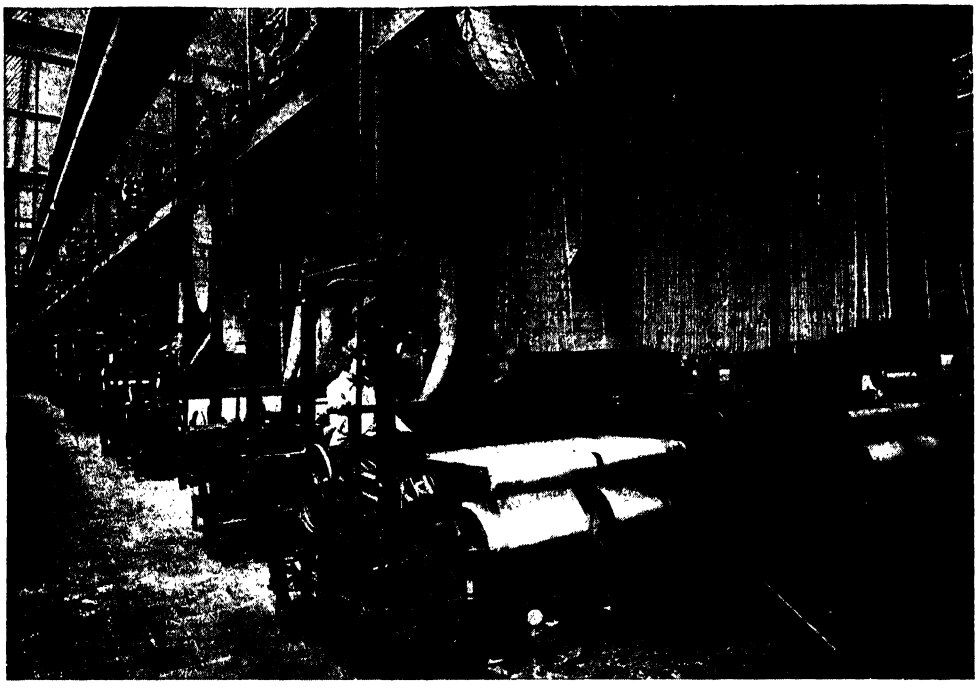
Many more processes are worked out upon the flax fibre before it is ready for the loom. At the spinning mill the fibres are drawn through coarse steel combs to remove coarse, loose and short bits and to straighten out tangles. This is called "roughing." When a bundle of about forty pounds of this

PREPARING DESIGNS FOR LINEN DAMASK



Before the beautiful damask table linens we all know are woven, artists must first draw suitable designs.

These men are cutting the design in holes on cards, somewhat as a tune is cut in holes on a player piano roll.



Looms like these, for weaving patterned materials with the aid of punched cards are called Jacquard looms, after the inventor. They are highly complicated machines. Hundreds of cards must be punched for each new design.

combed fibre is collected it is sent to a "hackling" machine, which is yet another combing process. This removes any short fibres, leaving nothing but long fibres which will be spun into "line" yarns. The hackled flax in bundles, or "tipplès," goes forward to the preparing-room spreader, a frame machine on which loose fibres are drawn out into soft ropes, or "slivers," before they are passed to the drawing frames, of which there are usually four. From these frames the slivers emerge arranged in degrees of fineness and regularity according to the quality of yarn to be spun.

Before sending the sliver to the spinning machine it passes through "roving" frames. Here it is reduced to the right diameter and becomes a "rove," losing the name "sliver." The rove is then twisted so as to cause the fibres to bind and acquire strength enough to be wound and unwound without parting. Finally the finished rove is wound on a bobbin, or spool, and is ready for the spinner.

Flax yarns are spun either wet or dry. In wet spinning, rove is first passed through troughs of hot water so that when the fibres pass between rollers they are soft and fall into their proper places easily. Finer linen is made by this method than by dry spinning which gives much strength but no great fineness. In wet spinning, the bobbins on which the rove is wound are fixed on skewers in the creel of the spinning frame. The rove passes over guides and is submerged in the hot-water trough. Next it passes to the feeding and drawing rollers, where it is wound on bobbins again. These are attached to spindles and turned so as to twist the flax into the necessary yarn. Flax spindles rarely run over 6,000 revolutions, or turns, a minute. Most yarns are given a left-handed twist, and the number of twists is controlled on the machine.

After the yarn is spun the spinning bobbins are sent to the reel-room and wound off into skeins. These are dried and made into bundles for shipping. The shorter fibre, or tow, is spun also and used for coarse materials.

The next operation is weaving, and the first step in this is the rolling of the skeins on to spools and thence on to the warpers' beam of the weaving loom. In weaving, the threads which run up and down the loom represent the "warp," while the cross threads are called the "weft," or "filling." As the

Pictures on pages 3317, 3319, 3320, 3321, 3322, courtesy, The Irish Linen Merchants' Association, N. Y.

Flax fibre, after retting, is a medium brown in color, and the woven fabric is therefore the same color. It has to be bleached. This process consists of boiling the pieces of linen in a chemical solution, washing them and spreading them out on the grass. This is repeated until the cloth is of a dazzling whiteness.

yarns run on to the weavers' beam they pass through a starch bath called "dressing." This smooths any loose ends and gives strength during the weaving process. Weaving is done by the shuttle which carries the weft passing under and over the warp threads. By changing the number of threads passed over or under by the shuttle, different kinds of linen are produced, such as plain cloth, twilled cloth or linen drill, and huckabacks. Most of the table linen used is damask, and it has a woven ornamental design and contrasting weaves.

When the woven fabric is taken from the loom it is run through the cropping machine, which cuts knots and loose threads from the surface of the cloth. The end is now in sight, for the fabric is ready for bleaching, or whitening. Pieces of linen are stitched together, end to end, in one piece many thousands of yards in length. This is called "a pot of cloth." It is put through several washes and boilings with chemicals, and is then spread on the grass for some days. This performance is repeated until a correct stage of whiteness is reached. The web of cloth is then put through a water mangle and a tank of starched dressing before it is passed over heated rollers, or "calenders," to dry it. The glossy finish is given by beating the linen for hours, then passing it once more over warm calenders.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 3341.

Courtesy, James McCutcheon Co.

A lovely tablecloth of linen damask in tulip design. Floral designs are the most popular. The chrysanthemum pattern is the favorite of all, and has been for many years. It is possible to buy a chrysanthemum-pattern cloth in a wide range of prices. The rose design is also a great favorite. Note how the pattern follows the lines of the table.

THE PAST IN PORTRAITS

Courtesy, Museum of Fine Arts, Boston

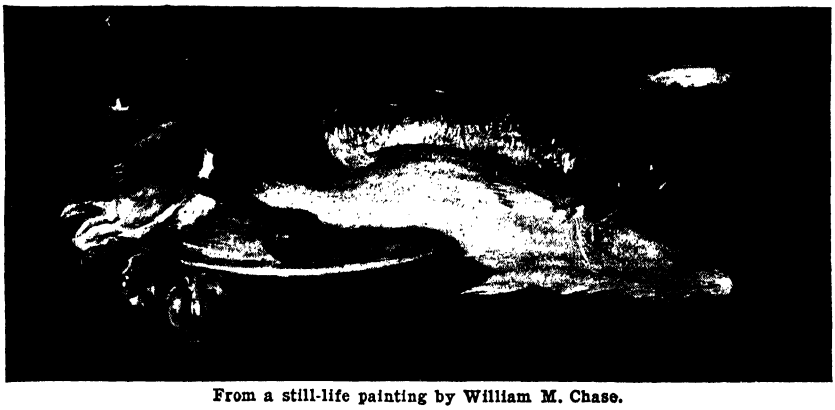
Mr. and Mrs. Ralph Izard, by John Singleton Copley. Copley went to England at the height of his career and stayed there until his death. His son, who became Lord Lyndhurst, was a famous British statesman.

Courtesy, New York Public Library

A portrait by Copley of Lady Wentworth, whose husband was the last royal governor of New Hampshire.

Courtesy, Pennsylvania Academy of the Fine Arts

This portrait of Major Thomas Biddle, by Sully, shows how the artist was influenced by Lawrence.



From a still-life painting by William M. Chase.

PAINTING IN THE UNITED STATES

PROGRESS IN THE EARLIER YEARS

THE people who first settled the New World were too busy clearing the wilderness, making new homes and protecting them from wild beasts and wild Indians to think about art. They seldom saw a picture. Indeed, the Puritans were inclined to condemn the beautifying of life by art and music as wrongful waste of time. In the Southern colonies, where life was gayer and where homes were more luxurious, one might suppose that art would make its appearance earlier than in the severe atmosphere of the North. In those homes there were paintings that had been brought from Europe. Yet Boston and Philadelphia were the cities first noted for fostering American art, and the part played by the South in the early days was that of patron, not of creator; for at Philadelphia many a Southerner had his portrait painted, and Northern artists traveled in the South to paint portraits there. However, there was little or no American art until the middle of the eighteenth century.

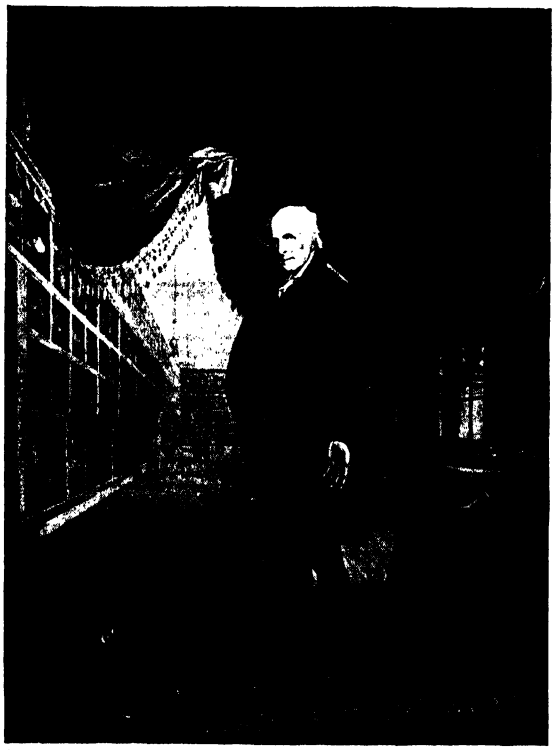
The first paintings made in America were all portraits. There were no photographers in those days, but there were some portrait painters who went about the country seeking for patronage. They were known as "limners," from the old word "illuminer." The earliest of them all is said to have been Gustavus Hesselius, from Sweden. Then came Peter Pelham and John Smibert, the latter of whom, a Scotsman, painted chiefly likenesses of the New England preachers, or "divines." He settled in Boston, where he died in 1751.

Of native-born painters who had become mature in their art before the Revolution, we may count three whose names are especially noted—Benjamin West, John Singleton Copley and Charles Willson Peale.

Benjamin West was born, of Quaker parents, near Philadelphia in 1738. He had no early training, but, fascinated by the colors—the vivid reds, blues and yellows—with which the Indians painted their bodies, he taught himself much by experimenting with these. A gentleman interested in the boy's efforts gave him a paint-box, and very soon he was successfully painting portraits. When he was twenty-one one of his patrons sent him

to Rome, and from then on he won great success. Much of his life was passed in London, where he was knighted and became very popular. There he had the honor of succeeding Sir Joshua Reynolds as president of the Royal Academy. He had the kindest feeling for needy art students, and helped many a talented young American. When he died in London, in 1820, he was buried in St. Paul's Cathedral with most impressive ceremony.

While he began as a portraitist, West won his greatest fame by painting biblical and historical scenes. He showed his independence by painting modern historical figures, not draped in classical robes, as was the custom, but clothed in the garments or uniforms in which the men represented actually lived and died. His first picture of this sort, The Death of Wolfe, now in the National Gallery of Canada, created a sensation and almost started a war of artists when it was first exhibited, in London in 1771. That may be counted a starting-point for realistic historical painting in England.



Photo, courtesy Pennsylvania Academy of the Fine Arts.
Charles Willson Peale's portrait of himself, called The Artist in His Museum.

His work looks somewhat hard and pretentious to us, although some of his portraits have charm and vivacity—such, for instance, as that of Peale, shown here. The success attained by West—an artist who had started with the crudest paints and with brushes made of hairs from the family cat—gave encouragement to others and influenced them to persist in their work.

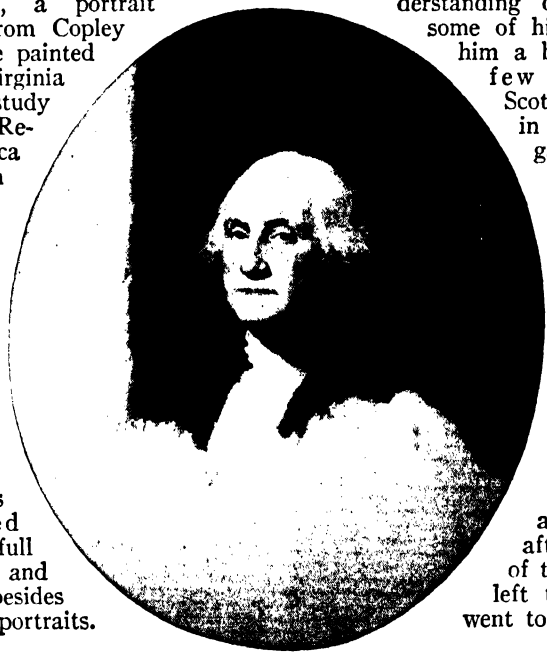
John Singleton Copley's parents came from Ireland. His father, a tobacconist in Boston when the artist was born in 1737, died soon afterward. Later the boy's mother was married to Peter Pelham, a painter and engraver, who gave his stepson valuable training. For a time Copley worked at engraving, but soon turned to portrait-painting. His subjects were the aristocrats of the New World, men and women of character and culture, and he was especially successful in conveying a sense of dignity and personal distinction, although his painting never lost a hardness and dryness of handling. One of his best-known portraits is that of Lady Wentworth, then a Boston belle of nineteen.

Copley himself, handsome, clever in conversation, of delightful manners, was a great favorite in New England society. When thirty-two he married Miss Clark, the daughter of a wealthy merchant, the very man to whom was consigned the famous cargo of tea flung into Boston harbor a few years later. Our early artists longed to study the pictures of the Old World. At the height of his success Copley went to Rome, and later to London, where he was welcomed by West and remained until his death, in 1815.

Philadelphia has the distinction of being the earliest American art centre. At the time of the Revolution it was the biggest, the richest and most fashionable city. From early days Philadelphia had been rather more liberal-minded toward the arts than had New England.

There lived and painted a native of the city, Matthew Pratt, one of the first American pupils of Benjamin West. And to Philadelphia came Robert Edge Pine, a well-known English painter, who in 1784 held in the State House one of the earliest exhibitions of European art.

But the most famous of native painters in Philadelphia was Charles Willson Peale, who was born in Maryland in 1741. As a boy, his father having died, he was apprenticed to a saddle-maker, but he early showed ability for painting. After some help and encouragement from John Hesselius, a portrait painter, then from Copley in Boston, Peale painted portraits in Virginia before going to study in England. Returning to America in 1769, he soon gained high reputation. After Copley's retirement in 1775, he remained the leading, and for about fifteen years the only portrait painter of established reputation in the country. His work included large canvases, full length portraits and family groups, besides many miniature portraits. He painted in Mount Vernon, in 1772, the earliest known portrait of Washington, and but for his industry under adverse conditions during the Revolution, we should not have had likenesses of many of the leaders in the conflict. He painted not less than fourteen life portraits of Washington, of which he made a number of replicas, the first full length being done in 1779 by order of the Supreme Executive Council of Pennsylvania. His last portrait of Washington was painted in 1795.



Photo, courtesy Museum of Fine Arts, Boston.
The unfinished Athenæum portrait of George Washington, by Gilbert Stuart.

In 1776 Peale had moved to Philadelphia, and during the war he was in active service as a captain. Before his death, in 1827, he had been influential in founding the Pennsylvania Academy of the Fine Arts. He also established a natural history museum, the first in the country.

His son, Rembrandt Peale, a painter of portraits and historical works, is especially noted for his composite likeness of Washington.

Gilbert Stuart was the first American painter that showed true individuality. Son of a Scottish refugee and a Welshwoman, he was born at Narragansett, Rhode Island, in 1755, and showed his talent for drawing as a child. An understanding doctor who saw some of his drawings gave him a box of paints; a few years later a Scotch artist visiting in this country gave him lessons and invited him to go back to Scotland with him. Young Stuart was placed in the University of Glasgow, but his protector died, and the boy, poor and homesick, was glad to make his way home on a collier. Soon after the beginning of the Revolution he left this country and went to London. There, when his money had been used up, he was befriended by West, who took him first as a pupil, then as assistant.

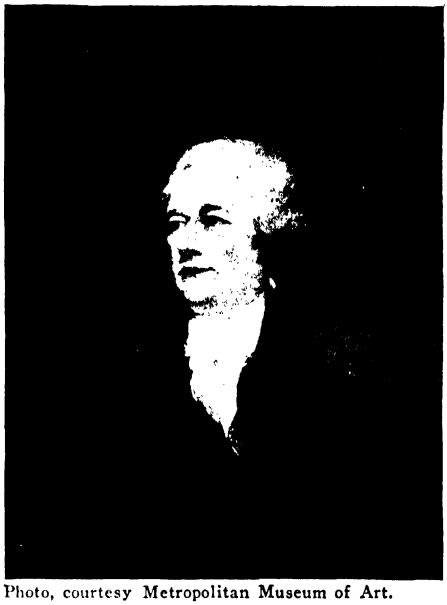
After eight years in West's studio Stuart set up a studio for himself, where he was soon very busy and very popular, painting the portraits of kings and princes, other artists and various persons of importance. His own gifts and accomplishments made him a favorite socially; but he had the independence to refuse to accept any sitter that did not interest him.

In 1792, drawn by an intense admiration for George Washington, he left his European successes behind and settled in

the United States, where he gratified his desire by painting portraits of Washington.

Three he painted from life; but the first he purposely destroyed, and the last he purposely left unfinished so that he might not have to part with it. This one, the noted Athenæum portrait, was bought from the artist's widow and now has its honored place in the Museum of Fine Arts in Boston. The second portrait, showing the full-length figure, was painted for Lord Lansdowne.

Saying, "I copy the works of God, and leave clothes to the tailor and mantua-



Photo, courtesy Metropolitan Museum of Art.
Portrait of Alexander Hamilton, by John Trumbull.

maker," Gilbert Stuart gave his attention to the face and character of his sitter, rather than to the garments and setting; only when these were expressive of the person did he emphasize them, as in the portrait of Dr. Fothergill, a distinguished Quaker physician, whose drab costume, though so simple, is given careful and delicate handling.

Stuart is "not a painter of great pictures, but of some great portraits. Yet the limitation is in a way an evidence of greatness. It was the fashion of his time to try and paint great pictures. From this he had the hardihood to separate himself, reaching with true originality of feeling after what really interested him, the big essentials in the subjects that he studied. . . . In the story of American art he holds a unique and dignified position."

After living in New York, Washington and Philadelphia he made his home in Boston until his death, in 1828.

John Trumbull (1756–1843) has been called the connecting link between the early portrait-painters and the American school of landscape-painting. Born in Lebanon, Connecticut, the son of a colonial governor, and graduated at Harvard, he fell under the best educative influence of his day. As a mere boy he joined the Revolutionary army and was soon making himself useful to Washington by his skillful drawing of the enemy's works. But he resigned from the army and went to France, then to London, where he had his turn at studying under West. His experience, however, was unhappy, for the English Government, indignant at the execution of Major André, threw the young painter into prison for eight months and then ordered him out of the country. He returned to England, however, to continue his studies after peace had been established.

The very stirring history then in the making aroused in him a desire to paint historical scenes such as The Battle of Bunker Hill. How highly esteemed Trumbull was in his day may be seen by the fact that Congress commissioned him to paint four pictures for the Capitol, for which $32,000 was appropriated, an amount worth far more then than now.

But he was so much more concerned with portraying facts than with expressing a thought in a truly pictorial and painter-like way that his work did not reach a high level as viewed in the light of our present standards.

AN ARTIST OF HIGH IDEALS WITH A NEW VIEW OF PAINTING

Washington Allston was among the first of his countrymen to see in color and the qualities of painting a separate and independent medium of expression. He was one of the few Southern early American artists, and was born in South Carolina in 1779. But he was educated at Newport, Rhode Island, and then at Harvard.

Allston had the advantage of four years' study in Rome, where he enjoyed the companionship of many distinguished persons, among them Keats, Shelley, Byron and Turner. Life in Rome and

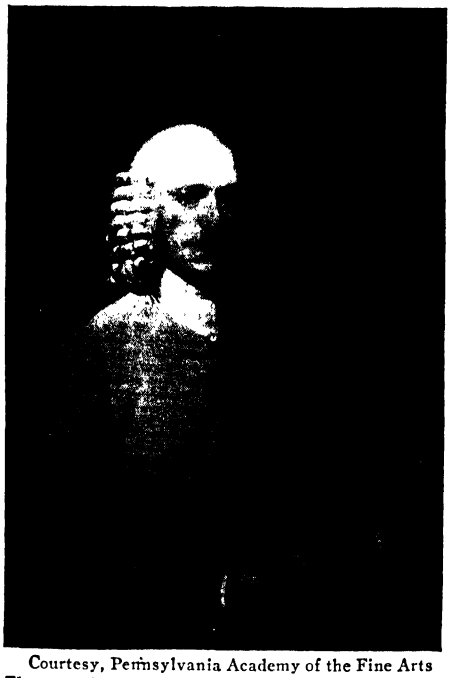
FROM THE BRUSHES OF THREE PAINTERS

Courtesy, Pennsylvania Academy of the Fine Arts

Mrs. James Greenleaf, by Gilbert Stuart. Although his portraits of Washington are most famous, Stuart painted charming portraits of many other people.

Courtesy, New York Historical Society

This portrait of Charles Willson Peale was painted by his friend and fellow artist, Benjamin West. It shows Peale at work, his brush in hand.



Courtesy, Pennsylvania Academy of the Fine Arts

The portrait of the Quaker physician, Dr. Fothergill, shows Stuart's skill in depicting character.

Courtesy, Metropolitan Museum of Art

Mrs. James C. Griswold, by C. L. Elliott. This shows a type of beauty fashionable in the 1860's.

the study of Raphael and Michelangelo kindled his imagination and stimulated him to attempt more than his rather limited brush could perform. The Dead Man Restored to Life is one of his best-known pictures. Though his achievement was not great, his high ideals and aspirations had a favorable influence on American art.

Edward Malbone, a boyhood friend of Allston, was a miniature-painter whose work is prized almost as much as the work of the best European miniature-painters. He died in 1807, a young man.

PORTRAITURE IN THE FIRST HALF OF THE NINETEENTH CENTURY

A few names stand for the only portrait-painting that was of real value in the second quarter of the nineteenth century. Thomas Sully in his long life painted a great number of pictures. Born in England in 1783, he was nine years old when he was brought to Charleston, South Carolina, to live. As a youth he studied painting with his brother-in-law, a miniature-painter in Charleston, and was afterward a student under Gilbert Stuart for a short time. When he was a young man he set up a studio in New York, but did not meet with success. Feeling the need for more study, he went to London to work under Benjamin West, stayed there as long as his money lasted, then returned to Philadelphia, where he lived until his death, in 1872. Among the portraits that he painted were three of presidents of the United States and one of young Queen Victoria of England. This he made in London soon after she began to reign. Sully's work shows the influence of Gilbert Stuart and of Thomas Lawrence, but he had neither the force of the former nor the elegance of the latter.

Sully's son-in-law, John Neagle (1799–1865), a practically self-taught artist, born in Boston, made his first success in portraiture in Kentucky. Later, in Philadelphia, he became director of the Pennsylvania Academy. His principal works are in the Quaker City, one of the best-known being the picture of Patrick Lyon at the forge. A fine portrait of Dr. William Potts De Wees shows the artist to have been capable of strong characterization and interesting composition. His drawing was very good and his coloring successful; and he left a reputation for industry and enthusiasm in his art.

Chester Harding (1792–1866), though born in Massachusetts, was in his early life a big, sturdy, hard-working pioneer in western New York. After serving as a drummer in the War of 1812 he tried his hand at various occupations, such as making chairs, peddling, keeping a tavern and house-painting. Self-taught, like so many others, he at last became a painter of portraits, and after a little study in Philadelphia had notable success in St. Louis, Washington, Boston and London. He finally settled in Boston. From his brush we have portraits of Madison, Monroe, Daniel Webster, Henry Clay and many others. While his technique was far from perfect, his faculty for perceiving and presenting the human nature in his sitters gives a result of lifelikeness and interest. He may be remembered as "an ardent creature, honest with himself and proud of his profession."

Another painter of portraits of famous men, both in America and in England, is Henry Inman (1803–46), who was born in Utica, New York. His work was faithful and painstaking and sometimes, as in his portrait of Chief Justice Marshall, achieved unusual force.

Charles Loring Elliott (1812–68) had the advantage of being the son of an architect and of studying art in New York. This instruction gave him much practice in drawing—a good foundation for his development. His use of the brush in painting, however, he must have learned for himself, as it was of a sort quite individual at the time—a sort that has become familiar since. With a brush fully charged with paint he got effects that we think of as belonging to a later generation of artists. He stands foremost among portraitists of his own period.

THE FOUNDING OF INSTITUTIONS TO ENCOURAGE ART

It was in 1805 that Peale and others succeeded in organizing the Pennsylvania Academy of the Fine Arts, which has the honor of being the oldest institution of art in the United States. In 1801 a New York Academy of Fine Arts had been started but had had to be given up. Then, during the fall and winter of 1825 to 1826 the National Academy of Design began its career as an important factor in the art life of New York and the whole country. Samuel F. B. Morse, who later gave up painting for invention, was one of the founders. These move-

EARLY FIGURE AND LANDSCAPE PAINTING

Photos, courtesy Metropolitan Museum of Art.

Hagar and Ishmael, by Benjamin West.

A Spanish Girl, by Washington Allston.

Photo, courtesy New York Historical Society.

"Destruction," one of the series of paintings, The Course of Empire, by Thomas Cole.

ments were significant signs of a growing consciousness of the need of art and the value of joining forces to improve opportunities and raise standards of taste.

In the half-century that followed the Revolution, the war for political independence, the United States had been finding its way to distinct national life in various directions. Industrial, or business, independence was worked out before an independent expression of thought and spirit could be reached; but it was not long before national feeling discovered an outlet in an art that went to the beauties of nature at home for subjects to portray. The "Hudson River School" is the name given to the first group of landscape-painters.

THE HUDSON RIVER SCHOOL, FIRST AMERICAN LANDSCAPE GROUP

The forerunner of this school was Thomas Doughty, who was born in Philadelphia in 1793 and died in 1856. His life gives us a good idea of the difficulties encountered by artists in the early days of the country, especially after it seemed to be more than ever cut off by the Revolution from the culture of the Old World. Doughty started as a leather merchant. Thirty years old before he began to paint more than by way of amusement, he was almost forty before he was able to travel abroad and study. He painted many landscapes, some of which have charm. His chief claim to distinction, however, is that he was the first to draw the attention of American painters to the beauties of their own country.

But the one who made the new movement prominent and popular was Thomas Cole (1801–48). Born in England, the son of a wall-paper maker, he came to this country with his family when nineteen. It was at the Academy in Philadelphia that he first had an opportunity to study pictures. From there he went to New York, and then sketched and painted along the Hudson and in the Catskill Mountains. In time his work came to the notice of two older artists, Trumbull and Durand. For a time Cole was very successful. He traveled abroad, and his work was exhibited in the Royal Academy, London. Influenced by the European taste for the grand historical style, he painted several series of pictures in which his romantic imagination took the scenes among which he lived and made them the setting for poetic allegory. One series is The Voyage of Life; another, The Course of Empire. In them the charm of his love for natural beauty is confused by the introduction of story motives or moral lessons. Gaudiness in coloring and mistakes in light effects are the chief defects in his painting.

Asher B. Durand (1796–1886), who was born in East Orange, New Jersey, commenced life as an engraver, but after a time began to paint portraits, and in the latter part of his life gave himself to landscape-painting, in which he reached real power of expression. He may be said to have studied painting from the pictures which he copied in engraving. By this work of faithfully copying pictures he gained skill in drawing, too; but his very skill and exactness in detail kept his paintings from showing the unity of composition that a painter gains by selecting and simplifying the parts of a landscape.

J. F. Kensett (1818–72), another engraver who turned to painting, is one of this group of men whose work is a milestone in the progress of American art. His landscapes have a sort of haziness that gives them an air of poetic dreaminess.

Doughty, Durand and Kensett had led the way in the study of nature and its presentation simply and directly in landscape. Following in the same path were two brothers, William and James Hart, born in Scotland, but early transplanted into the Hudson River valley, where, when they had learned to paint, they expressed a pure joy in nature's beauties. William lived from 1823 to 1894, James from 1828 to 1901.

LARGE CANVASES REFLECT THE GRANDEUR OF THE COUNTRY

As the country expanded and people learned more about it, the very size and grandeur of some of its features were reflected in the canvases of the painters. The Rocky Mountains, where lofty peaks and impressive masses stood sharply defined and undimmed under a clear, bright light, were a challenge to the skill of such men as Albert Bierstadt (1830–1902) and Thomas Moran (1837–1926). Frederic E. Church (1826–1900), another well-known painter of expansive scenes—sometimes real and sometimes imagined—was a pupil of Cole and looked for his subjects up and down the American conti-

nents, from Labrador to the Andes. All of these men painted what we may call "views"; that is, they might show what a scene "looks like, but not what it feels like." "This is the sharp line of difference between the earlier landscapes and those of the present day, in which we shall find the expression of *a mood in nature* to be the painter's aim."

Before the middle of the nineteenth century it became the ambition of young American artists to go to Germany and study in the Academy at Düsseldorf. Bierstadt, who had been born near by, returned there from the New World to become a student under the art teachers in the Academy. And James Hart had part of his training there. Another of the Düsseldorf disciples was Emanuel Leutze (1816–68), who, though born in Germany, had grown up in Philadelphia. He became an able painter, usually choosing historical subjects, although he painted portraits as well. He is best known through his picture of Washington Crossing the Delaware, a large canvas in the Metropolitan Museum of Art. The method of painting is not on a scale with the size of the picture, nor does it measure up to the conception of a great historical subject.

Beginnings of French Influence on American Painting

Later the influence of Munich was felt, through the American painters Frank Duveneck and William Chase, who studied there. Of them more farther on. But the strongest and most lasting influence upon American art, as upon that of most of the modern world, has been the influence of France, where the old and the new in method and thought found a broad platform on which to contest for control. You will recall how individualism, in the persons of French realists, impressionists, plein-airists and others, struggled to get away from the restraints of the Academy and its system.

It was at the time when the Barbizon group were making their protest that certain of the young American painters—able and thoughtful men—went to Paris to study. First among them was William Morris Hunt (1824–79), born at Brattleboro, Vermont. During his student years in Europe he went from Düsseldorf to Paris, then on to Barbizon to study under Millet. The more formal instructions of the first two were rounded out and deepened by the richer experience at Barbizon, where the young painter caught the feeling that a strong underlying motive based on the idea of truth has more value than mere skill in technique or importance of subject. The simplicity, sincerity and breadth of Millet's method, placing nature always before art, was in such contrast with Hunt's earlier training that he could not successfully adjust the two in his own painting. However, upon his return to New England he established a school at Boston, where he passed on to his pupils the great doctrine of sincerity in art, and the belief that art lies in the artist himself rather than in his subject.

Accustomed to the elaborate compositions and detailed method of the earlier men, Hunt's public did not at first see why he should choose simple subjects and treat them in a comparatively simple way. He produced landscapes, figure-studies and portraits; but his greatest work for national art development was accomplished through his teaching.

George Fuller, Whose Work Looked Toward the Future

Living at the same time, another New England painter progressed by his own independent effort to a point much farther along the road of modern expression. He was George Fuller (1822–84), a native of Deerfield, Massachusetts. After starting on the career of painter, he had to drop out of the world of art and become a farmer, when the death of his parents and of an older brother left him responsible for younger members of the family. Before his retirement, however, he had been made an associate of the National Academy and had traveled in Europe, visiting the great galleries and sketching.

Enriched by these experiences, but convinced that he must see nature for himself, Fuller painted alone as he found time, thinking only to give expression to his own thoughts and aspirations. Accident, in the form of a crop failure, brought his pictures to the public, when he found himself forced to send them to Boston to be sold. They were hailed with enthusiasm, and Fuller, after sixteen years of absence, again took his place among professional painters.

Under a veiled and subtle coloring his vaguely outlined figures glimmer with an

effect of light and air that gives them poetic charm. In his attempt to produce this impression of atmosphere he was moving in advance of his generation. Form and technique he never thoroughly mastered, but his genius called out, in color, effects that gave mystical beauty to what might seem the most commonplace subjects—a girl with turkeys or a boy driving home a calf. The secret is that he was always trying to give a feeling of things that lie below the surface. Some of his best pictures are: Winifred Dysart, Nydia, and The Turkey Pasture.

Although Fuller, as Charles Caffin says, "stood on the threshold of the New Movement, peering, like one of his own figures, through the veil," we must turn back to the first days of the Barbizon influence and trace the progress of those ideas which Hunt had introduced but could not fully exemplify in his own work. After a period of assimilation these ideas were to become an essential part of the national art thought, as natural as breath itself. Meanwhile we shall study the work of various men who lived through the time of greatest growth and expansion in idea and in method.

Thus far in a general way we have reviewed the two early periods of painting in America. The first, before 1825, was given to portraiture which aimed for the most part at following the traditions of English portrait-painting; while in the second, between 1825 and 1878, landscape work was done that introduced into art something truly American.

In looking at the landscapes of that time we must keep in mind that the young nation did not for a long time have many or large cities. The open country was the familiar environment of most of the people, wherever they lived—the only environment that many of them ever had. The landscape-painters knew and loved the countryside. And we must remember, too, that until about 1850 the painters did not have the help of practiced instructors or the example of older works of art to guide them, but had to learn for themselves, or from others who were self-taught.

THE CENTENNIAL EXPOSITION, A TURNING-POINT IN AMERICAN ART

The Centennial Exposition at Philadelphia in 1876 was the birthday celebration of the United States at the end of its first century. To the men and women, the boys and girls of the time, it was an exciting and important event.

Many of the people who went to the Exposition had never before had a chance to look at paintings and sculptures. And there they saw, besides, other things which opened their minds to a knowledge of the Old World's skill and artistry. Even those who could not go to Philadelphia were able to catch distant glimpses of the exhibits—not in moving pictures or fine photographic reproductions, like those of our day, but in drawings for magazine articles or in what you would think rather crude photographs.

In those days world's fairs and art exhibitions were not the familiar events that they are now. Remember that life then was not a thing of electric lights and motor cars, of telephones and talking machines, with crowding impressions such as rush through our minds every day. As for radio and airplanes and moving pictures, they were like things in a fairy tale. It was a time when travel was just beginning to be easy enough and money plentiful enough so that the people of the United States need not feel themselves quite set apart from the rest of the world.

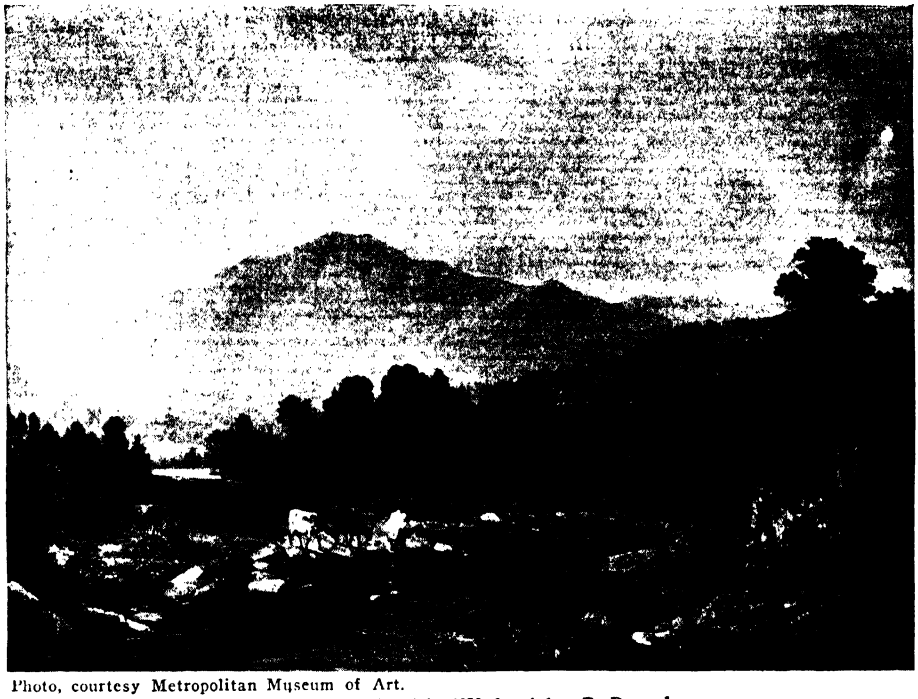
MUSEUMS OPENED, BRINGING ART TO THE PEOPLE

And already a start had been made in bringing together art treasures for the public to study and enjoy. Philadelphia, we have seen, played the rôle of pioneer, early in the century, with its Academy of Fine Arts. In 1870 Boston's Museum of Fine Arts was incorporated, and the same year gave a charter to the Metropolitan Museum of Art in New York. But the Centennial, more than anything else, helped the progress of art development by opening the minds of the people to new appreciation and by giving encouragement to the young artists who were coming home fresh from their years among the studios and richly stored galleries of Europe.

In 1877 a group of eager-minded young men founded the Society of American Artists. The names of these artists and those who joined them in the years that followed are names of significance in our story. In 1906 this society and the National Academy of Design were united, all members of the Society becoming members of the Academy.

The first president of the Society was John La Farge (1835–1910), who

STEPS IN THE PROGRESS OF LANDSCAPE



Photo, courtesy Metropolitan Museum of Art.

A landscape painted in 1853, by Asher B. Durand.

Photo, courtesy New York Public Library.

Cotopaxi, the painting by Frederic E. Church.

through taste and training had gained a broad culture. For very love of art, he studied it because of its part "in the large field of human thought and life" before he chose it as his own life-work. Born in New York, he grew up in a home where books and pictures were loved and appreciated, and where interesting and gifted men and women came together. After thorough foundation-study in school the young man went to Europe and visited Munich, Dresden and London, besides staying for some time in Paris. The work of the Barbizon painters impressed him as most important.

LA FARGE'S INTERESTING STUDIES IN THE FIELD OF COLOR

Still he did not intend to become an artist by profession; and upon his return to New York he studied in a lawyer's office. "No one," he has said, "struggled more against his destiny than I." When at last he did decide to devote himself to art he went to Newport and studied with Hunt. The department of painting in which he was a pioneer and leader in the United States is wall decoration. His work excels in decorative quality of line and color. Instead of copying the apparent colors of nature, La Farge, with the instinct of a scientist, analyzed them to find out the how and why of different effects. And so he worked upon the problem of all modern art—local color seen through the medium of lighted atmosphere. And he arrived independently at the same conclusion as Manet and the impressionists in France —that color and form must be presented as they are affected by varying gradations of light and air.

The influence of neighboring colors upon one another engaged much of his attention, too. In his later years he applied his discoveries in this field to the production of beautiful windows in colored glass, where he used differences in surface and thickness to enhance his rich and subtle color effects. In this art he has been followed in later years by Louis C. Tiffany, of New York.

In his mural painting La Farge aimed at a compromise between the natural and the conventional. He made the fine altar-piece for the Church of the Ascension, New York, and decorated the walls of a number of other public and private buildings. Christ and Nicodemus is one of his best-known pictures. Besides figure-studies he painted landscapes and flower-studies and interesting scenes in Japan and Samoa.

Two men who studied in Munich and who later became teachers of many other American painters stand out clearly and prominently in the period of change that came about the time of the Centennial. These are Frank Duveneck and William M. Chase. Both were extraordinarily able painters, with a "passion for good workmanship" and great cleverness and ease in the handling of brushes and paints, the technique of their art. In their hands, in fact, there seemed a sort of magic that could brilliantly control the materials with which they worked. Yet both of them are greater as teachers, because of the enthusiasm and inspiration they called out in their students, than they are as artists.

TWO CLEVER PAINTERS WHO WERE INSPIRING TEACHERS

Frank Duveneck (1848–1919) began in Munich to gather around him a group of eager pupils, and afterward was a leader in the art life of Cincinnati and an instructor in its art school for a number of years. He was always true to the older methods of portrait-painting, getting his chief inspiration from the Dutch school, using what has been termed "brown sauce" to get the effects of the old masters, and never yielding to the call of impressionism. But he led the way, among Americans, in proving the value of sound modeling of the figure and in *painting* the picture in upon the canvas—blocking it out directly in masses of color instead of first drawing the design and then coloring it. His portraits have living qualities and indicate real character, but are more interesting as examples of Duveneck's mastery of the brush than from any other point of view.

William M. Chase (1849–1916), who went to Munich in 1872, studied also in Paris with Carolus-Duran, and came back to America in 1878. He used a lighter, gayer, more nearly luminous color-note than Duveneck. With a joyous facility and remarkable cleverness he painted portraits, landscapes, figure-studies and still life—pictures that are full of delight in the painter's craft. All his life Chase continued to hold a central place in the art life of New York, a leader in the movement for technical improvement.

THE NEXT STORY OF THE FINE ARTS IS ON PAGE 3447.

MEDITATION AND REFLECTION

Illustrated by Lois Maloy

The Chambered Nautilus

From THE AUTOCRAT OF THE BREAKFAST TABLE

By OLIVER WENDELL HOLMES
(1809-1894)

THIS is the ship of pearl, which, poets feign,
Sails the unshadowed main,—
The venturous bark that flings
On the sweet summer wind its purpled wings
In gulfs enchanted, where the Siren sings,
And coral reefs lie bare,
Where the cold sea-maids rise to sun their streaming hair.

Its webs of living gauze no more unfurl;
Wrecked is the ship of pearl!
And every chambered cell,
Where its dim dreaming life was wont to dwell,
As the frail tenant shaped his growing shell,
Before thee lies revealed,—
Its irised ceiling rent, its sunless crypt unsealed!

Year after year beheld the silent toil
That spread his lustrous coil;
Still, as the spiral grew,
He left the past year's dwelling for the new,
Stole with soft step its shining archway through,
Built up its idle door,
Stretched in his last-found home, and knew the old no more.

Thanks for the heavenly message brought by thee,
Child of the wandering sea,
Cast from her lap, forlorn!
From thy dead lips a clearer note is born
Than ever Triton blew from wreathèd horn!
While on mine ear it rings,
Through the deep caves of thought I hear a voice that sings—

Build thee more stately mansions, O my soul,
As the swift seasons roll!
Leave thy low-vaulted past!
Let each new temple, nobler than the last,
Shut thee from heaven with a dome more vast,
Till thou at length art free,
Leaving thine outgrown shell by life's unresting sea!

Say Not, the Struggle Naught Availeth

By ARTHUR HUGH CLOUGH (1819-1861)

SAY not, the struggle naught availeth,
The labor and the wounds are vain;
The enemy faints not, nor faileth,
And as things have been they remain.

If hopes were dupes, fears may be liars;
It may be, in yon smoke concealed,
Your comrades chase e'en now the fliers,
And, but for you, possess the field.

For while the tired waves, vainly breaking,
Seem here no painful inch to gain,
Far back, through creeks and inlets making,
Comes silent, flooding in, the main.

And not by eastern windows only,
When daylight comes, comes in the light;
In front the sun climbs slow, how slowly!
But westward, look, the land is bright!

Ozymandias of Egypt

By PERCY BYSSHE SHELLEY (1792-1822)

I MET a traveler from an antique land
Who said: Two vast and trunkless legs of stone
Stand in the desert. Near them, on the sand,
Half sunk, a shattered visage lies, whose frown
And wrinkled lip and sneer of cold command
Tell that its sculptor well those passions read

Which yet survive, stamped on these lifeless
things,
The hand that mocked them and the heart
that fed;
And on the pedestal these words appear:
"My name is Ozymandias, king of kings:
Look on my works, ye Mighty, and despair!"
Nothing beside remains. Round the decay
Of that colossal wreck, boundless and bare,
The lone and level sands stretch far away.

A Little Work

From TRILBY

By GEORGE DU MAURIER (1834-1896)

A LITTLE work, a little play
To keep us going—and so, good-day!

A little warmth, a little light
Of love's bestowing—and so, good-night!

A little fun, to match the sorrow
Of each day's growing—and so, good-morrow.

A little trust that when we die
We reap our sowing! And so—good-bye!

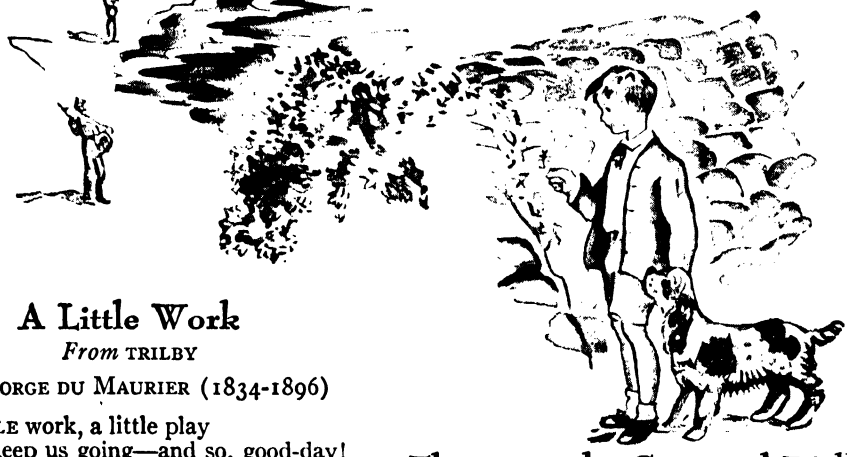
The Dreamers of Dreams

By ARTHUR O'SHAUGHNESSY
(1844-1889)

WE are the music-makers,
And we are the dreamers of dreams,
Wandering by lone sea-breakers,
And sitting by desolate streams;
World-losers and world-forsakers,
On whom the pale moon gleams:
Yet we are the movers and shakers
Of the world for ever, it seems.

With wonderful deathless ditties
We build up the world's great cities.
And out of a fabulous story
We fashion an empire's glory:
One man with a dream, at pleasure,
Shall go forth and conquer a crown:
And three with a new song's measure
Can trample an empire down.

We, in the ages lying
In the buried past of the earth,
Built Nineveh with our sighing,
And Babel itself with our mirth;
And o'erthrew them with prophesying
To the old of the new world's worth;
For each age is a dream that is dying,
Or one that is coming to birth.



Flower in the Crannied Wall

By ALFRED, LORD TENNYSON (1809-1892)

FLOWER in the crannied wall,
I pluck you out of the crannies,
I hold you here, root and all, in my hand,
Little flower—but *if* I could understand
What you are, root and all, and all in all,
I should know what God and man is.

Even This Shall Pass Away

By THEODORE TILTON (1835-1907)

ONCE in Persia reigned a King,
Who upon his signet ring
'Graved a maxim true and wise,
Which, if held before the eyes,
Gave him counsel at a glance,
Fit for every change and chance.
Solemn words, and these are they:
"Even this shall pass away."

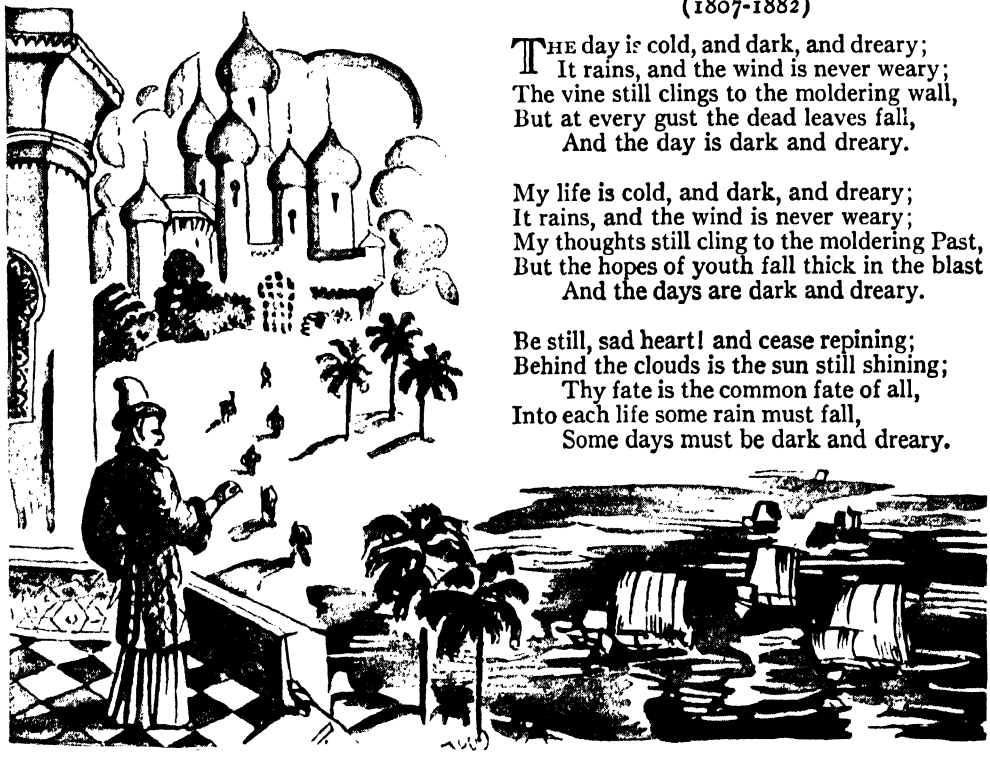
Trains of camels through the sand
Brought him gems from Samarkand;
Fleets of galleys through the seas
Brought him pearls to match with these.
But he counted not his gain
Treasures of the mine or main;
"What is wealth?" the King would say;
"Even this shall pass away."

In the revels of his court
At the zenith of the sport,
When the palms of all his guests
Burned with clapping at his jests,
He, amid his figs and wine,
Cried: "Oh, loving friends of mine!
Pleasure comes, but not to stay;
Even this shall pass away."

Fighting on a furious field,
Once a javelin pierced his shield;
Soldiers with a loud lament
Bore him bleeding to his tent;
"Pain is hard to bear," he cried,
"But with patience, day by day—
Even this shall pass away."

Towering in the public square,
Twenty cubits in the air,
Rose his statue, carved in stone.
Then the King, disguised, unknown,
Stood before his sculptured name,
Musing meekly, "What is fame?
Fame is but a slow decay—
Even this shall pass away."

Struck with palsy, sere and old,
Waiting at the gates of gold,
Said he, with his dying breath:
"Life is done, but what is death?"
Then, in answer to the King,
Fell a sunbeam on his ring,
Showing by a heavenly ray—
"Even this shall pass away."



The Rainy Day

By HENRY WADSWORTH LONGFELLOW
(1807-1882)

THE day is cold, and dark, and dreary;
It rains, and the wind is never weary;
The vine still clings to the moldering wall,
But at every gust the dead leaves fall,
And the day is dark and dreary.

My life is cold, and dark, and dreary;
It rains, and the wind is never weary;
My thoughts still cling to the moldering Past,
But the hopes of youth fall thick in the blast
And the days are dark and dreary.

Be still, sad heart! and cease repining;
Behind the clouds is the sun still shining;
Thy fate is the common fate of all,
Into each life some rain must fall,
Some days must be dark and dreary.

The Solitary Reaper

By WILLIAM WORDSWORTH (1770-1850)

BEHOLD her, single in the field,
Yon solitary highland lass!
Reaping and singing by herself:
Stop here, or gently pass!
Alone she cuts and binds the grain,
And sings a melancholy strain;
O listen! for the vale profound
Is overflowing with the sound.

No nightingale did ever chaunt
More welcome notes to weary bands
Of travelers in some shady haunt,
Among Arabian sands:
A voice so thrilling ne'er was heard
In spring-time from the cuckoo-bird,
Breaking the silence of the seas
Among the farthest Hebrides.

Will no one tell me what she sings?—
Perhaps the plaintive numbers flow
For old, unhappy, far-off things,
And battles long ago:
Or is it some more humble lay,
Familiar matter of today?
Some natural sorrow, loss, or pain,
That has been, and may be again?

Whate'er the theme, the maiden sang
As if her song could have no ending:
I saw her singing at her work,
And o'er the sickle bending;—
I listened, motionless and still;
And as I mounted up the hill
The music in my heart I bore,
Long after it was heard no more.

Waiting*

By JOHN BURROUGHS (1837-1921)

SERENE I fold my hands and wait,
Nor care for wind, nor tide, nor sea;
I rave no more 'gainst time or fate,
For lo! my own shall come to me.

I stay my haste, I make delays,
For what avails this eager pace?
I stand amid the eternal ways,
And what is mine shall know my face.

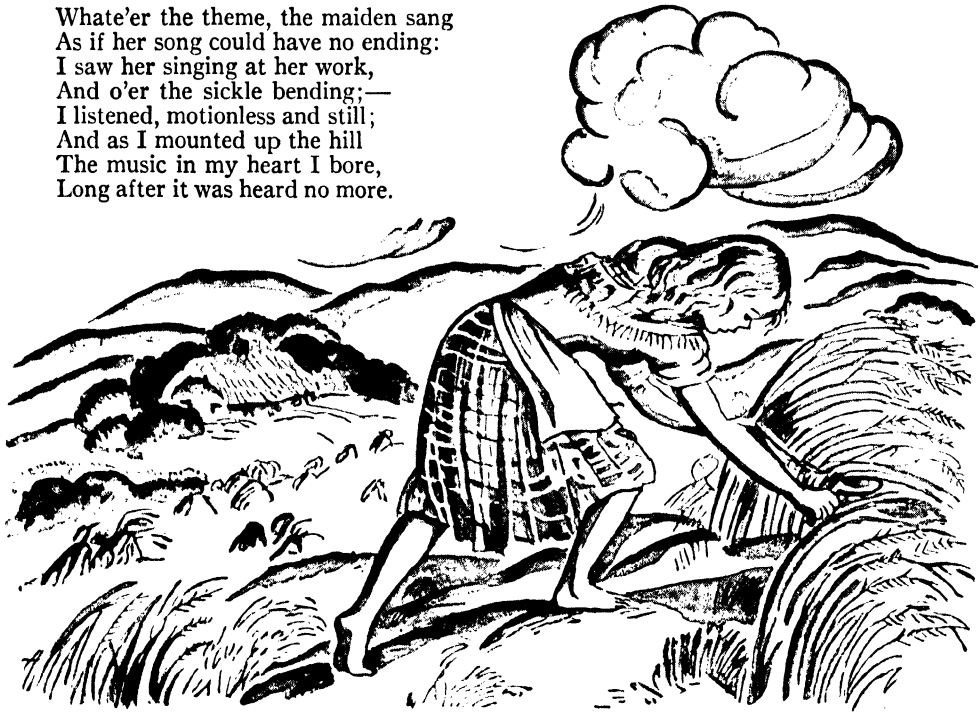
Asleep, awake, by night or day,
The friends I seek are seeking me;
No wind can drive my bark astray,
Nor change the tide of destiny.

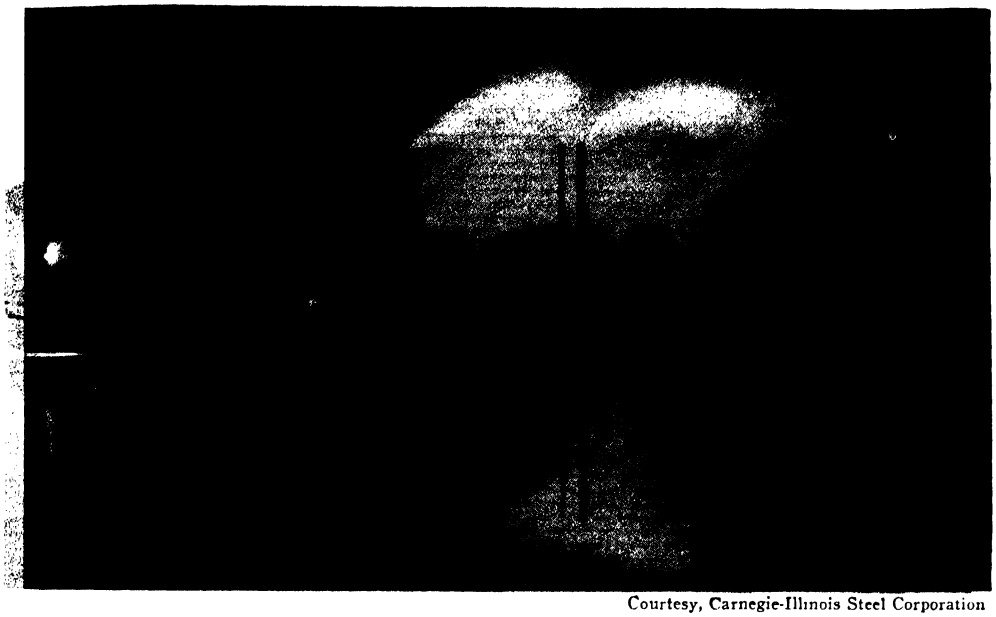
What matter if I stand alone?
I wait with joy the coming years;
My heart shall reap when it has sown,
And gather up its fruit of tears.

The stars come nightly to the sky;
The tidal wave comes to the sea;
Nor time, nor space, nor deep, nor high
Can keep my own away from me.

*By permission of the publishers, Houghton Mifflin Co.

THE NEXT POEMS ARE ON PAGE 3478.





Courtesy, Carnegie-Illinois Steel Corporation

Blast furnaces at night, piercing the darkness with their dazzling glow, present an unforgettable spectacle.

MAKING IRON AND STEEL

THE WONDERFUL SIGHT IN THE GREAT FURNACES

AMONG the most commonly used materials in our world are iron, and steel, which is a specially treated kind of iron. Ships, bridges, railroad locomotives, cars and rails, the skeletons of great buildings, automobile bodies, machinery of many kinds, tools and household equipment are generally made of iron and steel (though lighter metals are also widely used for some of these things). Iron and some kinds of steel are easily magnetized; and magnets are needed in making dynamos and other sources of electrical power. Therefore iron and steel are important in the electrical world.

Iron is one of the ninety-two basic elements of which the world is made. As you know, some of these elements are metals. Gold, silver, copper, tin, zinc, lead and so on, are metallic elements, and iron is another.

Iron is almost never found in the pure, or metallic, state although meteorites of iron containing small amounts of nickel have been found. It is generally found in an ore. That means that when the iron of the earth was still in the hot gaseous, or molten (melted), state it formed compounds with other elements—almost always with oxygen. To get pure iron, therefore, man has to drive out the oxygen. This step is called reduction of the ore.

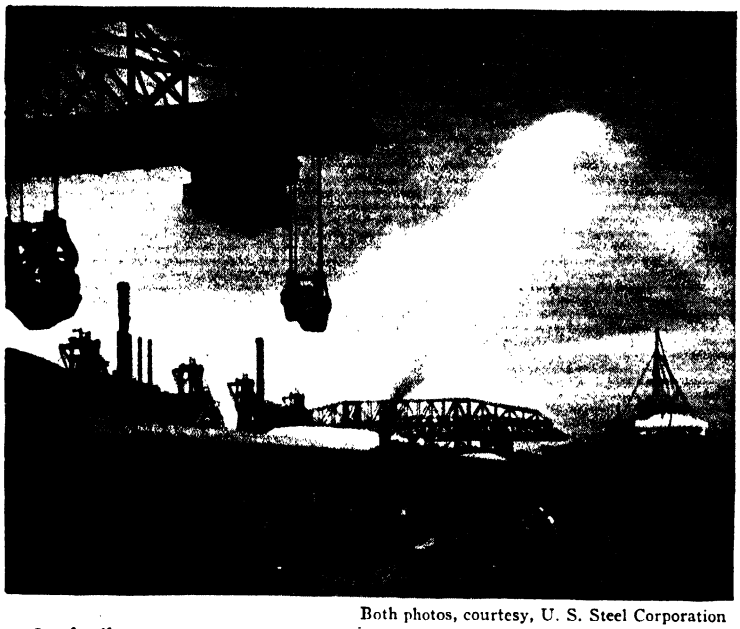
Carbon will take the oxygen out of iron ore at fairly high temperatures. The oxygen will fly from its combination with iron, and form new compounds with the carbon. Charcoal (partly burned wood) and coke (partly burned soft coal) are composed chiefly of carbon; so when iron ore and charcoal (or coke) are placed together in a furnace, and heated to the proper temperature, oxygen and carbon combine and rise as gas, while the iron sinks to the bottom as a molten metal. This operation is called smelting, and the product is pig iron. That, in short, is the main principle of the great iron industry; but to improve the properties of iron in order to make it more useful, other processes are necessary, as we shall see.

In ancient times a simple pit was used instead of a furnace. A crude form of bellows made from skins furnished a blast of air strong enough to increase the heat until the metal melted. Low walls of clay surrounding

the pit were presently added to it and later the pit was done away with altogether. The walls of clay became higher and the shaft blast furnace was made. In the jungles of Asia and Africa the primitive natives still use such a furnace for making the iron for their spears, axes, knives and agricultural implements. When iron is smelted with low heat, it is not like iron from our modern blast furnace, where temperatures are high, but is soft and malleable, that is, it can be hammered into various shapes.

Open pit iron ore mine in Minnesota. Some of the pits reach a depth of 350 feet.

In the year 1622 a little colony of Englishmen built an ironworks on the banks of the Falling River, sixty-six miles above Jamestown, Virginia. On the day that the blast furnace was scheduled to go into operation, Chief Opechancanough and his braves massacred all of the colonists except one boy who escaped to Jamestown. It is probable that preliminary tests were made in the furnace, as fragments of slag or cinder were in the ruins. But no iron was found. Massachusetts was the first colony to produce iron successfully. Production began in 1644 on the banks of the Saugus River near the present city of Lynn. Later iron production was begun by the people of Connecticut and Rhode Island. They and the Massachusetts people used "bog" and "pond" ore found in these eastern states.



Both photos, courtesy, U. S. Steel Corporation

Ore for the nation's big steel mills comes down the Great Lakes from Duluth.

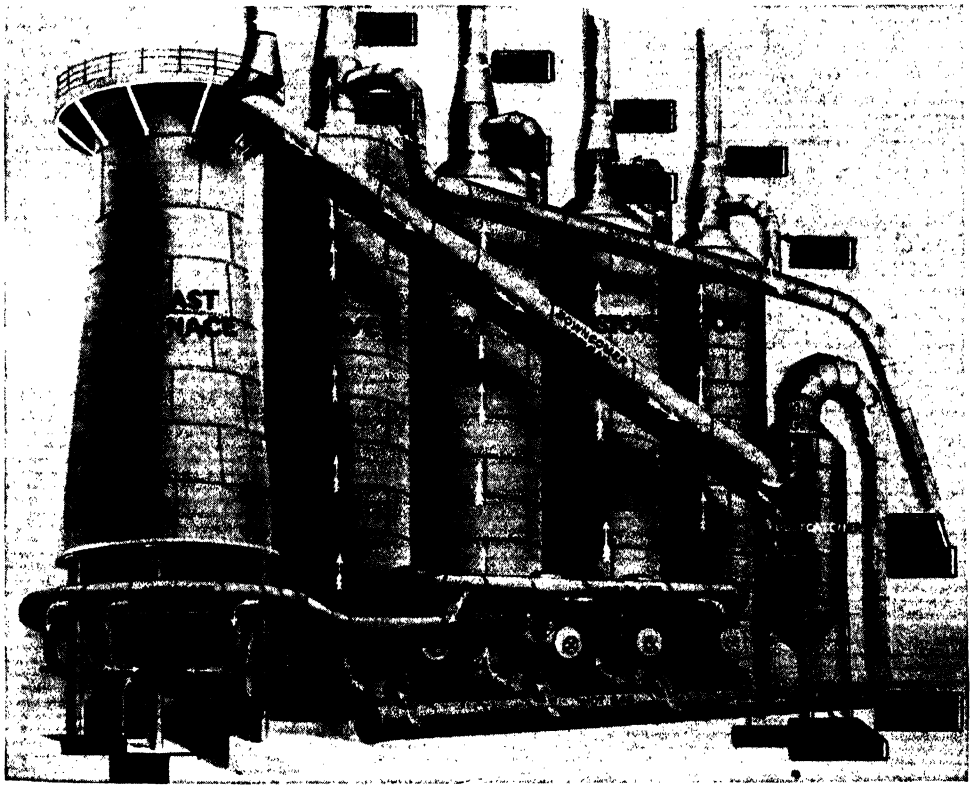
Charcoal, or burnt wood, was the only fuel used at that time. There was plenty of wood in America, but in England people became alarmed at the rapid destruction of their forests; and coal was suggested as a substitute. It was tried, but it failed because coal was too soft to stand the weight of the iron ore placed upon it. The weight packed the coal so tight that the air could not find its

way through the mass. The coal could not burn fast enough to produce a high enough temperature during the smelting process. However, during the experiments it was observed that much of the coal that was heated burned into coke. This coke showed the power to hold up the ore without being crushed, the very thing that coal was unable to do. From that time coke was the fuel, and remains the fuel today, for smelting ores. In the United States the use of coke became general about 1880, some fifty years after England had adopted it.

Iron ore is found in many parts of the world. Some of it is secured from deep mines, but there are places where it is so near the surface that, after the top crust of earth is removed, the ore can be scooped out. The greatest iron-ore region in this continent lies near the shores of Lake Superior. One of the pictures in this article shows an open-pit iron mine in Minnesota. One can see how readily the soft red ore can be taken from the open pit by steam shovels and deposited at once in the cars. These pits are three hundred feet deep in some places.

One would naturally expect the iron industry to be placed near the pits, but this is not always the case. Pennsylvania, Ohio, Illinois, New York and the Virginias, where less iron is found, are great iron-manufacturing sections, and much iron ore must be shipped to them from ports on the shores of Lake Superior. Alabama is an exception, for there both coal and iron are found close together. Nova Scotia has much coal, but brings most of the iron from Newfoundland.

If you follow the line of the bituminous, or soft-coal, belt, from which coke is made, you will see that it runs through the region just mentioned. This is called the Appalachian coal belt and is about 800 miles long and about 150 miles wide, and contains within its borders the great centers of the iron and steel industries. In fact, these industries will be found to lie closer to the source of the fuel than to the source of the ore.



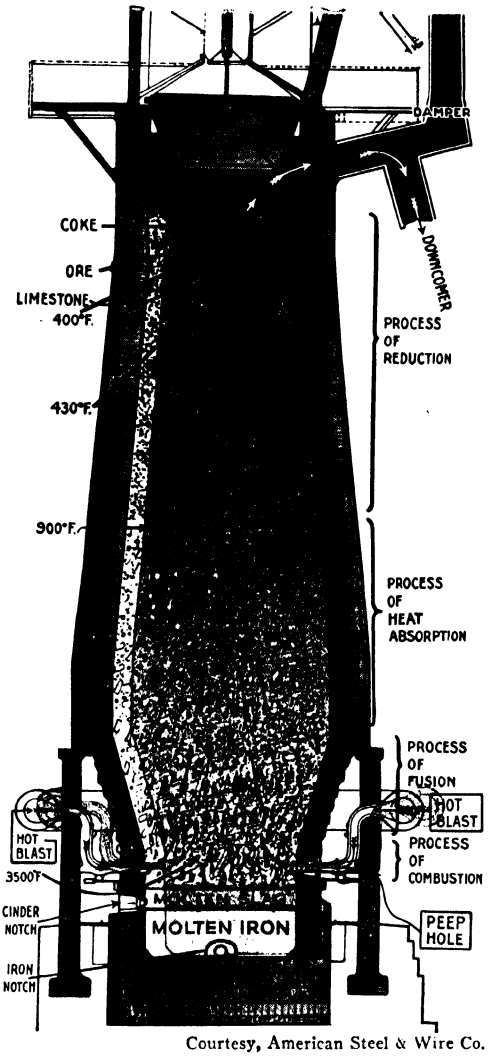
Courtesy, American Steel & Wire Co.

Heating air for a blast furnace. Gas burns in the three stoves on the left, heating the checkers (firebricks). The checkers in the fourth stove are hot. The top damper is closed; the gas is turned off. Cold air is forced through this stove. The air becomes superheated; it is forced through the hot blast pipe into the blast furnace.

Success in the iron and steel industries is partly due to the making of coke out of coal. Coke is simply soft coal heated until the gases are driven off. For years the coal was coked in what is called a beehive coke oven. The name of the oven was no doubt suggested by its resemblance to the ancient dome-shaped beehive. The beehive ovens were charged with coal at the top, usually while hot enough from the previous charge to ignite the coal put in. A small part of the coal burned and the gas that coal contains was driven off to burn at the top of the oven. The reason that all of the coal did not burn was that not enough air was allowed to enter the oven.

Of course, if gas from coal would burn at the tops of the coke ovens, it would also burn in furnaces and under boilers where it would be useful, so late in the nineteenth century men began to build what are called by-product ovens. These are very intricate structures of firebrick and steel that distill the gas from the coal and not only make more coke per ton of coal, but recover gas, ammonia and tar.

At the coke plants are stills, scrubbers, fractionating towers and other apparatus where the most surprising chemicals are separated from the crude tar mixture. There are ammonium sulphate for fertilizer, benzol to mix with automobile gasoline, toluol for explosives, naphthalene to keep the moths away and creosote to preserve railroad ties and telegraph poles. Some of the by-products are later manufactured by others into even more surprising things: plastics for instrument cases and automobile panels and a thousand other articles, saccharine which is at least three hundred times as sweet as sugar, dyes, medicines and even perfumes.



Courtesy, American Steel & Wire Co.

Diagram of a blast furnace stack. Iron ore, coke and limestone are fed in alternate layers through the top. Hot blasts from the bottom increase the heat inside the furnace. The heat melts the iron in the ore; the molten iron sinks to the bottom and is drawn off through the iron notch. The impurities float as slag above the iron. The molten slag is drawn off through the cinder notch.

The coke produced in the by-product ovens is loaded in cars and taken to the blast-furnace plants. The gas and the tar are used as fuels in making steel; the gas is piped to the mills and the tar is taken there in tank cars. It is interesting to note that, while gas is a by-product in the manufacture of coke, coke is a by-product in the manufacture of coal gas. (See the Story of Gas.)

The blast furnace is the first step in the process of making iron and steel. The shaft blast furnace that we have seen develop from the pit became over the years larger and higher until finally the large amount of charcoal and the increased blast produced a great deal of heat in the furnace. The reduction of the ore went on as before, only faster, but when the globules of iron became hotter they absorbed carbon from the charcoal and silicon from the stone-like impurities in the ore. Iron containing these elements is no longer malleable and hard to fuse, but brittle and easily melted. Instead of

TAPPING THE BLAST FURNACE

After the fire in a blast furnace is once started, it is kept going continuously, day and night, until the stack needs a new lining or until some other repair is needed, possibly three years later. In this picture we see the blast furnace being tapped. In a picture on a preceding page we saw how the iron ore, coke and limestone are fed into the fiery furnace from the top. The intense heat of the furnace melts the iron and it settles at the bottom. This molten iron is drawn off from time to time through an opening which is called an iron notch; it is shown at the right of this picture. The molten iron is guided through separate runners, or channels, into ladles. When the iron cools it is put through several other processes and then goes to the steel mill, where it is made into steel. The impurities in the iron have been cast off in the form of slag. (Slag is the scum which is thrown off from molten metal.) This slag, also in molten form, floats above the iron in the furnace because it is lighter than iron. The molten slag is drawn off every two or three hours from the furnace through the cinder notch, seen at the upper left in the picture; it is the higher of the two tapping holes. The slag is directed into a runner. It flows either into ladles (shown at the left of the picture) or else into a stream of water, which breaks it up in granular form—that is, in the form of grains. The slag obtained in tapping is not a waste product. Granulated slag is used to make cement. Slag taken to the dump to cool and "weather" may later be used to make ballast or roofing material.

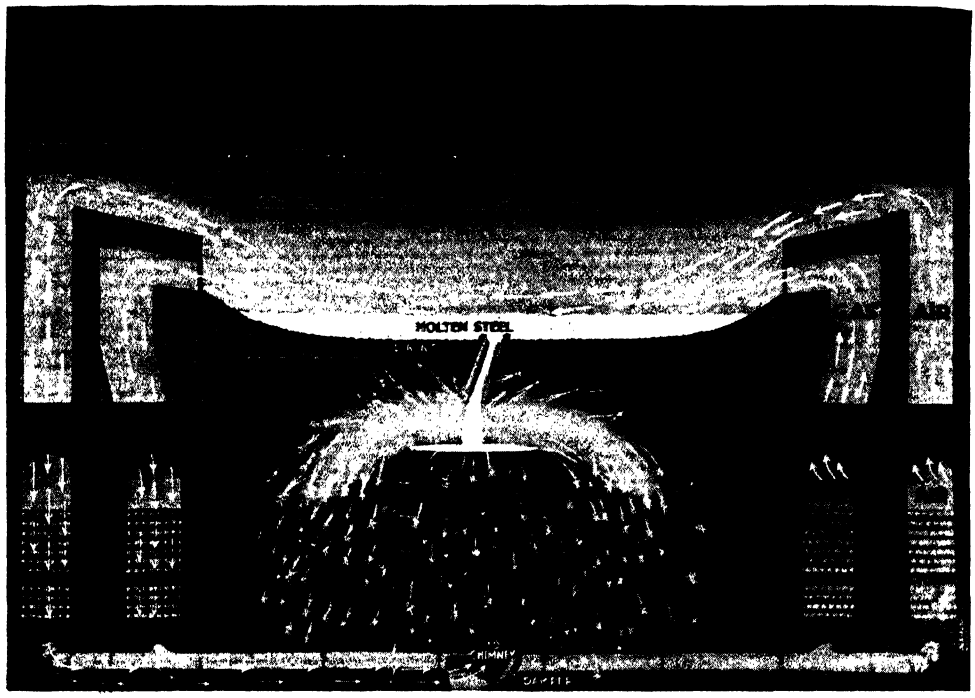


Diagram of an open hearth furnace. The charge at the top is the "bath." Burning gas pours over the top of the bath, burning away the impurities in the metal. The flow of gas and air is reversed from time to time.

being dug out from the furnace in the solid state, it ran out as a stream of hot metal into sand molds. It was called pig iron because molds were formed on each side of a central runner called the sow and the whole was thought to resemble a family of pigs.

In the early furnaces it was found that if limestone were added to the ore and fuel in the furnace, the impurities fused with the limestone in a mass called slag, which floats on top of the molten iron. This comes about because lime combines easily with silica, the chief impurity in ore.

Now the blast furnace receives a layer of coke, a layer of iron ore, a layer of limestone, then one of coke, one of iron ore, and one of limestone, and so on. The molten iron sinks to the bottom of the furnace and is tapped, or drawn off at intervals through an opening called the iron notch. The slag sinks down and floats on top of the iron. Slag is removed at intervals through an opening, called a cinder notch, above the iron tapping hole. Everything put in the furnace comes out either molten or as a gas. Once lighted a blast furnace remains in blast day and night for several years.

The blast furnace has now grown from the little rim of clay around the top of a pit to a stack about one hundred feet high and to a diameter of as much as twenty-six feet at the bottom or hearth. The blast furnace and the equipment that goes with it have become a very complicated apparatus. Until within the last few years the furnace was sometimes undependable. It might refuse to make iron or it might freeze. Sometimes a part would slip and scatter ore dust over the countryside. Now the engineers have learned to control the operation and such things very rarely happen. There was always a little sentiment about a blast furnace. Not so long ago they were named for women, often for the wives of the owners. The Eliza, Carrie, Lucy and Isabella furnaces have been well known in the industry. This practice is dying out.

The diagram shows the blast furnace and how it works. The men who operate it watch the temperature of the blast, watch the slag, watch the quality of the iron; in fact, they watch everything about the furnace.

Since the blast furnaces as they grew larger made an iron that was brittle, of course it could not be forged or welded. So a new problem was created. Some of the iron was cast into pots and other utensils, stoves, firebacks

MAKING ELECTRIC FURNACE STEEL

Certain types of high-grade alloy steel are made from steel scrap in electric furnaces, such as the one shown in this picture. The electric furnace holds up to a hundred tons of metal. Huge carbon electrodes, or terminals (shown at the top of the picture), are lowered to within a few inches of the charge of scrap and then the electric current is turned on. An electric arc leaps from one carbon electrode to the other, passing through the metallic charge below as that is the easiest path, with a deafening crackling sound, like that of the motors of a big plane warming up. The width of the air gap between the electrodes and the charge is automatically regulated; this is brought about by clever devices which raise or lower the electrodes as the resistance in the current varies. Intense heat is produced; it converts the steel scrap and certain alloying materials (such as chromium, nickel and molybdenum) into the finest steel. The metal is poured from the bath by tilting the furnace. In this picture forty tons of stainless steel are being poured. In certain cases the steel is poured from the ladle through a runner, or channel, which leads to the bottom of a mold, instead of being poured directly into the mold itself. The chief advantage of this method of pouring through a runner is that it insures a better surface in the finished steel. This is due to the fact that splashing against the side of the mold is avoided.

The Bessemer process. The big bowls containing the charge are called converters.

(the back walls of furnaces and fireplaces) and the little machinery used in those days. But a method of changing the brittle iron into a malleable form, for wider uses, was needed, and before long it was found.

In 1784 Henry Cort invented the puddling furnace for converting pig iron into wrought iron. This was a coal-heated process. Pig iron as it came from the blast furnace was put on the platform, or hearth, of another furnace. The firebox lay at one end, instead of underneath as in the blast furnace. As the fire grew hotter, the burning gases from the coal passed over the mass of pig iron on the hearth. A man called a puddler kept stirring the iron with a long bar. As he did so, it gradually became a hot, spongy mass, filled with liquid slag. The spongy mass was rolled into a ball, called a bloom, weighing from 150 to 200 pounds. Most of the slag, containing silicon, carbon and other unwanted elements was squeezed out of the bloom. The essentially pure iron that remained was rolled and worked as desired. This was called wrought iron. The puddling furnace has about gone, notwithstanding the good qualities of wrought iron that it made. It was forced out by the improved steel-making processes invented later. Wrought iron is produced only on a small scale at the present time. Nevertheless it was important in the period before steel became well established. Rails, bridges, locomotives, car axles, pipe and countless smaller articles were made of wrought iron in the nineteenth century.

Steel is a rather pure iron hardened by the absorption of carbon. After the native mentioned on page 3342 obtains his lump of iron from the small blast furnace, he heats it in a forge like a blacksmith's fire to soften it so that he can hammer it into tools. The iron

Both photos, courtesy, U. S. Steel Corporation

Here we see the important process of teeming—that is, pouring molten steel into an ingot mold. The man in the picture is filling a big spoon with molten steel in order to get a sample for testing purposes.

picks up carbon from the charcoal used for fuel and becomes steel of a fair quality. If he gets tired of blowing his forge and rests for a little while, the steel absorbs more carbon and becomes harder. These processes are the basis of all modern iron and steel making.

It was only a step from the simple process described above to the cementation process of making steel. Here bars of iron were packed in charcoal and allowed to stand for quite a long time at red heat. The iron absorbed carbon and became steel. It was called "blister" steel. The Damascus and Toledo blades, famous swords of the Crusaders' times, were made in this way. Their deservedly good reputation was due to the skill of the iron workers of those days.

In 1742, Robert Huntsman of Sheffield, England, melted the bars of blister steel, made by the cementation method, in small crucibles. By choosing his bars and by additions that were easy to make in a crucible, he was able to make a fine steel. The best steels in the world were made by the crucible process until early in this century when the electric furnace was developed. Table cutlery, tool steel for cutting wood and metals, knife blades, files, surgical instruments and the like were all made by the crucible method. Now, because the electric furnace can make just as good steel, and make it cheaper, the crucible process has almost disappeared.

In 1854 Henry Bessemer in England reasoned: "Steel is only cast iron with the impurities removed and a little carbon added. I will burn these impurities out of the molten iron with air." He did so and thus the greatest step in the history of the industry was taken.

The modern Bessemer converter is a sort of gigantic pear-shaped kettle with the small end, at the top, open. It is suspended on trunnions (pivots) about halfway up its height, and can be tipped. The bottom is detachable and fitted with tuyeres (air pipes) containing small holes. A blast of air is forced through the tuyeres and through the molten metal in the converter, or vessel. The oxygen of the air unites with the carbon in the iron and burns away the impurities.

HOW MOLTEN IRON IS CONVERTED INTO STEEL IN A MODERN BESSEMER CONVERTER

A Bessemer converter blowing is one of the most glorious sights in industry. The vessel is turned on its side, molten iron is poured into it from a ladle, and then the vessel is tipped upright again with the blast turned on. At first there is a great burst of flame and shooting sparks. Then red-brown fumes with dull red pointed flames appear, as manganese and silicon start to burn with the oxygen in the air. As the burning of silicon is completed the dull red flame changes to bright yellow tinged with green. Now carbon begins to burn with a long yellow-white flame. It is very spectacular. The flame shortens when most of the carbon is burned out. Watching the flame closely through special colored glasses, the blower turns down the vessel just at the right moment when the flame wavers and brown fumes of iron oxide appear.

The molten pig iron has been turned into steel. The lever man pours the steel into a waiting ladle. The whole blow lasts only twelve or fifteen minutes. Meantime another vessel has been receiving its charge of iron and as soon as the first is turned down the second one is turned up and another heat is blowing. Too much carbon has been removed, so after the "blow" a little carbon and other desired materials are added.

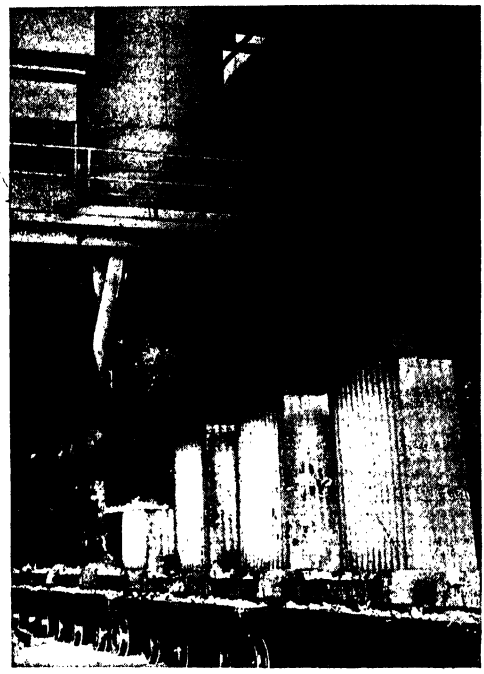
As you can see, this process is capable of producing thousands of tons of steel where the puddling furnace made only a few hundred pounds of iron and the crucibles even less of steel. Therefore, Bessemer steel came to be used extensively for rails at the time when railroads were being built all over the world, for steel ships that soon began to replace those of wood and a little later for steel cars, pipe lines and high buildings.

THE OPEN-HEARTH FURNACE HAS ALMOST CROWDED OUT THE BESSEMER PROCESS

The open-hearth furnace, though it was invented about the same time as the Bessemer process, was slower in coming into general use. When it did become established, however, it crowded out the Bessemer process until now Bessemer steel is used only for special purposes. The open-hearth heat takes eight to twelve hours to make, depending upon the size of the furnace, but it can be controlled more easily than the Bessemer and the steel is more suitable for many uses. The furnaces are shallow hearths covered with an arched roof with uptakes on each end and checker chambers for heating the air and sometimes the fuel under the charging floor. Hot burned gases pass through the checkers at one end of the furnace across the molten iron, for about fifteen minutes; then the valves are reversed and the heated checkers heat the incoming air.

The open-hearth charge is not only molten iron like the charge of the Bessemer converter, but steel and iron scrap as well. Scrap is metal that has been used and partly worn

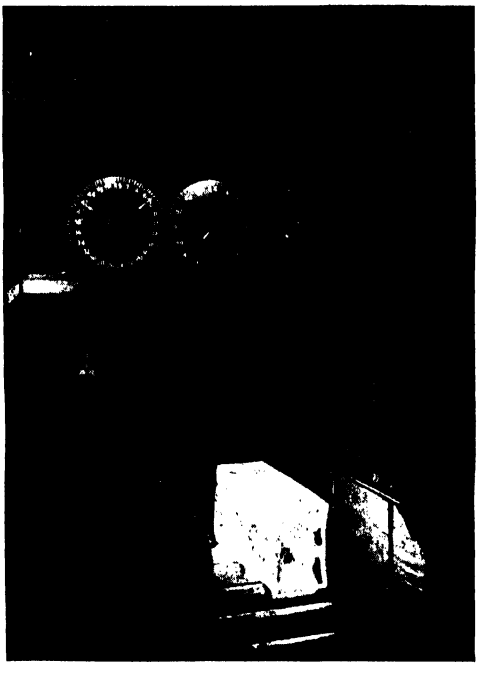
FROM INGOT TO SLAB OF STEEL



The ingot train. Here the molds are stripped from the ingots of steel.

Upper photos, courtesy, U. S. Steel Corporation

Before steel ingots are rolled, they are heated white hot in pit furnaces, called soaking pits.

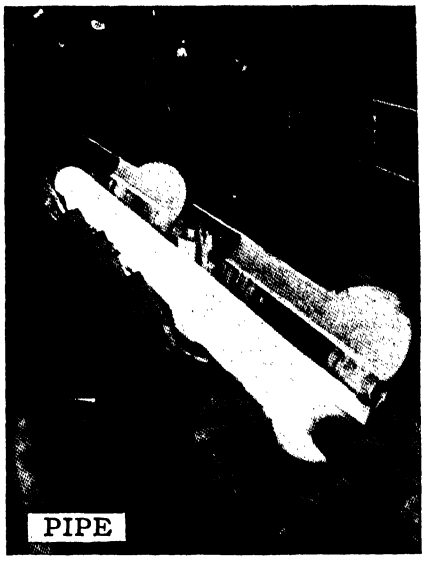


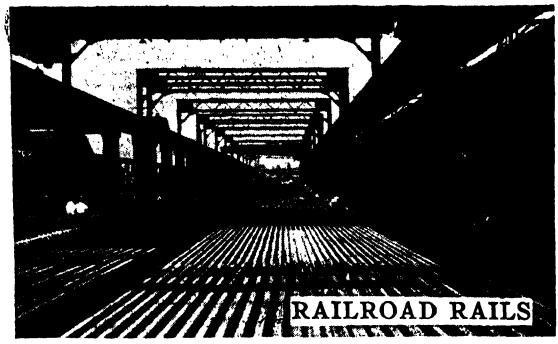
In the blooming mill steel ingots, like that shown above, are rolled into various shapes.

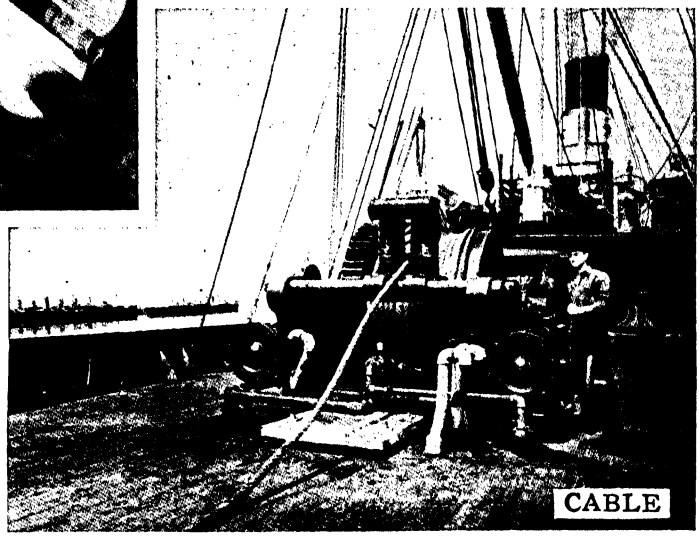
Lower photos, courtesy, Jones & Laughlin Steel Corp.

The chunky ingot shown in the picture to the left has now been rolled into a long slab of steel.

STEEL IN MANY SHAPES

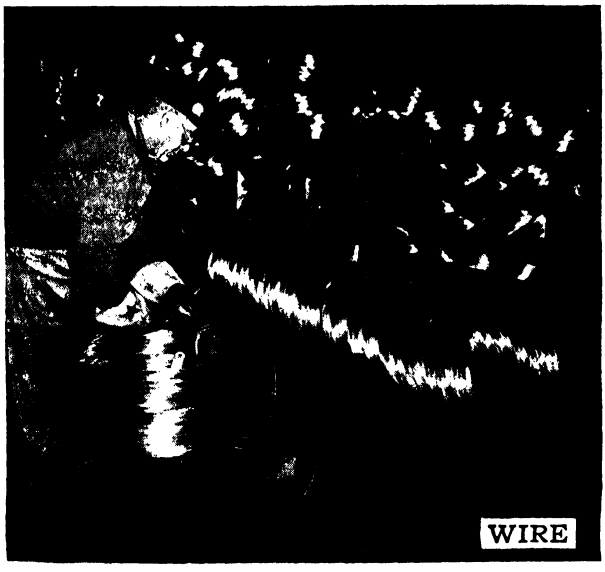

PIPE

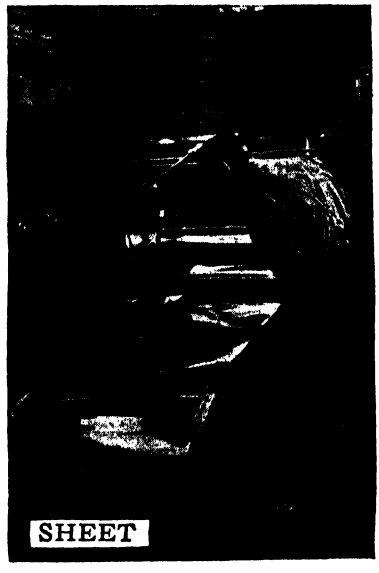

RAILROAD RAILS


CABLE

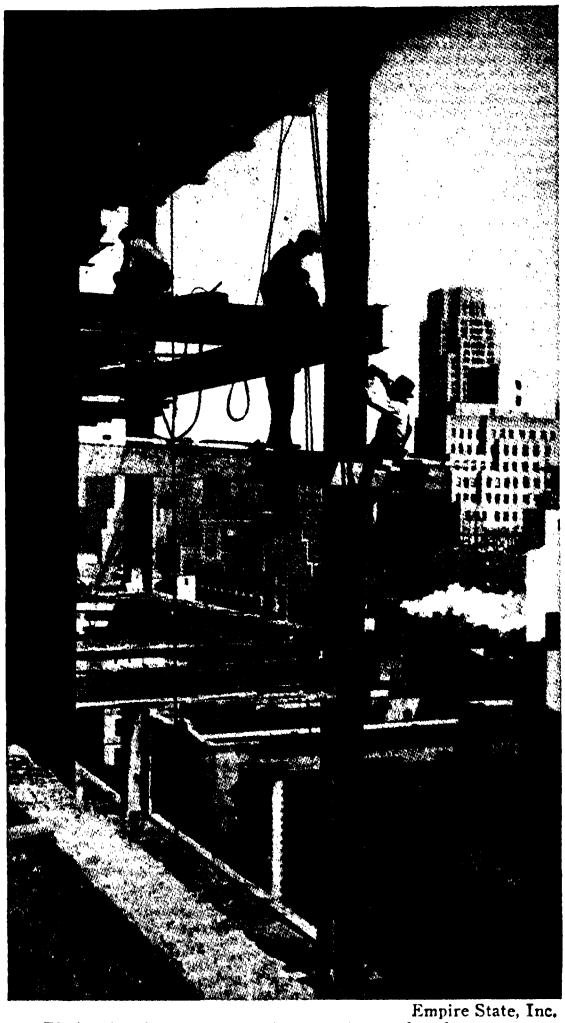
Center and lower left photos, courtesy, Jones & Laughlin Steel Corp.; other photos, courtesy, U. S. Steel Corp.

It has been said that steel is the "backbone of the nation"; for thousands of steel products are required to meet our present needs. Here we see a few of these products.


WIRE

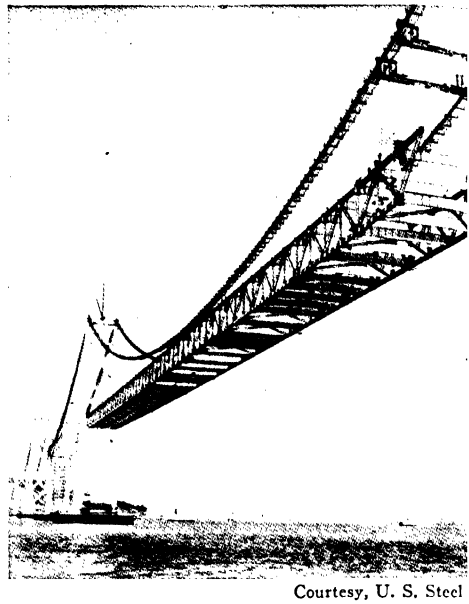

SHEET

STEEL IS USED IN MANY DIFFERENT WAYS



Empire State, Inc.

Fitting in place the steel girder skeleton of a skyscraper.



Courtesy, U. S. Steel

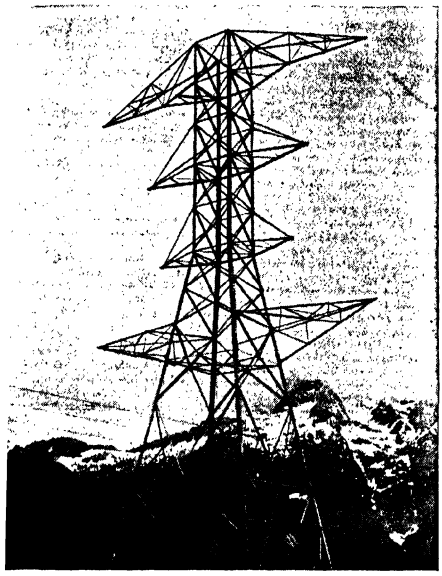
Building a steel suspension bridge.

A modern stream-lined train—one of the

out. Buildings with steel skeletons are sometimes torn down to make way for newer buildings, rails and cars are constantly wearing out and all kinds of machinery are being abandoned, either worn out or no longer suitable. These are among the sources of iron and steel scrap. The steel mills, too, make steel scrap. It comes from the leftovers when beams, plates and rails are cut to measure.

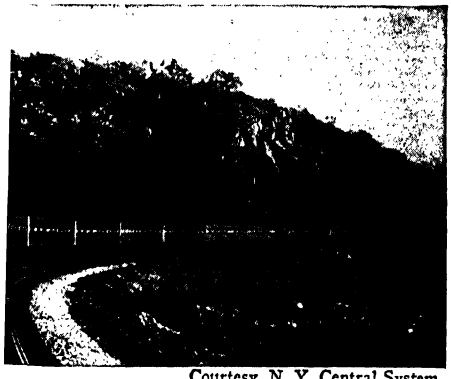
The open-hearth fuel is gas, tar or oil. It may be part of the gas which was made at the coke ovens, it may be natural gas which is best of all, or it may have to be made from coal. After it is made the molten steel is poured through the bottom of a ladle into ingot molds. It soon solidifies into an ingot shaped by the mold. The molds are stripped off and the ingots are hauled to the rolling mills to be made into steel products of a thousand uses. Steel for practically every purpose is made in the open-hearth furnace except the finer grades of tool steel and stainless steel.

The newest method of making steel is the electric-furnace process. Here heat is supplied by electric current. The Heroult furnace, which is the type most used, is a squat cylinder with a hearth for the steel and adjustable electrodes projecting through the roof. When the electrodes are lowered close to the iron in the bath, current is sent from one, down through the iron and back up again to



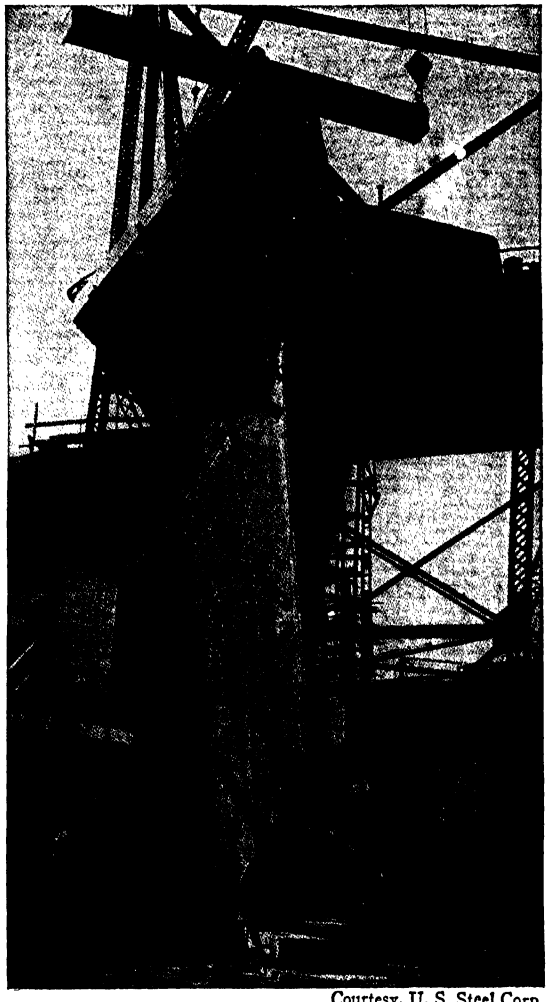
Courtesy, American Bridge Company

A transmission tower in the Far West.



Courtesy, N. Y. Central System

most useful and ornamental products of steel.



Courtesy, U. S. Steel Corp.

Setting in place the prefabricated bow of a ship.

the other electrode. As the current crosses the gap of air, from the electrode to the charge, and again on the return journey, sparks are emitted like those of an old-fashioned arc lamp. The higher grades of tool steel, cutlery and stainless and other special alloy steels are made in the electric furnace.

Steel castings are today one of the most important steel products. They are used for railroad cars, locomotives, steamships, heavy machinery and artillery. Cast steel has almost entirely replaced cast iron.

After the ingot is formed and stripped of its mold, it is almost always rolled. A very few are forged under a press into heavy armor plate and large shafts.

At the rolling mill all the ingots are reheated. Then they are rolled in a blooming or slabbing mill to blooms, billets or slabs. Slabs are flat and will be rolled again on plate mills into plates for cars, ships, welded pipe, tanks, barges, or boilers, or on strip mills for tin plate for tin cans, sheets for refrigerators, stoves, automobiles and railroad passenger cars. Blooms are rolled into shapes for buildings, car frames, bridges, ships, steel piling and machinery. Billets are rolled into rods for drawing into wire, bars and small shapes, hoops, bands and other things.

Article prepared with the assistance of John G. Mapes, of the American Iron and Steel Institute.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 3545.

Why Does Iron Feel Colder than Wood?

OUR feeling that anything is hot or cold does not depend wholly upon how hot or cold the thing really is. The marble top of a table and the table itself are both of the same temperature, but the marble feels much colder than the wood. All the parts of a hammer are of the same temperature, yet the iron head feels much colder than the wooden handle. In all these cases the thing we feel is colder than our skin, as a rule, and so heat will flow from our skin into it. Our feeling depends on the rate at which the object takes heat from our fingers. Marble and iron take heat from our fingers quickly; they make our fingers cold, and so we say that these substances are cold, meaning really that they make us cold. But wood does not take heat away nearly so quickly from anything warmer than itself, and so we say it is not so cold. We ought to say that marble and iron are good conductors of heat and that wood is a bad conductor.

WHY DOES IRON FLOAT ON MERCURY AND NOT ON WATER?

All questions of floating and swimming and flying depend on the comparative differences between various things in relation to gravitation. Iron is heavier than water, or, as we say, its specific gravity is greater than that of water. Iron must therefore sink in water. Mercury is heavier than water and therefore mercury must sink in water. But mercury is heavier than iron, and it must therefore sink in iron, which is just another way of saying that the iron must float on the mercury.

WHY DOES IRON BEND WHEN IT IS HOT?

We all know that some things will rather break than bend; others will bend and then come back again to their old shape; yet others after bending will stay in the new shape. Various names are given to these different properties of matter. A general rule that applies almost always is that the colder a thing is, the more rigid it is. This applies to the three great states of matter, solid, liquid and gaseous; for it is only in the coldest of these—which is the solid state—that things can have any rigidity at all, and, as a rule, the colder a solid thing is, the more rigid it becomes. We believe that when a thing is made hot, the molecules of it are thrown into a state of greater motion, and we know that they are farther apart, for the thing expands. But if the molecules are farther apart, and if they are moving about more violently, they can not be holding on to each other so tightly as before, and so the thing that, when it was cold, could not be bent, can now be bent.

WHY IS IRON ROOFING SOMETIMES CORRUGATED?

If you suspend a strip of cardboard between two books, it will sag or even buckle when you place a paperweight in the middle. Now fold the cardboard several times lengthwise in "accordion pleats" and you will find that it remains firm even when weighted. Sheets of iron are often corrugated to give them this additional firmness, and also because they may then be handled more easily.

IS IRON HEAVIER WHEN IT RUSTS?

When we know what happens when iron rusts, we have the answer to this question. What happens is that the outside of the iron

which is exposed to the air is oxidized—that is, a certain amount of the oxygen of the air combines with the iron. This oxygen, like everything else, has weight, and its weight must be added to the weight of the iron itself in the combination. Therefore, the answer to the question must be: yes, the iron increases in weight by the weight of the oxygen which it has added to itself.

But the rust, or oxide of iron, is friable, a word from Latin that means "crumble-able." The rust will crumble away under the influence of water or wind or anything else rubbing against the iron, and so the iron thing will lose not only the oxygen that it has taken into itself, but also the part of the iron which has combined with the oxygen. So an iron object, when it rusts, finally loses weight. If an iron or steel bridge were allowed to crumble away in this fashion, it would gradually weaken and finally break. Such a bridge must be kept painted, then the oxygen in the air can not reach the iron and combine with it.

WHAT IS A TENANT?

Many persons do not own a house or property but live on property belonging to another, paying rent for the privilege. Such a person is known as a tenant, or one who holds the property (from the Latin word, *tenere,* meaning to hold), while the one who owns the land is called the landlord (lord of the land). The system is very old, as we learn from history.

In country districts, many farmers who have more land than they can cultivate often rent part of it to one or more tenants, who generally live in houses built for them upon the land. Rent may be paid in money, but very often the rent of the land is a share of the crop produced by the labor of the tenant. There are many forms of tenancy in the world today. Very often the length of time the property is to be held and the rent to be paid are set forth in a contract signed by both landlord and tenant. This is called a lease.

WHAT DO WE MEAN BY CONTRABAND?

Contraband originally meant simply against the law, but has come to describe chiefly those goods that a warring nation will prevent from reaching its opponents, even if the goods are carried by a neutral vessel. Arms have always been contraband, and may be seized, and sometimes the vessel carrying them is seized or sunk. Articles are classed as (1) contraband, that is, goods useful in war; (2) conditional contraband, that is, goods that might be useful in war; (3) non-contraband. In modern warfare dozens of articles are useful for which there was no military use a century ago.

There is no fixed list accepted by all nations. In recent wars gasoline, rubber, copper, steel, lead, chemicals, coal, and even food, have been declared contraband. A nation attacking another is likely to declare as many articles contraband of war as it can without making dangerous enemies of those neutral nations that attempt to trade with the opposing power.

WHAT IS THE ORIGIN OF THE WORD ASSASSIN?

In the eleventh century a powerful Mohammedan chief Hassan ben Sabbah fled for reasons of state from Cairo to the mountains of Persia where he gathered about him a band of fierce warriors. He founded a Mohammedan order that had as one of its tenets the secret murder of all enemies. Hassan placed himself at the head of the order, with the title Sheik-al-Jebal, or Old Man of the Mountains. The youths chosen to execute the murders were first stupefied by smoking or chewing hashish, dried hemp flowers. They came to be known as *hashaskin* or hashish-eaters, and Europeans mistakenly called them assassins. The order lasted for almost two hundred years from 1090 to 1272, when it was finally put down.

WHAT ARE PUBLIC UTILITIES?

In the department of Familiar Things we read about wonderful inventions and discoveries that gave us many things we use every day—telephone, telegraph, radio, electric light and power, water and gas and transportation. Because these common services are so important to our modern life, the companies that supply them can operate only by special authority from the government. They are called public utilities.

An ordinary business may refuse to deal with certain persons for reasons of its own, but a public utility must serve one and all; it must treat everyone equally, both in its rates and its quality of service. To make sure of this, public utilities are generally under government control. Sometimes a public utility is owned by the state.

Many public utilities must send their services through public property—gas mains are carried underground, railway tracks on the

surface and telephone and telegraph wires overhead—and so they are required to obtain rights, or franchise, for the use of the property. Franchises are given for a period of years. When railroads first came into being the public was so pleased that franchises were granted for unusually long terms, even up to 999 years.

WHY DOES HEAT MAKE PAPER CURL UP?

There is a certain amount of water in ordinary paper. If we heat a piece of paper, the water is changed into a gas, which passes off into the air. Spaces in the paper that were filled with water before are now filled up with air, which is very much lighter. If there are any forces in the paper tending to make it curl up, they are now more free to act, for they do not have to lift the weight of water that was previously in the paper.

Also, we must remember that paper, like almost everything else, shrinks when it is cooled and expands when it is heated. If the change in temperature occurs at exactly the same rate in every part of a thing, then, as its size alters, its shape will not alter; but if one side of a thing gets hot or cold at a slightly different rate from the other side of it, its shape will change, and if it is thin and flat, we shall notice the change by finding that it curls.

WHY DO WE PUT A SPOON IN A GLASS BEFORE POURING IN HOT WATER?

When hot water is poured into a glass, breakage sometimes occurs because the glass expands too quickly and unevenly, particularly at spots near the bottom where internal tension often exists. A spoon in the glass sprays the hot water against the sides, which become heated before the water reaches the bottom. This tends to equalize the expansion of the sides and bottom. The water is also cooled slightly by this contact with the sides and by the heat absorbed by the spoon.

WHAT LANGUAGE WAS USUALLY SPOKEN BY JESUS CHRIST?

There is a great group of languages that are all classed as Semitic. Among these languages are some that are named after the old word for Syria, the word Aram. It was one of these Aramaic languages that was spoken by Jesus, for before His time Aramaic had become the language spoken in Palestine. We can learn a lesson here. The Aramaic language itself is not a beautiful one to hear. The words are not beautiful so far as their mere sound is concerned. Nor is this what would be called a highly developed language. It is far from being so. The language that Jesus spoke was humble, and so in keeping with everything else that we know about His life. Yet in this humble language, with its rather ugly sound, Jesus said the noblest and most beautiful things that have ever been uttered on earth.

WHERE SHOULD WE LOOK FOR THE EARS OF A FROG?

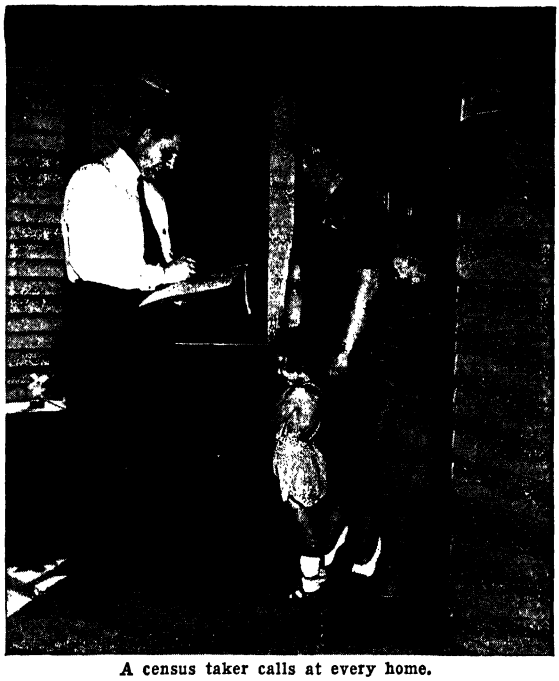
What we generally call ears are merely outside flaps of skin which, when they are large, serve the purpose of collecting the sounds in the air around. The real hearing is all done inside the skull. In the case of frogs, as in the case of birds and lizards, there is a hole some distance behind each eye. Inside this hole is an inner ear. There is a middle ear, too, for the purpose of conducting the sound to a special nerve, which takes it to the brain, where the real hearing is done. But the frog has no ear that we can see.

WHAT WAS THE ORIGIN OF TRIUMPHAL ARCHES?

It has been thought that the first idea of the arch came from the vault formed by the branches of two trees meeting. The origin of a triumphal arch standing by itself must have been an imitation of arches temporarily erected for the ceremonial triumphs with which the Romans celebrated their victories. All that could recall the glory of recent war, trophies, pictures of battles, and, above all, inscriptions to the honored conqueror, had a place in the decorations. But as the empire grew, the victories were so often renewed that the Romans built strong arches to serve for all triumphs, and this idea has been handed down to us. Many triumphal arches are found in Italy; France has several Roman arches in Provence. The Paris arch was built to Napoleon's glory. The Marble Arch in London and the Washington Arch in New York are based on Roman models.

The victorious military leaders of ancient Rome tried to outdo one another with the impressiveness of the triumphal processions that they led through these victory arches. One feature of such a parade was to include as many important prisoners of war as possible. Even kings and queens were made to march in their captors' procession. Cleopatra killed herself rather than be a part of Augustus Caesar's triumph.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3473.



A census taker calls at every home.

THE CENSUS OF THE UNITED STATES

ROLLCALL OF A NATION

ONCE in ten years, in the years ending with 0, a census is taken in the United States. The last census of the population was in 1940. In fact, there are very few countries, except China and some parts of Africa, that do not take a census of population at about ten-year intervals. In time of war, or in case of some other extended emergency, the ten-year census is usually postponed or omitted.

The word census comes from the Latin, meaning a numbering. However, the old Roman census was not a count of the whole population, but a register of male citizens and their property on which to base taxes and military service. The modern census has no such meaning. It is intended to draw a picture of the country in which it is taken. The United States 1940 census is more complete than any previous census. (Its official title is the Sixteenth Census of the United States: 1940.)

It found out how many people there are in the United States, in its possessions, in each state, county, city and town. By comparing this census with previous ones, we can tell how fast the population is increasing; also what communities are growing and which ones are losing some of their people.

The 1940 census gives us the population figures of the country. But it tells us much more. To give you some idea of the ground that was covered, let us point out that census-takers had to find out the following facts about every inhabitant of the United States: age, sex, color, address, marital condition (whether single, married, divorced or widowed), nationality of parents, place of birth, education, employment, amount of salary or wages and also something about source of income from investments. And all this represented only a part of the information that was made available.

This information was obtained in the most direct way possible. Every house in the United States and its possessions was visited by a census-taker and questions were asked about every person living in that place. It was important not to pass by any home and also not to have more than one census-taker interview the same family. The country, therefore, was divided into about 140,000 districts, and a large map was made of each; 140,000 census-takers were trained and equipped for the work and each was given his own district. The final report of each census-taker completely covered the district as shown by the map.

The count showed that there were 131,669,275 people in the United States. For each and every one of all those millions of persons, there is a card in the files of the Bureau of the Census, in Washington. The facts that are on the cards are not written down in

On machines like this cards are punched with holes in carefully marked places. Each hole tells a fact. There is a card for every man, woman and child in the country on file in the Census Bureau.

words, but are noted by means of holes punched in various places on the cards. The young lady in the picture is punching a card. Propped in front of her is a pile of reports, with the answers to the questions written on them. Each person is given a number. A small card, one of those on the table, is numbered to correspond, inserted in the punching machine that you see, and the holes punched according to a code. If the person is male, a hole will be punched in a certain place on the card; if he is white, a hole will go in another place. When the card has been punched, anyone who knows the code can "read" the facts from the holes even more quickly than by reading the written report-sheet. There is a wonderful electric machine that can "read" and sort the cards, too, and do it very fast; and another machine, called an electric tabulator, which adds up the figures and prints the final calculation.

The tabulator is one of the wonders of modern life. It is used in many government offices, and in banks, great stores, factories and other places all over the world where figuring is done on a very large scale. It can add, subtract and divide, by means of punched cards. The system of electrical tabulation by punched cards was originated in the United States Bureau of the Census and first used in tabulating the results of the 1890 Census. The machine used then was invented by Herman Hollerith, an employee in the Census Bureau. Many improvements have been made in the course of the years, and the machines which were used to tabulate the 1940 Census are almost incredibly efficient. One tabulator can add forty-five long columns all at the same time, and print the results, and do it in a small fraction of the time that it would take a human bookkeeper to do it, even though the bookkeeper had the aid of an adding machine. For example, if you wanted to find out how many males and how many females there are in a population of 130,000,000, one punch-card machine could separate the two sexes for you in 678 eight-hour days, or a little more than two years. One clerk would take about 6,700 days, or almost nineteen years. If you wanted to get the information quickly, you could have it in shortly over a month by using twenty-two machines; or 223 hand workers. The machine is more accurate than the hand worker,

and not only is it more accurate but it is about ten times as fast.

The results of the 1940 population census, together with figures from other censuses of 1939 and 1940, were classified and edited by an office force of about 10,000 persons and published in about 150 big volumes and something like 300 pamphlets.

The 1940 census has tables showing the area and population of the United States from 1790, the year of the first census, to the present, giving land and water area, total population, increase in population and density (population divided by area). In 1790 there were four and a half persons per square mile. Today there are about fifty.

The census tells us how many people to a square mile there are in each state. In 1940, for instance, there were more than 10,870 persons per square mile in the District of Columbia and only one person to a square mile in the sparsely settled state of Nevada.

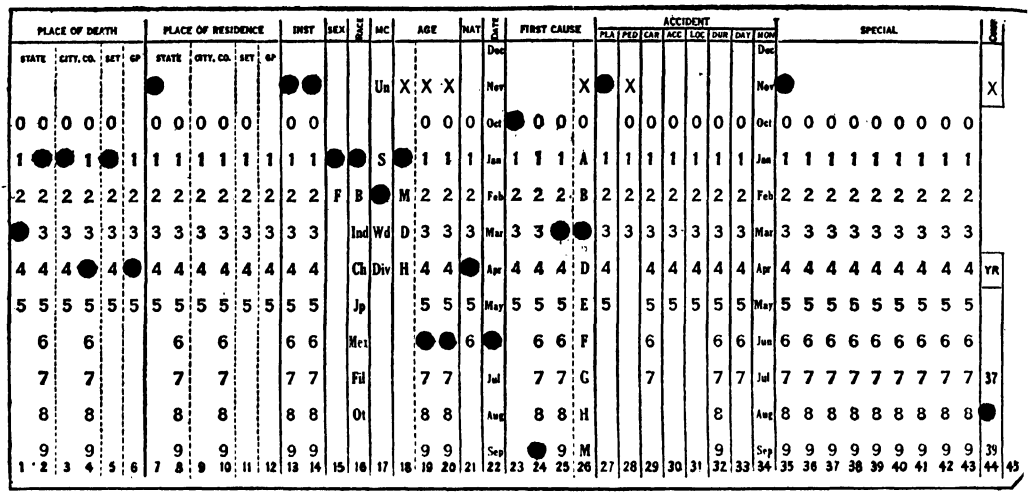
There are tables showing us how many people live in large cities, in small cities, in towns and in rural (country) places. The Indian population and the area of Indian reservations are also given. Since 1790 the population has been becoming steadily more "citified." In recent years much has been done to make farm life more enjoyable and profitable. Future censuses may show a change in the rate of movement from country to town in the United States.

The rate of population growth in the United States, as shown by the census of 1940, is less than half that of any previous ten-year period. If this rate continues to decline (grow less), Americans may be faced with a decreasing population by 1975. Immigration from foreign lands is no longer large; formerly it helped to increase the population.

The United States birth rate, according to the census of 1940, continues to decline.

All pictures courtesy U. S. Census Bureau

The young lady in the foreground has a pile of punched cards in front of her, which she is feeding into the tabulator. This is a machine not much bigger than a typewriter and easy to move around.



Here is a card, punched for the tabulator, or counting machine. Every hole tells a fact about the person, place of residence, sex, age, race and so on. In order to read the card you would have to know the "key."

There is a constant increase in the average age of the population; there are comparatively fewer young people and more older people.

The census tells us where our foreign-born people come from and what languages they speak. It divides the population into age groups and income groups. It tells us how many people can not read or write, and it shows us where most of them live. It shows the size of families; the number of homes owned and homes rented, in the country and in town; the number of people who work and the sort of work they do.

The section on vital statistics gives figures relating to deaths and births by sex and age and also by states. The most common causes of death are shown.

The number of patients in certain hospitals and other public institutions is given. A report is given on immigration and emigration, on the countries involved and the quota of immigrants from each country. The number of men and women from foreign countries who were made naturalized citizens of the United States is shown.

There are many pages of figures on education, covering schools and colleges, vocational education, schools for the blind and for the deaf and so on.

There is information on the occupation, industry and employment of every worker. Separate censuses of manufactures and businesses show the state of both industry and business in the United States.

Every five years a survey of agriculture is made. The census of agriculture provides a great deal of valuable information about farms, crops, livestock, types of farming carried on, machinery, farm labor and farm income. An irrigation census tells us the area of the land that is benefited by irrigation projects of various kinds. A census of farm-drainage projects has been taken in the thirty-five states where such enterprises are particularly important. Mining and quarry facts collected during the 1940 census year makes our knowledge of this industry more exact.

The millions of facts, like those we have mentioned above, that we find in the census of the United States are put to work in a good many different ways. Government agencies of many different kinds are able to carry out welfare work, control programs and social-security programs more effectively when such facts are known.

Business men use census figures in planning manufacturing and sales efforts. Buyers of advertising space in newspapers and magazines use census figures. Educational agencies will know where to work harder to raise the standards of education. Those who write books on geography and history and those who draw maps need to know the census facts. For you and me a census is a fine thing. It helps us to know our own country and to understand the ways in which it has grown. Through the census we get a clearer picture of the past, and perhaps even a glimpse of the future.

Article prepared with the assistance of Dr. Vergil D. Reed, Assistant Director of U. S. Census.

The Greeks were assembled at Aulis, ready to sail for Troy. But no favoring wind came.

THE SACRIFICE of IPHIGENIA

THE Greeks had gathered at Aulis. Now they were ready to embark for Troy, but no favoring wind came to swell their sails which, as the days passed, hung limp and motionless against the tall masts of the fleet. In order to learn how they might obtain favor with the gods they consulted Calchas the soothsayer, and Calchas told them that no favoring wind would blow until a supreme sacrifice should be made; that Iphigenia, fair daughter of Agamemnon, must be slain upon the altar to appease the immortal gods.

King Agamemnon was as one distraught, so fierce in his heart was the conflict between his honor as a warrior and his love for his child. At last, urged by his companions, he sent for Iphigenia, pretending that before his departure he would give her in marriage to Achilles, whose virtues and merits he highly extolled. Iphigenia was secretly pleased to be the chosen bride of so great a warrior, and regal preparations for the marriage were speedily made.

But the decision by no means ended the struggle in the mind of the wretched king. As days passed his gloom deepened, until one night at midnight he sat down in his tent at Aulis and, with head bowed in sorrow over the tablet in his lap, wrote to his queen words blotted with hot tears. When at last he fastened it with his seal, he called to his aged attendant and said: "Old man, thou knowest how Calchas bade me offer my daughter Iphigenia that the fleet might have a prosperous voyage to Troy; how, when I heard the words, I bade the herald go throughout the army and bid them depart every man to his own country, for I would not do this thing; how my comrades, even my brother Menelaus, persuaded me until I consented; how then I wrote a letter to my queen that she should send our daughter to this place to be married to King Achilles. Now I have changed my mind, and write, 'Send not the child to this land, for I will give her in marriage at another time.' So hasten. Sit down in the wood which overlooks the road, and suffer not thine eyes to sleep. Beware lest the chariot with my queen and daughter pass, and see well to it that thou keep this seal unbroken."

Scarcely had the old man left the tent when Menelaus, suspecting what the king might do, laid violent hands on the servant, wrested the letter from him and broke the seal.

"Help! my lord!" cried the old man. "Here is one who hath taken the letter and broken the seal!"

As the king, greatly alarmed by the old man's cries, rushed from his tent he was

halted by a messenger, who said with due courtesy: "Greetings, great King, I am come at thy command, bringing thy fair daughter with thy queen Clytemnestra; with them is thy little son Orestes. They pause by the spring to rest the horses after the long journey. All the army is gathered around them asking many questions as to why they have come; one altogether comely seems already quite enamored of thy fair daughter, and the queen is impatient for thy faithful embrace. The child Orestes clings to his sister's hand and begs to be taken to his father. Make haste to join them lest some ill betide, for I would prove myself thy faithful steward over so great a keeping. I fear lest one steal the heart, another the jewels, and yet another the wedding finery with which the escorts are laden, while I come to tell thee."

Now the king was tormented almost to madness. What should he say to the trusting queen, bringing at his command his daugther whose husband was to be Death? Clytemnestra must return to the maidens left at home. To Iphigenia he would say that she must deck herself in bridal robes and jewels. What could he say to little Orestes, who would cry with anguish if his sister ceased to lead him by the hand?

THE ROYAL CHARIOT DREW UP AND THE QUEEN AND THE MAIDEN ALIGHTED

While Agamemnon was still in torment with such thoughts the royal chariot drew up before the tent; attendants helped the queen and the maiden to alight. Tenderly wife and daughter greeted the king, after which the queen busied herself giving orders to her servants; to one she committed the care of the boy Orestes, to others the unloading and safekeeping of the caskets she had brought for her daughter's marriage.

But Iphigenia, seeing the troubled countenance of her father, began to ask him many questions. "Art thou not glad to see me, my father? Why art thou so sad?"

"He that commands an army has many cares."

"Perish these wars and all thy troubles! But, my father, if thou art truly glad to see me, as thou sayest, why dost thou weep?"

"I weep because thou hast a journey to make, far from me."

"And must I make it alone or with my mother?"

"Alone, my child, for none may go with thee."

"Must I go to dwell elsewhere?"

"Hold thy peace, child."

"I go, dear father, on whatever journey I am bid. Only order the army, win all battles, and come back, as ever—victorious."

"But I must first make sacrifice to the gods."

"That is well, for due honor must be paid the immortal gods. Shall I lead in the dances, my father?"

"O my child, how I envy thy sweet innocence! And now go into the tent. But first kiss me, for we shall long be parted." When she was gone, he cried aloud: "O city of Priam, what woes thou bringest!"

THE QUEEN'S MIND WAS OCCUPIED WITH THOUGHTS OF HER DAUGHTER'S MARRIAGE

Then the queen came to him, not noticing his distress, so occupied was her mind with the marriage of her daughter. With many questions she tormented him; about the estate of the bridegroom, his lineage, and where he dwelt; the time and place of the marriage, and what part was it the king's pleasure that she should take? Should she not hold the torch for the bride? To which the imperious king replied that she must return at once to the maidens left at home, for he himself would attend to everything needful here. Nor could all the murmurings of the queen avail, for the king said sternly: "Be persuaded, lady. Both that which is within and that which is without the house do I order."

Thus dismissing her, he set about arranging her departure. Scarcely was he gone from his tent on this errand when there came a herald announcing Achilles with a message from the army for the king, which message was that the men were wearied with waiting, and unless they might speedily sail, would return each man to his own land.

As soon as the queen heard his name, she advanced to Achilles, and making it known to him who she was, greeted him as her daughter's bridegroom. And when the young man seemed much abashed, the more amazed did he look when she said to him: "I know that men are often abashed with strangers when the talk is of their marriage."

"What sayest thou, lady? I can not speak for wonder at thy words," replied the young man. "I was never suitor for thy daughter."

Then the queen herself was beyond measure astonished, and cried in wrath: "Is it not shameful that I, a queen, bring my daughter to an unwilling bridegroom?"

And as Achilles would depart to make questionings as to what it all meant, there came the old man who had carried the letter

THEN THE WIND CAME OVER THE SEA

and bade him stay; and when he had been assured that no harm should befall him for telling, he told the whole truth.

Then was the queen overcome with grief and horror. "Alas, what treachery is this! O Achilles, son of Thetis, help me now in this extremity, for wrong has been done under thy name. It is thy name that has undone us, both me and my child. Suffer her not to die for the wrongs which are not hers nor yet mine. Would there were an altar to which I might flee, or any friend but thee in the whole army."

"Lady, since thy daughter has been given me in word, my sword shall soon see whether any man take her from me!"

Even as he spoke these words to the anguished queen, King Agamemnon returned to say that all was ready for the departure of the queen.

"Tell me," she cried, "wouldst thou slay our daughter? Have I not long been a loving and faithful wife to thee, and is this my recompense that thou slay my innocent child, having caused me with false promises to bring her here?"

The king was bowed in silence, not knowing what to say. Nor did the queen cease her reproaches, which continued with such piteous cries as caused her daughter to hear. Running from the tent with the child Orestes, Iphigenia cast herself on her knees before her father, saying: "O my father, slay me not! I am thy child. I was the first to call thee 'father' and the first to whom thou didst say 'my child.' And thou wouldst say to me: 'Some day I see thee a happy wife like thy mother in the home of a noble husband.' And I would answer: 'For all thy benefits I shall reward thee, for when thou art old and perhaps broken, I shall receive thee and care for thee with the tenderest love.' All this I remember, though thou forgettest. Listen, I pray thee, to the entreaties of my mother and to the cries of Orestes my brother. Though he be but a babe too young for words, yet weeping, he implores thy mercy. For their sake, if not for mine own, have pity and slay me not."

While still the distracted king stood bowed in doubt, Achilles came running from the camp to say there was terrible tumult among the men, who were crying out that the maiden must be sacrificed without delay, and that when he would have stayed them from their purpose, they had answered him with stones, so that he had barely escaped with his life. Nevertheless he would fight for the maiden, and trusted there might be faithful men and true who would stand by him and help him to save her life.

When the maiden heard his words, she stood forth and said: "Hearken, my mother, be not angry with my father. It is idle to fight against Fate. This young man must not suffer, for his help will avail nought, and he will only perish. All Greece looks to me. Without me the ships can not make their voyage, nor the city of Troy be taken. Wherefore I give myself a willing offering for the people. Let the Greeks take the city of Troy and it shall be my memorial."

Nor could the maiden be turned from her resolve, though they besought her with tears and entreaties. So they that were appointed led her to the grove of Artemis, where an altar had been erected. The whole army of Greece gathered around, and Iphigenia spoke gently to them.

"I pray the gods that ye prosper," said the maiden. "Win victory in this war, and come back in safety to your homes. To this end with good heart do I offer my neck to the sword." The king covered his face with his mantle. All the host marveled at her good courage. The herald commanded silence, and the soothsayer put a garland upon her head and drew the sharp knife from his sheath.

Then there befell a marvelous thing. Calchas struck with his knife, and the sound of the stroke was plainly heard by all. But the maiden was not there. In her stead lay a great hind, and the altar was red with the blood of the animal.

> For Artemis was merciful, and caught
> The victim away in darkness, and the Greeks
> Slaughtered a hind, esteeming it the maid.
> But she was rapt to Tauris, there became
> The priestess of the sanctuary. . . .

Then the wind came over the sea, and the sails were filled, and the Grecian host was carried to Troy, as the soothsayer had prophesied.

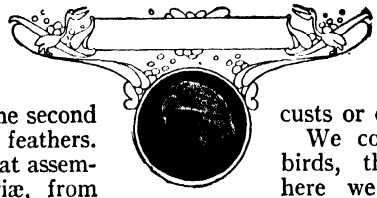
When the little boy Orestes grew up he went in search of his dear sister and came at length to Tauris. To this city Iphigenia had been carried by Artemis to serve as a priestess in the temple. It was her duty to sacrifice all strangers to the goddess, and she was about to perform this gruesome task when she recognized Orestes. Then, indeed, were they joyful. They fled the city, taking the image of Artemis with them.

The story of Iphigenia has been told with slight variations by many writers, in particular Euripides and Aeschylus, who were two of the greatest dramatists of all time.

THE NEXT STORY OF GOLDEN DEEDS IS ON PAGE 3465.

A Swift on its nest.

PECKERS, HUMMING-BIRDS AND HORNBILLS



WE took leave of the perching birds proper on page 3288, and here we make our bow to the second Order in the world of feathers. We have come to a great assembly named the Picariæ, from *picus*, the Latin word for "woodpecker." We shall talk of many birds besides the true woodpeckers in this chapter, but we shall see in all the present group certain characteristics of which the woodpeckers are the type. Nearly all the birds in the present group build their nests in holes in trees or banks, and their eggs are a plain or creamy white.

We begin with the Jacamars, a South American family, though we must confess that little is known of their habits of nesting and bringing up their young. But travelers are familiar with the shiny Green Jacamar with his bluish crown. The brilliant Red-tailed Jacamars sit quietly till a flying insect heaves in sight. Then they launch themselves with the suddenness of a coiled spring uncoiling. The Great Jacamar shows ten and a half inches of lustrous green, chestnut and white.

Next to them rank the Puffbirds which sit quietly for hours with feathers spread. They look somewhat like dull kingfishers, but are very different in habit. Some have been seen to nest in the hollow of a living bamboo and to have their crops full of noxious locusts or other injurious insects.

We come now to the type birds, the woodpeckers, and here we may utter a little whoop of triumph. Woodpeckers peck. They creep about trees, and hit the trunks resounding whacks with their hard, tough bills; and where they have been at work we may find little heaps of chips, and holes in trunks where no hole was visible before.

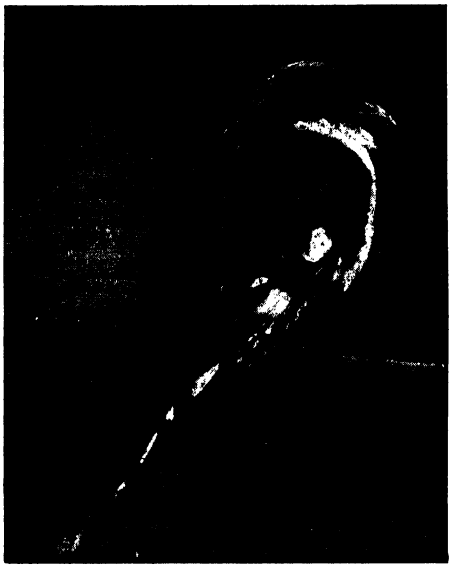
Now, any sort of offense, imaginary or real, suffices to place a bird under sentence of death. Farmers pronounce sentence of outlawry against the woodpeckers, great and lesser. The charge for which the poor birds were indicted was that they tore open the trunks of fine trees, and even ripped open telegraph posts, in order to make nests. A charge has only to be repeated often enough to be believed, and so this one was. We grew to believe the woodpeckers pests of our woodlands and to proscribe them as little villains. But wise heads doubted, and expert watchers were set to work to learn what the woodpecker meant by his activities.

The result was a vindication of the birds. It is true that they did dig open trees; they did at times assail the

QUAINT AND LOVELY BIRDS OF MANY LANDS

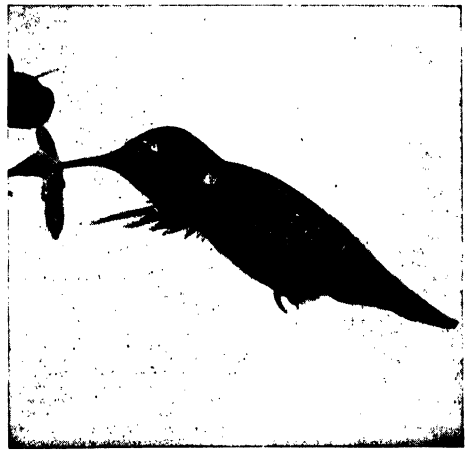
The elate hornbill.

The toucan.



The Cuban trogon.

The motmot.

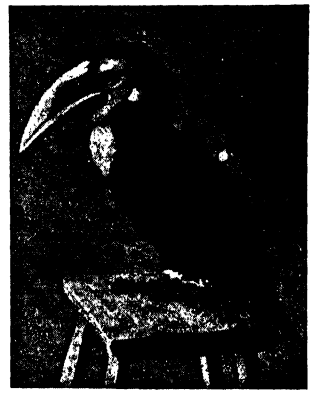


The humming-birds of the tropical world.

A FLOCK OF BIRDS WITH CURIOUS BEAKS

The black hornbill.

The Nepalese hornbill.



The rhinoceros hornbill.

The sacred kingfisher.

The frogmouth.

The laughing kingfisher.

The Abyssinian ground hornbill.

telegraph poles. But in every case it was to search for insects secreted within; in every case the wood attacked by the birds had previously been attacked by disease or fungus. Rot had come with the entry of the insects on which the birds feed, and it was for these insects alone that the woodpeckers pecked. In no single instance did the watchers find a sound tree or sound telegraph pole attacked. Woodpeckers have a great mission in life; it is to find wood-hidden insects and convert them into woodpecker banquets, and the task leaves no time for the fun of tearing open sound trees and telegraph poles.

The eyes of birds are keener than ours. They detect rot and decay which escape our notice, and by laying open the wounds they reveal dangers to the woodman. Follow the woodpecker, and either cut or treat the tree he taps open, and the rest of the trees will escape infection from the one in which disease is germinating. Instead of killing woodpeckers we ought to honor them as guides to the safeguarding of our woods.

THE WONDERFUL TONGUE AND STRONG BEAK OF THE WOODPECKER

Of course the bird does not make all his holes in order to excavate insects. Some of them serve for the reception of the eggs. But the extraction of his food is a matter of great interest. It is performed by a wonderful tongue which can be protruded far beyond the limits of the beak. This tongue is long and worm-like, but pointed and barbed at the tip, and is received into a sheath which runs like a canal around the top of the skull.

The beak of the bird is a two-halved chisel, which rips and digs as it is applied with great force by the bird's powerful head and neck. Then, to complete the marvel, the extraordinary tongue, when it does shoot out, is found coated with a substance as gluey as that which enables a frog to snap up a worm or a butterfly. Fine climbers, the greater number of woodpeckers have the tail feathers stiff and elastic, as a support to them when creeping and running about the upright trunks of trees.

It is a tremendous family—about 350 species—of many patterns, many lands, many sizes. There are Golden, Gray-headed, Red-headed, Pied, Black, Bay and Rufous woodpeckers, Great Spotted and Great Black, and Pigmy woodpeckers known as the African cardinals.

There are many species of American woodpeckers, which you will find described in the chapters on Birds of North America. The Ivory-billed and the Pileated are rare and will soon be extinct, but the Downy Woodpecker, the Red-headed and several other species are still fairly common. Of course, as forests are cut down they will tend to disappear.

Some species show a certain foresight not usual with birds. The California Woodpecker makes holes in trees and packs them with acorns, and the eastern Red-headed packs acorns into the crevices in the bark. Spiders, of course, store food, and squirrels and other rodents also, but these woodpeckers and the shrike are among the few birds which provide for the future.

A BIRD WITH THE VOICE AND MOVEMENTS OF A SERPENT

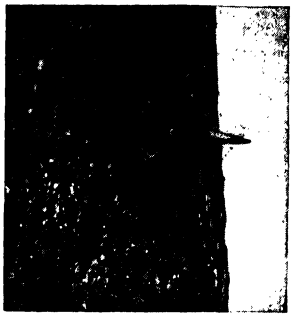
A European bird which is often mistaken for a small woodpecker as it runs with rapid creeping gait along the upright trunk of a tree, licking up ants and other insects, is the strange Wryneck. Seven inches in length, with the upper reddish gray feathers striped with little wavy black lines, this summer visitor is a masterpiece of adaptation to surroundings, difficult to see at all when it is still.

It derives its name from the strange motions of its neck, which twists and writhes as the head darts after food, with the motion of a small serpent. There is something decidedly like a reptile about the wryneck, notably the alarming hissing sound it utters when its nest is approached or when the bird is handled.

A hole in an old apple tree in a garden visited by thousands of people every year was firmly held to be the retreat of a snake, so fierce was the hissing issuing from it; but it proved to be only poor little mother wryneck uttering her defense of the eggs she was brooding in the hole.

"Cuckoo's mate" is the familiar English name of the wryneck. The title arises from the fact that if the wryneck and the cuckoo do not arrive together, the lesser bird's sharp ringing note is sure to be shortly followed by the louder call of the cuckoo. The birds cover the same range of country, and where one is heard the other is not far distant in time or geography.

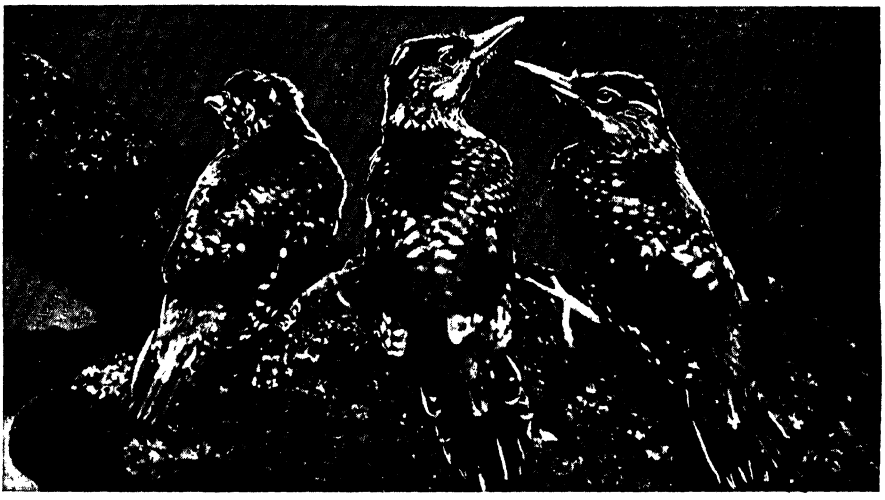
BIRDS AND THEIR HAUNTS



A green woodpecker.

Kingfisher and prey.

Woodpecker feeding young.

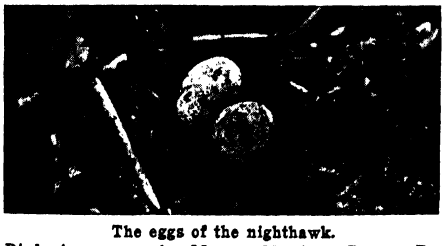


A fine group of great green woodpeckers.

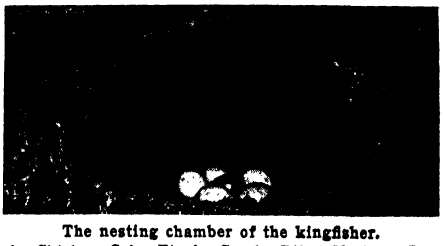
The wryneck.

The nighthawk, or nightjar.

The hoopoe.



The eggs of the nighthawk.



The nesting chamber of the kingfisher.

Bird pictures are by Messrs. Mortimer Batten, Brook, Chislett Coles-Finch, Crook, Pike, York & Son.

THE AFRICAN BIRD THAT LEADS MAN TO THE HONEY OF THE BEE

We must travel to Africa to find the nearest kin of these birds, the Honey-guides and Barbets. Of these the first-named has more than one claim to attention. As some birds take to buffaloes and rhinoceroses as partners, the honey-guides have constituted themselves allies of man.

Their food is honey and the larvæ of bees, and ages and ages of experience of African life have taught them that man likes honey too. Therefore the sight of a man in the vicinity of a bees' nest suggests an ultimate meal to the bird. So what more natural than that the little detective should fly to the spot where it knows bees live?

It does fly to them. It guides an observer to the spot, calling loudly as it flies, and perching from time to time to see that he is following. He reaches the nest and the bird comes in, jackal-wise, for the remnant of the spoil. The whole process is fascinating, but though there seems acute reasoning in the bird's actions, it seems probable that the sequence is purely instinctive and not associated with true thought.

Another notable feature of honey-guide life is that the bird is as notorious a trespasser on the nests of other birds as the cuckoo. The smaller species lay their eggs in the nest of the red-vented woodpecker, the small tinker barbet, or the pied barbet, while the large, White-backed Honey-guide selects for the purpose the nest of the banded barbet.

American barbets escape this fraud, for there are no honey-guides there, and the African victims need not move us to tears, for they are stout, heavy-billed birds, quite capable of defense. Entirely tropical, they are burnished by the sun of Africa, India and Central America into the utmost luxuriance of plumage. For their diet of fruit, flowers, shoots and insects—raw flesh too, at times—they have developed a powerful beak which is notched in some species, toothed in others, and in one American genus has the tip four-sided, as it were, so that the upper part fits into a sort of cradle.

South and Central America boast the nearest allies of the barbets on the other side from the honey-guides. These are the grotesque Toucans—gaudy, gorgeous creatures with enormous but very light beaks, with extravagant coloration extending even to the naked parts of the body.

THE TOUCANS ARE CONFINED TO THE NEW WORLD

There are from fifty to sixty species of toucans, all confined to the tropical parts of the New World. The typical form is two feet in length. The plumage generally is black, but the throat is white, tinged with yellow and often edged with red. The beak is extraordinary. At least eight inches long and three inches high, the color is bright orange. Other species differ in color, but the beak is always large.

Such a bill might be expected to overbalance its owner, or be too heavy for the neck to sustain. Not so; the beak is exquisitely fashioned for lightness. The external horny covering is thin; the interior is a fine network of air-filled, bony fibres, marvelously designed to give the maximum of strength with the minimum of weight. The bill of the toucan is ugly, judged by our standards, but what human art could match the perfection of its efficiency?

SOME OF THE BEAUTIFUL AND LAZY COUSINS OF THE TOUCAN

The Trogons, cousins of the toucans, sixty in species, are natives of tropical America, Asia and Africa. They are just as gorgeous in the color of their fine, soft plumage, and their food of fruit and insects is similar. But they are better fliers than the toucans. Like a pretty woman whose sole attraction is in her face, they are slow and stupid in spite of their beauty, and cling, torpid and melancholy, to a bough until they have espied an insect or a fruit. Then they fly off, harvest the booty, and return to their original perch to eat it. Sluggishness is the badge of them all. Of course they are smart enough on the wing, or they could not catch flying insects; but they brood long on the boughs, moping, mum.

THE QUEZAL, THE MOST HONORED BIRD OF MEXICO

One of the most beautiful of all the trogons is the Quezal from the mountains of Mexico and Central America. This bird, hardly larger than a dove, bears marvelous golden green plumes more than three feet long. The bird itself is golden green and scarlet. When the Spanish explorers first visited Mexico they learned that no one was allowed to kill the bird

and that only the chiefs were allowed to wear its feathers.

The Colies, an African group coming next, are distinguished by far greater activity. Their flight, achieved by tremendous beating of wings, seems labored, like that of parrots; but the colies are never averse to an aerial voyage, with excuse or without. They are parrot-like, again, in their manner of creeping about branches and in their habit of hanging head downward, even sleeping, many clustered together, in this quaint position.

THE HUMMING-BIRDS, THE JEWELS OF THE BIRD WORLD

From these lazy birds in fine feathers we turn to the Humming-birds, which display the most intense activity. They are confined to the New World, and South and Central America would deserve the attention of the naturalist if they had nothing else to show than these living jewels. Only a few species are found in the United States, and only one, the Ruby-throat, is seen in Canada. It breeds as far as Labrador. Several other species are seen in California and, of course, in southern Texas.

There are about five hundred species of humming-birds—creatures of many sizes, many designs, many hues. Some are of quite dignified dimensions; others are such marvels of minuteness that, when divested of their feathers, the grown bird is found not to exceed a bee in size.

Some have plain, tiny beaks; some have long, hooked beaks; while some have the bill pointed, straight and sharp as needles. They differ as much with regard to plumage. Nature seems to have tried all her arts in embellishment here. There are humming-birds as sober of coat as our little wrens, but the species rise in such a scale of ascending glory of color and metallic lustre that Nature herself cannot surpass it for loveliness.

THE BEAUTY AND ACTIVITY OF THE TINY HUMMING-BIRDS

The discoverers of the American mainland, when they saw these birds, thought that here were creatures almost divine, perfect in power, in radiant splendor, in food, in life. They thought the humming-birds existed, as the gods of old were reputed to do, on ambrosia and nectar. But though some species sustain life almost entirely on the flower's deep fountain of honey, none rejects an insect, and some species live mainly on this food.

But for this carnivorous habit the little marvels could not range away into the warmer parts of North America and down to forbidding Tierra del Fuego. But whatever their habitat, whatever their diet, humming-birds seem to embody the very poetry of existence, as far as life at the highest pitch of joyous and lovely activity is concerned. Their flight is unique. To say that they swim in the air is too lethargic a simile; everything they do is more like a lightning flash.

They rush into an open flower, drink with their tubular tongues, dart backward, rise like a tiny bolt into the sky; flash upward, sideways, forth and back; drop like a shot toward the ground—all at incredible speed. The eye cannot follow the beat of their rapid wings. The birds flash into sight, disappear and reappear before one has time to form a phrase—fast as thought, swifter than words.

Their song is too excited and high-pitched to be sweet or comprehensible, and their spirits seem to maintain the same exalted level. They are pugnacious also. They fight like little Furies in the air, and when they do not fight they pretend to do so. Their sport, like that of the Vikings of old, is either battle or mimicry of battle.

THE SWIFTS, WHICH ARE COUSINS OF THE HUMMING-BIRD

The Swift, which is a humming-bird cousin, is a bird almost as active. Here we have the wonder of our temperate skies. This bird, from the earliest peep of dawn till the last flicker of light has faded from the sky, flies, darts, wheels and tumbles through the air. It seems that, but for the coming of absolute darkness, he would reveal to us, in his own life, the solution of perpetual motion.

The food of the swift is taken in the air; it drinks by dipping its bill into stream or pond as it flies; it rests only when in the nest during the few short hours of summer darkness. All sorts of estimates of its speed exist, but the flight is so darting, erratic, and difficult to follow that a correct statement is impossible. Yet there is common agreement among close observers that the distance covered by these birds during their hours of flying day by day would, if devoted to a straight course, carry the bird two or three times around the earth in the course of a month.

Where swallows are found swifts may

be expected. We may distinguish the swift by its great sickle-shaped wings, its short tail, its sooty hue, its whitish throat, and, above all, by the shrill, piercing scream uttered from time to time as it flies. The joy of life is manifested by the humming-birds in their sunny forests, but it is also revealed in every motion of a swift as it cleaves the shining air of a summer sky.

A LITTLE BIRD OF THE EAST WHOSE NEST IS EATEN BY MAN

There are about seventy-five species of swifts, and they are common to nearly all lands. They are in Lapland for part of the year, and in Africa; in the Old World and in the New. The Alpine Swift is common throughout mountainous Europe; the Needle-tailed Swift of the East has sometimes drifted into Western Europe, but it is happier in the warmer Orient. There it keeps the company of swifts famous for their extraordinary nests, composed almost entirely of the birds' saliva. All swifts have the salivary glands well developed, and glue their nests to supports, but the nest of the Salangane is almost entirely of saliva. They nest in caves, and the nests are attached to the walls. These are the edible birds' nests of commerce which, with the fins of shark, lend a strange savor to many a Chinese banquet.

Most swifts nest in holes in the thatch of cottages, in belfries, in cliffs and towers; but there are species called Tree Swifts which produce their eggs in the hollow trunks of trees, while one Guatemalan species gathers multitudes of seeds, glues them together and forms a wonderful tube for its nest. In North America the Common Swift builds its nest in the unused chimneys of buildings. We generally, but incorrectly, call it the Chimney Swallow. Three other species of swifts are found in North America, but they are not common.

Our old friend the Nighthawk, or Nightjar, is next in order. He is called by a half dozen other names—Mosquito-hawk, Bull-bat, Goatsucker and the like. This bird is seen only in the late evenings as he sallies forth for his nightly hunt, unless we are fortunate enough to find him nesting on the ground or resting, not crosswise, in the common manner, but lengthwise on the bough of a tree. He is entirely an insect-hunter, and his prey is, in the main, night-flying moths. The great gape of his beak, kept wide open as he wings his way, is in part responsible for the preposterous legend that the nightjar sucks the milk of goats. No nest is built, but the eggs are laid on the ground, on a stump, or even on a flat roof. If disturbed when on the nest, the female will tumble off, pretending to be lame, and attempt to draw the disturber away. The eggs are so nearly the color of the ground that they may escape notice, even when in an open place.

Keeping his ways to secrecy and his journeys to the night, the nightjar has thriven in many lands and branched out into a variety of species of which we have several. A near relative is the Chuck-will's-widow, with a mouth two inches across. Sometimes humming-birds and small sparrows have been found in its stomach, but its chief food is insects. The Whip-poor-will, so called from its mournful note, is smaller. Though often heard, this bird is seldom seen. It breeds from New Brunswick and Manitoba to Virginia, and winters in Central America. Like the nightjar, it builds no nest, but hides its eggs in the leaves or in an old stump. Its habits are also much like those of its larger relative, even to pretending to be unable to fly when the nest is disturbed. The young are able to run when very young and move swiftly on the ground long before they can fly.

From an almost world-wide family we turn next to one which is restricted to a group of islands—the West Indian Todies—quaint little green and red birds which burrow in banks, like sand-martins, but hunt, and live much the life of the fly-catchers. Of much wider distribution, yet confined to Central and South America, are the motmots.

A BIRD WITH A MOST PECULIAR TAIL

The Motmots are beautiful tropical American birds about the size of the jay, and show many shades of blue and green in their plumage. They are solitary in habit, and live on small reptiles, insects and fruit. The most peculiar feature is the tail. The middle pair of feathers is no longer than the rest. For an inch or two in the middle the quills are bare so that they are sometimes called racket feathers. For a long time it was thought that the birds bit off the barbs of this middle portion, but it seems that the barbs are weaker in this part and that the

bird breaks them off unintentionally when cleaning its feathers.

The Old World has no motmots, but Bee-eaters instead. These birds do not eat their feathers, but they fill the place occupied by those which we have been studying. To an African savage the bee-eater is a guide to food, for he knows the bird will unerringly locate the home of bees to devour the occupants as they enter or leave their fortress-home. It is particularly fond of the grub and eats them greedily when the storehouse is opened.

The same habit in European and Asian bee-eaters causes these birds to be much disliked where bees are hived by men, for, like the honey-guides, they will swallow the bees of a man-made beehive as readily as the wild bees of the forest. We can only say on the birds' behalf that they devour an enormous number of wasps and other noxious insects, and that bees were their lawful inheritance long before man became an owner of anything but life.

A VISITOR TO BRITAIN FROM THE BURNING DESERT SPACES

Certain peculiarities in the structure of the palate seem to link bee-eaters with the Hoopoes. These are Old World birds which winter in the tropics, but go north in summer. The European Hoopoe winters in Africa, but goes as far north as England in summer. It might breed there, but its colors are so striking that it is soon shot. It is a beauty, mightily crested with black-tipped feathers. The general color is sandy brown to match the desert's dusty face, broken up with black and white to harmonize with shadow and shade.

China, India, Africa, and favored areas throughout the length and breadth of Europe afford the hoopoe a narrowing breeding-ground. It prefers to nest in hollow trees, ash and willow for choice. As explorers have found the birds rearing their young beneath large stones, in crannies in sunny walls and banks as well as in warm caverns, there seems a suggestion that the bird has learned the lesson of disappearing forests. It must change its nesting-sites or die out, even where stupid collectors do not shoot the parent or meanly steal its eggs.

Having said that there is some resemblance between the make-up of hoopoes and bee-eaters, we have now to extend the comparison and find the next link in the Hornbills. The beak of the hoopoe is neat and graceful, that of the hornbill a sheer monstrosity to human eyes; yet the birds, superficially so unlike, have hidden features in common.

THE PECULIAR BEAKS OF THE BIG FAMILY OF HORNBILLS

Here we have an assembly of birds, scattered over Africa, India, throughout the Malayan area, and away to New Guinea. The family of fifty or more species is distinguished by what seems to us futile absurdity and ugliness. The birds range in size from species five feet long, with a wing span little less, down to examples no bigger than magpies, but all have extraordinary development of the beak. In some it is merely insignificant, but it shades in varying degrees of importance up to sizes which give the bird the name of Rhinoceros Hornbill, Helmet Hornbill, Solid-casqued Hornbill, as well as titles indicative of color and other peculiarities.

It is suggested that the bills of some of these birds are protected by casquets, or helmets, in order that these growths may act as shock-absorbers, that they may even serve as hammers with which to break nuts. But there are beaks which have the helmets open in front as though they were decaying—which they are not; and there are others, great in size, which are almost as light as the cuttlefish bone which we buy for our canaries.

Then the solid-crested hornbill has a helmet so heavy and dense that it is carved and decorated into ornaments in the Far East. These ornaments have a bright yellow interior and scarlet edges, which are the natural colors of the bone of this bird.

HOW MR. HORNBILL SHUTS UP HIS WIFE IN A TREE

Hornbills are all short-legged, save those species which keep to the ground. They eat fruit, insects, reptiles—anything they can find, even carrion. They all have this peculiarity, that the hen, when she is sitting on her eggs, is walled up by the mate, either in a hole in a tree or in a nest formed by converging branches. From the moment the eggs are laid she emerges no more till her chicks are ready to come out and face the world with her.

The male labors to feed her. He collects food and brings it to her prison, tapping at the entrance to call her attention, and feeding her as she thrusts her head out of the little opening left for the pur-

pose. At certain periods he vomits up the lining of his interior organs and gives her that as well. But, with all her feeding, when she creeps out with the family she is a gaunt, miserable spectre.

THE KINGFISHER, ONE OF THE LOVELIEST OF BIRDS

It seems almost an insult to name the lovely Kingfisher in the same breath with the hornbill, but it is that way the relationship lies. The European Kingfisher is one of the loveliest things in feathers. Sapphire, cobalt-blue, green, sable, orange, chestnut, buff, white and coral-pink are blended so well that the result is a thing of beauty.

Like the first song of the nightingale, the first glimpse of a kingfisher skimming like a flash of glory over a sunlit river is an experience to be remembered. The bird deserves his name; he is the sovereign fisher of streams and pools and of all the fresh waters throughout the vast regions he haunts. He is not large—hardly bigger than a sparrow—but his appetite is enormous. He eats insects, worms, crabs and shellfish as well as fish.

He lives near his work, a hole in a bank, the decaying root of a riverside tree. At times, for reasons we cannot divine, the bird will nest farther afield; then, with every fish or water insect that it can spare from its own meal, it must fly to feed the six or eight gaping youngsters hungry on a heap of stinking fishbones and other material on which they are bedded.

The species we know best is the blue Belted Kingfisher, found all over North America. He is considerably larger than the European species, and is less highly colored, but his habits are the same. In Texas is a smaller species, greenish instead of blue.

Our kingfishers will sometimes burrow six feet or more into a bank. The entrance is left large enough for one bird to enter at a time but at the end it is hollowed out to give plenty of room for the nest. The eggs require sixteen days to hatch, and both parents share in the task. The female tries to draw human intruders away by pretending to be wounded, while the male utters violent threats.

Nearly all the world has kingfishers of some sort—fish-eaters, insect-eaters, eaters of reptiles and little mammals. An Australian species, whose harsh cry in the scrub and bush has given it the name Laughing Jackass, is a kingfisher that lives far from water. In all, there are at least 125 species of kingfishers.

WHAT THE ANCIENTS THOUGHT OF THE KINGFISHER

Ancient poets write of a wonderful bird called the Halcyon, by which they evidently meant the kingfisher. Its nest floated on the sea. Alcyone, daughter of a god, and her husband Ceyx, were transformed into these birds. Her father Æolus, god of the winds, would keep the sea still long enough for the eggs to hatch. So we have the phrase "halcyon days," meaning peaceful and happy. Other superstitions have grown up around the bird. Its dried body will avert thunderbolts. If it is kept in a wardrobe, moths will not touch the clothes. Hung from the ceiling, its bill will point in the direction from which the wind comes.

In coloring and in some details of form the kingfishers resemble the Rollers, an Old World family of some score or more of species of swift-flying green and blue birds, whose flight is rendered eccentric by somersaults or rollings in the air. The Kirumbos of Madagascar seem to be their closest relatives, and lead to the Frogmouths, which link up in turn with the Oil-birds, or Guacharos.

The Frogmouths look like examples of our nighthawks changed by residence in the Australian continent, but they crawl more than they fly. In one branch of the family they have attained a decidedly owl-like outline, and so have been given the name of Owlet Frogmouths.

The Guacharo, better known as the Oil-bird, gets its title from the fact that its young, before feathering, are simply masses of yellow fat which turn to oil with the least persuasion from artificial heat. The fat is used both for cooking and for lighting. The adult bird, like the nightjar and the frogmouth, is a night-flier; noiseless like those, feasting on oily fruits and nuts with which the slender tips of its native trees are crowned. There is only one species which is found in Northern South America and its islands.

The nests of the oil-birds, resembling huge cheeses, are made in dismal caverns. Oil-birds lay from two to four white eggs. The natives enter these gloomy caverns and take the young, while old birds hover around uttering harsh cries. The bird itself is about the size of a crow.

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 3497.

Courtesy, Dennison Manufacturing Company

These striking little puppets, Romeo and Juliet, are made from crepe paper, paste and cloth. They are not worked by strings. Each one of them fits over one of your hands and is worked by a thumb and two fingers.

ROMEO AND JULIET—PUPPETS

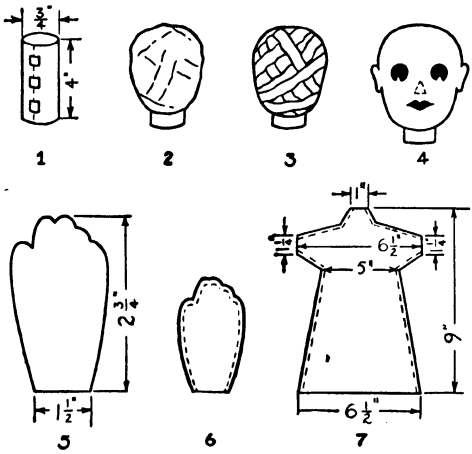
HOW would you like to give a puppet show, with two little puppets, Romeo and Juliet, reciting the famous balcony scene from Shakespeare's play of Romeo and Juliet? These two puppets are made from crepe paper, paste and scraps of cloth. They are very easy to manipulate. Each puppet fits over one of your hands and is worked by a thumb and two fingers.

This is the way to make the puppets. Prepare a tube of mat stock (lightweight cardboard) 4 inches high and ¾ inch in diameter. Fasten with gummed tape (figure 1). This makes a hollow tube in the head of the puppet for your finger. Stretch and wrap a strip of flesh-colored crepe paper, 2 inches wide, round and round the tube to form a head. This should be 3½ inches high and 7 inches in circumference when finished. Paste the strip as you wrap; be sure to leave ¾ inch at the bottom of the tube for the neck (figure 2). Give a final wrapping with a ½-inch strip, this time also covering the neck (figure 3).

Paste on a wad of crepe paper, pea size, for the nose, and two small wads for the ears. Then wrap again with a ½-inch strip, pressing the paste-moistened paper in place to help shape the nose and ears. When dry, cut the eyes from black paper and a mouth from four thicknesses of red crepe paper, pasted together. Paste in place (figure 4). For hair, cut a 5-inch square of black crepe paper. Use plenty of paste on one side. Place the pasted side on the head and push up into little wrinkles to make the correct shape. (See illustration.) For the girl's hair, add strips of black crepe paper, slashed into a fine fringe, around the back of the head.

Cut four hands the shape of figure 5, 3½ inches high and 1½ inches wide. Sew or paste together around the edge (figure 6). Cover on both sides with flesh-colored crepe paper, pasted in place. Cut off the surplus around the edges. While still moist, curve slightly and mark the finger divisions with the blunt edge of your scissors blade. Spread the hand slightly.

The body is a sleeve-like piece made to fit over the hand and forearm. It is usually made of two pieces of cotton cloth cut the size and shape indicated in figure 7. Sew it up at the sides and shoulder, but be sure to leave it open at the bottom of the sleeves, neck and the bottom of the dress.



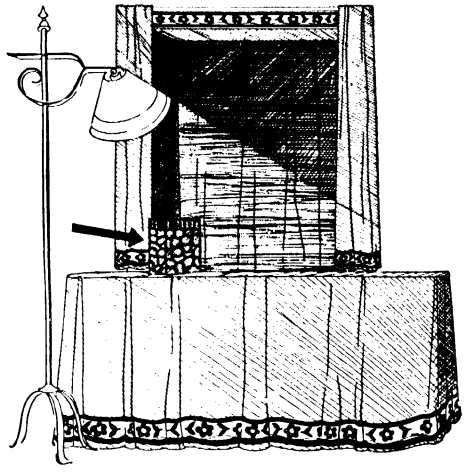
1-7. Steps in the process of making the puppets.

Punch holes in the bottom of the puppet's neck and the openings of its hands. Slip the right hand of the puppet on your thumb, the left hand on your middle finger and the head on your forefinger. Pin the dress in place on the neck and hands; then sew. Romeo and Juliet should be dressed in pieces of real cloth. Sequin cloth will produce the jeweled effect for the front of Juliet's gown.

Now for the stage. You may make a simple stage in any reasonably deep doorway. Place two chairs in front of the doorway and put a plank or board across them (figure 8). The ironing board will do very nicely. Crepe paper curtains conceal the chairs and furnish drapes for back and sides. Crepe paper with flower designs will add greatly to the attractiveness of the curtains and drapes. Just paste it around the edges to produce an ornamental border effect (figure 8). The balcony where Juliet will stand is made of cardboard covered with paper (figure 8).

One person may manipulate both puppets. He will put his right hand in the mitten of which the body of Juliet is composed; Juliet's head will fit over his index finger and her two hands over his thumb and middle finger. Romeo will be fitted over the performer's left hand in the same way. The performer will sit on a low stool behind the board, his head hidden.

He may now recite the balcony scene from Shakespeare's Romeo and Juliet; he must make Romeo's voice sound as deep and masculine as possible, whereas Juliet's voice will be high-pitched and feminine. As he recites the lines, he will cause Romeo and Juliet to make dramatic gestures. You will be surprised to see what droll effects can be produced. For example, Romeo will raise one hand aloft in pleading while the other will be pressed against his chest, and he will nod his head vigorously. Juliet's hands will shoot up in surprise; then she will bashfully hide her head in her hands. You will be able to produce many other effects of this kind.



8. The stage; the arrow indicates the balcony.

CHARADES

A CHARADE is a puzzle, the solution of which is a word of two or more syllables. Each syllable is given to the solver by means of a description or a dramatic representation. By putting the syllables together you will have the desired word. For example, suppose that you are given the following descriptions: "My first (that is, the first syllable) is a beast of burden; my second is a place where a river may be crossed with ease; my whole (that is, the whole word) is a place of learning." Here is the solution: the beast of burden is an ox; the place where a river may be easily crossed is a ford; the place of learning is Oxford.

Can you solve the following charades? They are really quite easy. If you can not guess the first syllable, try the second; it may give you the necessary clue to the word. The solutions are given on page 3380.

My first is dark and full of mystery;
My second, a place of hospitality.
When sailors know my third is on the way,
They fear the worst and even the wicked pray.
My whole thrills poets with its lovely note,
That trills and warbles in its dainty throat.

My first is something you shouldn't be at all,
For if you are, you're very mean and small.
You'll find my second on animals galore;
You have it too and buy it in a store.
Lassies fair of high or low degree
Oft wear my whole, as you can sometimes see.

You'll all agree, I'm sure, that it is mete
To shun my first, which is full of deceit.
My second is solid and a very tower
Of strength; my whole's a famous national flower.

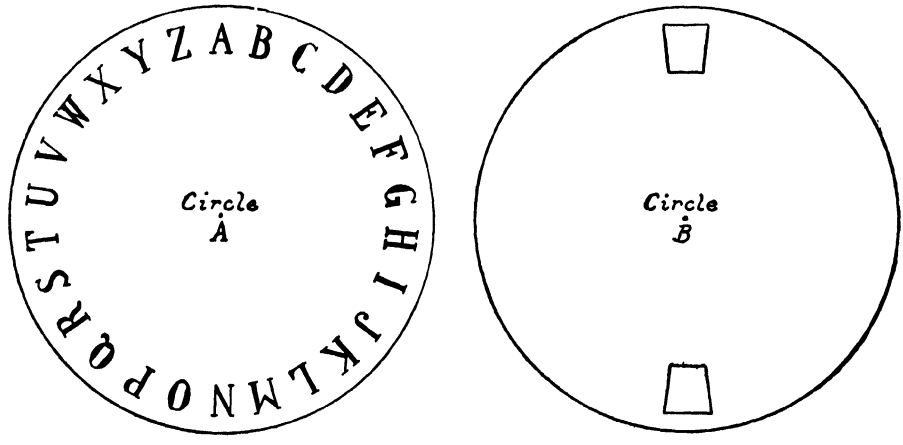
My first's a digit that boys and girls alike should know;
My second's the fifth of twelve, all passing in a row.
My first and third are one, like brothers in a ballad;
My whole is often used to make a tasty salad.

If you're my first, you're thin; perhaps you're tall.
As for my second, it may not count at all.
My whole was formerly worn by warriors grim and bold;
But now it's often worn by ladies young or old.

AN AUTOMATIC CODER

SUPPOSE you received the following message on a post-card: "QRNEWBUAUNIVATNJBAQRESHYGVZRJVFULBHJRERURERLBHESEVRAQWNZRF." You would be greatly puzzled. You would wonder who could possibly be writing to you in Russian or Hungarian or Rumanian or whatever that outlandish-looking language is. And yet the fact is that the message is written in plain and simple English; only it is in code, produced by an automatic coder. Would you like to know how this coder works?

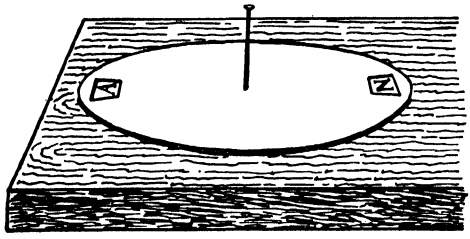
First of all trace on thin tracing paper Circles A and B, shown in figure 1; trace the letters in Circle A and the two 4-sided figures in Circle B. Then transfer the circles with their letters and figures to a heavy piece of cardboard by means of carbon-paper. Next cut out the two circles; also, with a sharp knife cut out the slots formed by the two 4-sided figures in Circle B. Go over with ink the letters in Circle A. Now run a pin through the centre of Circle B and through the centre of Circle A; fasten the pin to some sort of firm material like a



1. The two circles of the automatic coder.

drawing board or the side of a wooden box. Circle B must be on top.

You will note that when one of the slots in Circle B is so arranged that a letter is in the centre of the slot, another letter will be revealed in the opposite slot. When one slot shows *A* the other will show *N* (see figure 2); when one shows *B*, the other shows *O*, and so on.



2. The automatic coder in action.

Now suppose that you wish to write "Come here now" in code. Turn the top card till one slot shows *C*, the first letter of the message. The other slot will show *P*. Set down *P* on a piece of paper as the first letter of the coded message. Now turn to letter *O*; the opposite letter will be *B*. Continuing in like fashion, *M* will give you *Z* and *E* will give *R*. The first word, therefore, corresponding to "Come" will be "PBZR." Continuing, "here" will be represented by "URER" and "now" by "ABJ." Run all three words together; this is done to make the decoding of the message more difficult for those not possessing the code. You will now have the message "PBZRURERABJ."

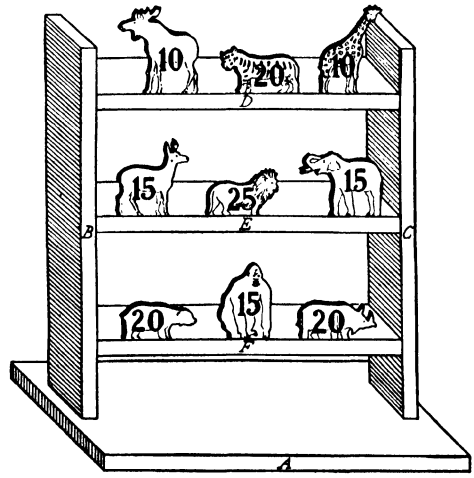
To decode the message, use the same method as before. That is, turn the top card of the automatic coder so that one of the slots shows *P*; the other will show *C*. Next turn the card so that one of the slots shows *B*; the other will show *O*. Continue with the rest of the message and you will have "COMEHERENOW," which you will recognize readily enough as "Come here now." Can you decode the message given at the beginning of this article?

Explain the code to one of your friends and have him make an automatic coder. You will find it great fun to correspond with your friend by post-card, using this code. Your family will be consumed with curiosity to know the meaning of these messages.

HOW TO MAKE A TARGET SET

HERE is a fine target set that any boy can make at very little expense and with no great difficulty. First of all, prepare a board 24 inches by 18 inches by 1 inch; this is to serve as the base of the target set. (A in figure 1.) The sides, (B and C in figure 1) are made of boards 24 inches by 6 inches by 1 inch; these are to be screwed into the base. The crosspieces (D, E and F in figure 1) are 6 inches wide by 1 inch thick and are exactly long enough to fit between the sides B and C. Now screw the crosspieces into position with the lowest one set 4 inches from the base and the other two at 7-inch intervals.

The animals are to be made of soft, thin wood, not more than ¼ inch thick; the tops or bottoms of cigar boxes will be very good for this purpose. We give the patterns for these animals in figure 2; note that each square represents a square inch. First draw the pattern on a piece of paper, including the numerals that you find prominently displayed on each animal. Then transfer your drawing to the wood by means of carbon paper. Cut the animals to shape, along the heavy black line indicated in the pattern.



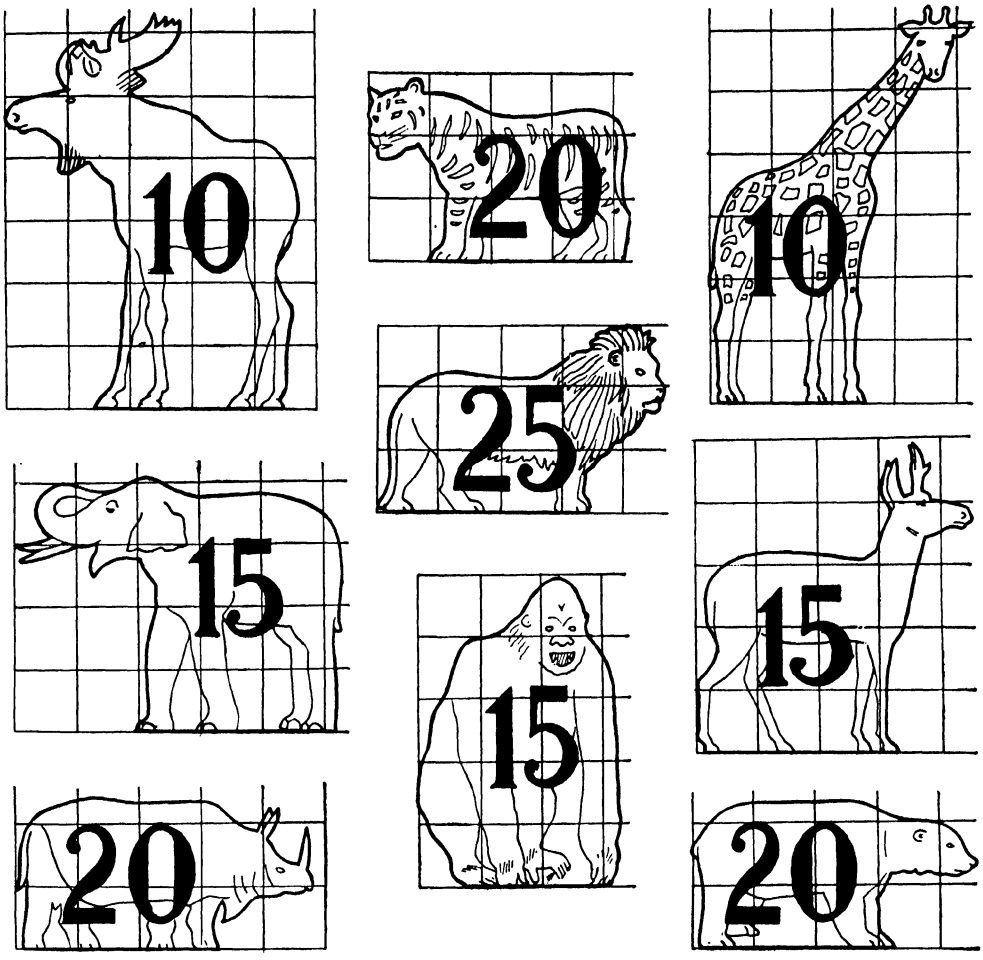
1. The target set, showing the animals in position.

You may use a jigsaw or the animals may be whittled out with a knife. Finally, add the appropriate colors, using watercolors for the purpose.

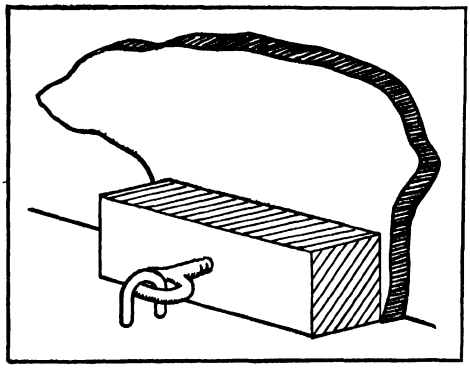
Next, add a cleat to each animal. The cleat is to be 1 inch wide, 1 inch deep and just long enough to fit across the animal at the bottom. The bottom of the cleat should be flush with the bottom edge of the animal (see figure 3). Screw an eye screw in the middle of the cleat, as shown in figure 3; the eye portion of the screw should lie parallel with the long dimension of the cleat.

When all the animals have been thus prepared you are ready to attach them to the crosspieces, in such a way that the painted surface of each animal will be flush with the front edge of the crosspiece (see figure 3). Set the animals at equal distances from each other. To secure an animal to the crosspiece, pass a staple through the eye screw and then hammer it into the crosspiece (figure 3).

The target set is now complete and your friends and you may now show your marksmanship. A rubber ball or beanbag may serve as your projectile; you will find it even more interesting to use the crossbow which we show you how to make on page 751. You should stand at a distance of at least five feet from your animal targets. Of course the farther back you stand, the more skill is required to knock over the animals and the more fun you will have in putting your marksmanship to the test.



2. Patterns for the animals of the target set.



3. How the animal is fastened to the crosspiece.

Each of the marksmen taking part in this target practice takes one shot at a time at the targets and if he is successful in knocking over an animal he receives the number of points indicated on the animal. He may be able to knock over two or more animals at a time, in which case he receives the total sum of points for all animals knocked over. The animals that are knocked over are not set up again until the end of the game, so that each animal put out of commission reduces the number of targets by one.

Each contestant shoots at the targets in turn until all have been knocked over. The player who has the greatest number of points becomes the winner of the competition.

SOLUTIONS TO THE RIDDLES ON PAGE 3251

1. The syllable *to*. 2. The postman. 3. The beard. 4. The mirror. 5. Your name. 6. The word *scent*. The *head* refers to the letter *s*, that begins the word scent. 7. A blank paper. 8. A goose, which could provide you with a quill pen. 9. A book. 10. To-morrow. 11. A cat. A catboat is a sailboat. A cat-o'nine-tails is a whip. The cat is a cousin to the lion, the King of Beasts. Carrie Chapman Catt is the name of a famous woman reformer. 12. The earth. Of course the faithful follower in this riddle is the moon.

ANSWERS TO THE CHARADES ON PAGE 3376

1. Night-inn-gale: nightingale. 2. Petty-coat: petticoat. 3. Sham-rock: shamrock. 4. Toe-May-Toe: tomato. 5. Gaunt-let: gauntlet.

A MYSTIFYING ARITHMETICAL TRICK

THIS puzzling little trick will impress your friends with your mathematical skill. Ask one of your friends to provide himself with pencil and paper, for he will have quite a bit of figuring to do. Ask him to choose a number from 1 to 10; he is not to tell you what number he has chosen. First he must multiply the number by 5; next, add 6 to the product obtained; then multiply the result by 4. He now adds 9 to that product and multiplies the last sum by 5.

When he tells you the result of this last operation, you must pretend to be lost in the most difficult calculations; then tell him the number that he chose originally. As a matter of fact these calculations will be simple indeed. You will find that the last two figures of the number that your friend will give you after he has done all his adding and multiplying will be 65. Drop these last two figures (65) from the sum that your friend gave you; subtract 1 from what is left and you will have the number that your friend chose.

Let us take an example. Suppose your friend chooses the number 9. He would then go through the following operations: $9 \times 5 = 45$; $45 + 6 = 51$; $51 \times 4 = 204$; $204 + 9 = 213$; $213 \times 5 = 1065$, which is the sum that your friend will give you. Drop the 65 from this amount and you will have 10; subtract 1 from 10 and you will have 9, the original number.

You should memorize all the arithmetical operations involved in this trick; do not read them from a paper.

THE NEXT THINGS TO MAKE AND TO DO ARE ON PAGE 3503.

From the T. F. Healy Collection

An exciting moment in the history of printing: Gutenberg examining the first proofs of his famous Bible.

INVENTORS OF PRINTING

THE art of printing, as we know it today, has been built up from the inventions and improvements made by many men during the past five hundred years or more. The beginnings of printing were very simple, but the gradual growth of the art has given rise to a number of important industries and has caused a great number of inventions to be made. These include folding and bookbinding machinery, paper-making machinery, the making of inks of all colors, the designing of type and the preparation of illustrations.

Printing may be simply explained as the art of transferring ink from types, engravings and other designs to paper or other substances. There are three main printing processes in wide use today. These are known as typography, engraving and lithography.

Typography, or letter-press printing, is the most important of these processes. It is used in printing most newspapers and books. In this kind of printing the ink is applied to the raised surfaces of the type, and to the cuts used for illustrations. The printing surfaces are in "relief," that is, they are raised above the other surfaces of the printing plate.

Engraving is made on metal plates, such as copper or steel, by the intaglio process, that is, the lines of the letters are cut, or engraved, below the surface of the plate. The ink is spread over the plate, and then the surface is wiped clean, leaving only the ink in the engraved lines. The paper is pressed down on the plate so it will take up the ink in the engraved line. This process is used for artistic printing, for printing paper money, bonds, invitations and for other special purposes. Gravure is a special kind of engraving process. We shall speak of it later.

There is another process that goes by the name of engraving. This is relief engraving on wood, or etching plates with acids so

as to leave the design in relief. Illustrations made in this way can be used along with type in the typographical process of printing. These engravings are often called cuts.

LITHOGRAPHY MEANS STONE-WRITING AND IS DIFFERENT FROM "LETTER-PRESS"

Lithography is printing from a flat surface, or sometimes from a partly engraved surface. Lithography means stone-writing, that is, printing from a stone surface, and it is the basis of much of our color printing. It is the same in principle as the modern "offset" color printing, which we shall tell about farther on in this chapter.

Because the typographical process, or letter-press printing, is the most important and useful, the men who invented it and improved it are of the first interest to us. For thousands of years, ever since mankind learned to make some kind of writing, there has been a most urgent need to make copies of records, manuscripts, official documents, histories, poetry and many other writings.

Until the invention of movable metal type and the use of a crude press in about the year 1450, copies of writings were made almost entirely by hand. Every country that had a written language had men who did nearly all the writing and most of the reading, too. In some countries, such as ancient Greece and Rome, the leading men, some rulers and generals were educated and wrote well, but the philosophies, histories, poetry and other things they wrote had to be copied by hand by professional writers, or scribes. It sometimes took months to make one copy of a book, so we can see why books were scarce and expensive. Only rich men and rulers could afford to have libraries.

The importance of the scribes, or professional writers, is shown in the Bible. It was they who kept the sacred writings and laws. They acted as secretaries to the government, and often had great influence in the government.

HOW MEN SPENT THEIR LIVES COPYING BOOKS BY HAND

In addition to such men, who were, like St. Paul or St. Luke, highly educated, there were many professional copyists whose lifework was making copies of books and manuscripts, or who were simply secretaries to rich or powerful men and did the writing for their masters. The great mass of the people, including many of the well-to-do and even important men, were ignorant and unlettered.

After Christianity came to Europe, the monasteries became the centers of learning. Monks not only made copies of the Bible, which was translated into Latin, but they also collected and made many copies of the ancient classics. In the devastating wars of the Dark Ages most of the libraries of ancient times were destroyed, and only in the libraries of the monasteries was much of the old classic literature preserved. The copying of the Bible alone was a long and exacting task. There were not Bibles enough to supply the needs of the churches, and outside of the churches Bibles were very rare.

HOW THE REVIVAL OF LEARNING MADE A GREATER DEMAND FOR BOOKS

Before the year 1400 A.D. there came about in Europe what is known as the Revival of Learning. This brought an urgent demand for books of all kinds; but there was no way of filling this demand since every book had to be copied by hand. A number of men began seeking methods by which copies of books could be made in large numbers. About the middle of this fifteenth century the problem was solved.

The solution was simple. A large number of separate types of each letter of the alphabet were made. These letters could be assembled in rows of words and clamped into a frame, or chase, in a press. Ink could be spread over these types, paper laid on top and pressed down solidly so that the ink would come off on the paper. When all of the copies that were wanted had been printed, the types were taken out of the frame, cleaned and distributed; types for each letter were put in a separate little compartment of a shallow tray called a case. The types were then ready to be set up again for printing the next page, and in this way could be used over and over again.

ONCE THE METAL MOLDS WERE MADE ANY NUMBER OF LETTERS COULD BE CAST

The type was made of metal: usually of lead combined with some harder metal, such as zinc, tin or antimony, so that it would not wear out too soon. The type was cast in molds. Each letter, figure, punctuation mark or other character had to have a separate mold made for it. Thus a whole set, or font, of type would take about 100 separate molds, including those for capital letters. The molds required skillful workmanship and making them was a long, tedious job, but once they were made any number of types could be cast from them.

This was the great invention of printing, and in principle it is in common use today,

A PAGE FROM AN OLD MUSIC BOOK

Courtesy, the Pierpont Morgan Library

Although the invention and use of movable types made great and wonderful changes in the art of bookmaking, and enabled people of all walks of life to read and possess books, it was also responsible for the dying out of many precious arts. Among these was the hand lettering and illumination of books. Above is a page from a fourteenth-century Florentine antiphonarium, or book of musical compositions. The musical notes, words and pictorial decorations were lovingly and carefully done in gold and in clear, glowing colors on the creamy parchment.

though many wonderful improvements in machinery and methods have taken place in the meantime. The press which was first used for pressing the paper firmly down on the face of the type was a makeshift arrangement something like the cider or cheese presses which were used in those days. It had a solid bottom plate upon which the type rested, and a movable top plate which was raised and lowered by a heavy screw.

The outstanding person in this invention of separate molds from which large numbers of separate type could be made was John Gutenberg of Mainz, Germany. He is believed by many people to have been the first person to invent this form of printing. For a long time historians believed that he was actually the founder of the art of printing. There were, no doubt, other men who had the same idea as Gutenberg, and who worked toward the same end. The idea of separate types was not new, for we now know that attempts had been made to use separate type made of wood. This, however,

Courtesy, the Pierpont Morgan Library

This is a page from a book in which the pictures and the text were printed from painstakingly carved wood blocks.

would mean that many hundreds of pieces of type would have to be carved out separately, for wood can not be molded as metal can. This would have been an endless task, and wood is not durable.

The idea of printing also was not new, for small books printed from engraved wood blocks had been made many years before Gutenberg started printing (about 1450). Such books were called "block-books." They were printed from blocks of wood which usually had pictures and a few lines of text engraved on them. Books of this kind continued to be produced for some time after the invention of movable type.

A woodcut initial letter from one of the books of the famous printer, William Caxton.

Block-printing was very old in China, Japan and Korea when printing from blocks began in Europe. It is said that the Chinese printed from molded clay types as early as the eleventh century. The Koreans printed from movable types made of metal in the fourteenth and fifteenth centuries. The British Museum, in London, England, has a book which was printed in Korea with movable type in the year 1337. However, like many other inventions done in the Oriental countries, this was not much developed beyond its first stages. These inventions in the East were not known of in Europe in the fifteenth century, and the European inventors worked independently.

The printer's device with which Caxton signed his books.

Very little is known of the early inventors of printing in Europe, and very little was written about them or their inventions until long after they were dead. Who was exactly the first to use movable type in printing is not so important as who first gave printing the start which caused it to begin spreading almost immediately over Europe, and from there to the whole world. The great work that Gutenberg did was to print several hundred copies of the Bible, which took printing out of the experimental, or inventive, stage and established it as a successful industry that has never stopped growing.

What little we know about Gutenberg has been gleaned from records of lawsuits in which he was engaged, and from bits of information about him and his family, gathered here and there, long after his death. We know that he was born in Mainz, Germany, but the date of his birth is not certainly known. Sometimes it is given as 1397, and sometimes as late as 1400. He died in 1468. He was a member of a prominent family in Mainz. His father's name was Gensfleisch, but the son took the name of Gutenberg in honor of his mother who came from the city of Gutenberg. In those days people often adopted the name of their native city as a surname.

When John, or Johannes, Gutenberg was about ten years old there was a great uprising in Mainz of the poor against the rich of the city. John's parents were among the rich, and they were forced to fly. They moved to Strassburg, where John grew up. His first business venture that is of interest to us was in experiments for polishing stones and making mirrors. For this he needed more money than his people at home could furnish, so a man named Andreas Dritzehn helped him to borrow the money. Dritzehn thought so much of Gutenberg that he went into partnership with him.

Gutenberg's mirrors were good, and he seems to have been successful for some years. However, the mirror business came to an end when the partners made a large stock of mirrors to take to Aix-la-Chapelle, where there was to be a pilgrimage. The pilgrimage was postponed and the stock of mirrors could not be sold.

In 1438 Gutenberg entered a new partnership with Andreas Dritzehn and Andreas and Anton Heilman. This time it was for the purpose of going into the printing business. This we know because later, when Andreas Dritzehn died, his two brothers brought suit to be allowed to enter the partnership in his place. They lost the suit and from then on Gutenberg seems to have borrowed money

Culver Service

Caxton, in his printing room in Westminster Abbey, reading the first proof sheet from his press.

from several people to carry on his work. It is believed that he must have made progress in his work during this time, and fragments have been discovered that are said to have been printed by him before 1450. In any case, he was able at about this date to borrow the sum of 800 guilders, a fairly large amount in those days, with no security but some tools which had not even been made.

The man from whom Gutenberg borrowed, John Fust, belonged to a prosperous burgher family of Mainz. Some people have looked upon him as a great benefactor and partner of Gutenberg, while other people have spoken of him as a crafty moneylender. Gutenberg's work did not make money right away, and he asked Fust for an additional loan of 800 guilders in 1452. With these two loans he evidently financed the printing of his great life-work, the famous "Gutenberg Bible of forty-two lines." This book had 1,282 printed pages with two columns of forty-two lines each. It is also called the "Mazarin Bible" because the first copy to be described was found in the library of the French Cardinal Mazarin.

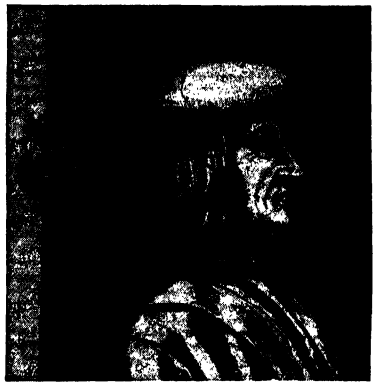
The Bible was finished before August 15, 1456. It was printed in Latin and bound in two great volumes. Some copies were printed on vellum, a fine grade of parchment made of tanned calfskin. There are forty-one perfect copies of Gutenberg's Bible still known to be in existence. One of these, printed on vellum, is in the Library of Congress in Washington. It is valued today at $350,000.

The issuing of this Bible had a tremendous effect. It established a high standard for printing. It filled a great need. Men agreed that it was "as clear as handwriting." It was cheaper than hand-copied Bibles, and more quickly done; and there was no limit to the number that could be printed. Gutenberg received no profit from his great accomplishment, and apparently little fame until several hundred years later. No sooner had the great work been finished than a quarrel arose between Gutenberg and Fust. The wealthy Fust demanded back the money

he had lent. He knew that Gutenberg could not pay him at that time, and that may have been the reason why he pressed his legal claim for the money. Since he could not get the money, Fust seized all of the printing plant and Gutenberg was turned out.

Gutenberg later found a good friend in a Dr. Conrad Humery (or Hummer), who enabled him to set up another plant from which he printed a few books; but nothing prospered with him after that. He ended his days as a pensioner of the Archbishop of Mainz. Nobody noted his death. Nearly four hundred years after his death the citizens of Mainz erected a statue in his honor, and have since lived in the reflected glory of his accomplishment.

Fust, having got rid of Gutenberg, started in the printing business. Gutenberg, it is said, had had a skilled assistant, a worker in metals named Schoeffer, who was of great help in carrying out Gutenberg's ideas in making the type. Schoeffer is supposed to have suggested carving out models of the different letters in hard metal and punching them into a stiffer metal to make molds. Melted type-metal was then poured into these molds. In this way a large number of types could be made as fast as the mold could be cooled. This was a great success and saved all the trouble of trying to carve out a large number of separate types from metal or wood.



The T. F. Healy Collection

Aldus Manutius, a great Italian printer.

Schoeffer went with Fust and they carried on the printing business, doing some notable work. However, in 1462 the city of Mainz was attacked and sacked. Fust and Schoeffer had their office wrecked, and their workmen spread to different countries, taking their knowledge of printing with them. Whether Fust deserved this for his treatment of Gutenberg is not for us to say, but his disaster was a blessing for others, because it spread the knowledge of the printing craft. Before the end of the century more than fifty printing establishments had been started in all the countries of western Europe, and in the next century printing was begun in America.

Researches made within the past hundred years have shown that other men were working on the same lines as Gutenberg, and it has been claimed that several of them succeeded in printing from movable type before he did. The most important of these rivals of Gutenberg was a man named Lourens Janszoon Coster, of Haarlem, H' lland. The Hollanders claim that he actually printed a book from his type before Gutenberg began printing, and that his servant stole his types and took them to Gutenberg at Mainz, Germany. The servant or Gutenberg then, according to this story, printed with the Coster types in 1442. Other versions say that Coster invented printing in 1446, and that Gutenberg did not begin printing until 1450. This is but a sample of the contradictory claims made. There is no doubt that Coster did printing some time before and after the year 1450. So did Gutenberg: but it is too late now for us to know which one actually did it first.

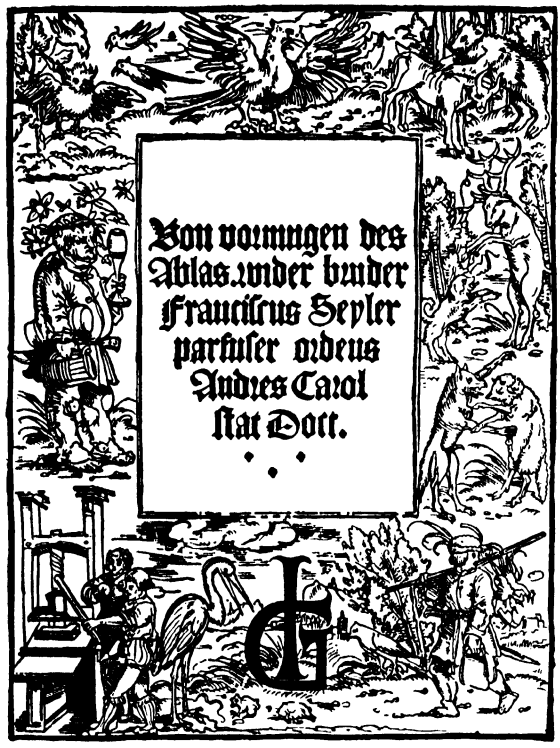
After printing spread through western Europe new inventions or improvements came slowly. At first printers followed Gutenberg's methods and used a very crude kind of press. This was made with a heavy upright frame of wood, with stout crosspieces to hold the heavy plate upon which the type rested, and a movable plate, or platen, which could be raised and lowered. An iron screw came down through the frame and was worked by a movable lever or bar. The bed that held the type had to be taken out to be inked, and then slightly dampened paper was laid carefully on the type. The type bed was then slid into position under the top platen, which was pressed down firmly by the screw. It took a good deal of pressure to get a good impression of ink on the paper. Then the screw was untwisted, the top platen raised, the type bed slid out, the printed paper taken out, and the type re-inked for another sheet of paper.

The ink was applied in this way: Leather bags were stuffed to make them fairly solid. These were covered with the ink and lightly pounded over the top of the type. This was a very slow process. Probably not more than fifty to sixty pages an hour could be printed. Yet the process was ten or twenty times

faster than hand copying, and most workmen worked long hours in those days. This same type of wooden press, with some improvements, seems to have remained in general use for nearly two hundred years.

Most of the printing done in that period was books or treatises on subjects of interest to educated people. Such people were not very numerous, so a thousand copies, or even a few hundred copies, would be a good-sized edition.

About 150 years later printing houses began to print posters, or news-pamphlets at irregular intervals. Printed books were then so numerous that education was becoming more common: at least there were many more people who could read and write. The work of the old professional writer, or copyist, was about done. The earliest printed periodical that we are sure of that had the news of the day in it, was the German FRANKFURTER JOURNAL, started in 1615. In a few years there were weekly newspapers or pamphlets in Holland and in other countries. Soon there arose a demand for better and faster presses, to supply the growing demand for newspapers.



The title page of a book printed by Johann Grünenberg in 1520. The drawings, by Lucas Cranach, show a printing-press.

About this time Willem Janszon Blaeu of Amsterdam, Holland, made a marked improvement in the wooden press. He invented a device to allow the bed on which the type rested to be run in and out quickly. This reduced the time and labor of handling this heavy part of the machine. He also improved the hand-screw arrangement to save time and make the work more accurate.

The wooden-framed, upright hand press, with various improvements continued in use for nearly 350 years, and remarkably fine work was done with it by many printers. Just before the French Revolution the first iron-framed press was invented by a Frenchman named Pierre. It was taken to England, and the third Earl of Stanhope, who was of a mechanical turn of mind, invented many improvements. Later improvements were made, and up to recent times this type of press was used especially for fine hand-printed books. Its greatest speed was about 300 pages an hour with two men to run it. In principle the rigid iron-frame press was just a perfected form of the original wooden press.

The Stanhope press was followed by a number of other iron presses, such as the Albion press used chiefly in England, and the Columbian and Washington presses used in the United States. These hand presses have been superseded by power-driven "jobbing" presses of quite different design. The usual jobbing press used in small printing and newspaper offices all over the country today is of the type designed by George P. Gordon of the Golding Press, New York. In all the modern presses the ink is applied to the type by a series of rollers that work automatically.

Modern presses will print newspapers, magazines and other periodicals in editions of hundreds of thousands, and even millions. These have developed in the past 150 years.

In 1790 William Nicholson, of London, suggested a design for a cylinder press. He proposed that the type be placed on a flat bed under a cylinder covered with some suitable material, and the paper fed between the turning cylinder and the sliding bed; or,

that type be fastened on the cylinder, with a pressure cylinder under it, and the paper fed between. The ink was to be applied by rollers. He also suggested that the type be made wedge-shaped so as to present an even, rounded printing surface. William Nicholson was an editor and author and was familiar with printing. He was not, however, a machine designer or craftsman, and it was left to others to put his ideas into practical form and make them work successfully. His ideas formed the basis for the great presses of today, but it took the work of many men to develop them.

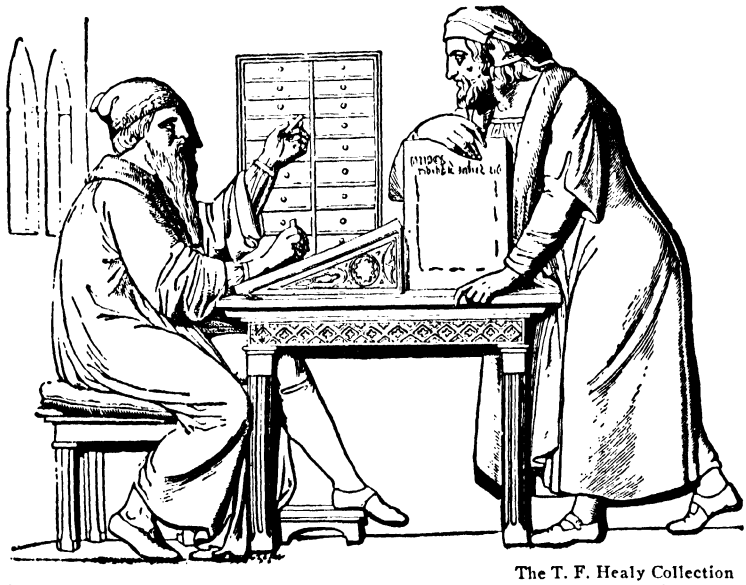
Frederick Koenig, a German inventor working on these lines, produced the first practical machine. His invention was to place type on a flat bed which moved back and forth under a large pressure cylinder. This is known as the reciprocating type of cylinder press. He induced the LONDON TIMES to install two of his presses in 1814. He had some trouble with the inking arrangement, but the presses were fairly successful. They were the first presses to be run by steam engines, and each press could turn out nearly a thousand copies per hour, printed on one side.

The circulation of THE LONDON TIMES was then about 15,000 papers per day, and was growing rapidly, so the owners of THE LONDON TIMES did everything possible to encourage the improvement of the cylinder type of press. Improved designs of cylinder presses soon followed, using two cylinders; other details were greatly improved, and it became possible to print both sides of the sheet of paper on one machine, which doubled the output. These machines were known as "perfecting presses," and for some time they held the lead amon ; improved presses.

One of the most important improvements was in the inking arrangements. The ink used is a thick gummy ink made of boiled linseed oil mixed with soot or lampblack, or with various colors. It is spread on the type by a series of rollers which look like soft elastic rubber, but are a plastic composed of glue, glucose, glycerine and sugar. Other important improvements were in devices to handle the paper so as to cut down the number of men required to operate the presses, and to increase the speed.

The great improvements made from the early part of the nineteenth century to the present were largely brought about by the demand of newspaper publishers for still faster presses. Of the many men who worked to bring about faster and better presses, four generations of the Hoe family are outstanding; they have been in the business of inventing and building all kinds of presses for nearly 150 years.

The first Hoe, Robert, was born in Leicestershire, England, in 1784, and died in the United States in 1833. He went to the United States in 1803, and entered into partnership with his brothers-in-law, Matthew and Peter Smith, to sell hand-printing presses they had invented. He took over the business in 1823, having in the meantime begun the invention of cylinder presses. Robert's son, Richard Marsh Hoe, working with his brother, Peter Smith Hoe, perfected the Hoe rotary press. This rotary press did not have the type on a flat bed; the type was on a large revolving cylinder against which smaller pressure cylinders worked, and



The T. F. Healy Collection

Early Dutch type-casters examining a matrix, that is, a pattern or mold for type.

papers could be fed in under each of these pressure cylinders. A later model of this rotating press, known as the Hoe Lightning Press, was patented in 1846 and was further improved under the name of the Hoe Web Perfecting Press. These later models increased output to 8,000 copies per hour, and finally, to 20,000 copies per hour.

Richard, who was born in 1812, died in 1866. The sons of Richard and Peter then carried on the business, and one of them, Robert, became head of the firm. He was born in 1839 and died in 1909. Improvements continued which made an enormous increase in the speed and volume of printing newspapers and periodicals. Robert Hoe was followed by his son, Robert, who was born in 1876, and became president of the Hoe company and of other companies. The Hoe company is now the largest manufacturer of printing machinery in the world.

Until some time after the middle of the nineteenth century, the rotary presses printed on separate sheets of paper, of which as many as six could be printed on one side at the same time. Later improvements made it possible for both sides to be printed while going through the press. The next big step in increasing speed was due to the invention of William A. Bullock, who was born in New York State in 1813. He learned the trade of a machinist, and devoted his life to the perfecting of a press that would print on a continuous roll, or web, of paper, instead of on separate sheets. This press was called the Planetary Press. Bullock met with a fatal accident while he was operating one of his machines, and died in Philadelphia in 1867. In 1871, the Hoe company began the construction of a rotary perfecting press to print on a roll, or continuous web, of paper. This press printed from stereotyped plates fastened to the cylinder.

From then on, the development of the press may be simply described as combining two, four, six and even eight machines, connected with machinery to cut, fold and count the output. In the large, or "octuple" machine, four presses are built, one on top of the other, and a duplicate set of four presses is placed opposite to these, with a large gap between. In this gap is placed the cutting and folding machinery. All eight of these presses feed into the central cutting and folding machinery. The output of these machines is 100,000 sixteen-page copies per hour. The number of copies varies according to the size and the number of sheets in the copy. This mammoth printing machine is 54 feet long, 19 feet high and 12 feet wide. It is run by electric power.

The printing of newspapers, magazines and other periodicals has now gone far beyond the simple printing of reading matter. Advertisements, illustrations and color printing from one to four colors, all enter into the publishing of papers and periodicals. With the invention of the rotary press, or cylinder press, two very important inventions were made respecting the type and its use. The first of these is called stereotyping.

Originally all printing was done directly from the type, which was used over and over again. When many thousands of copies of newspapers began to be printed every day, the type began to wear out too soon, and

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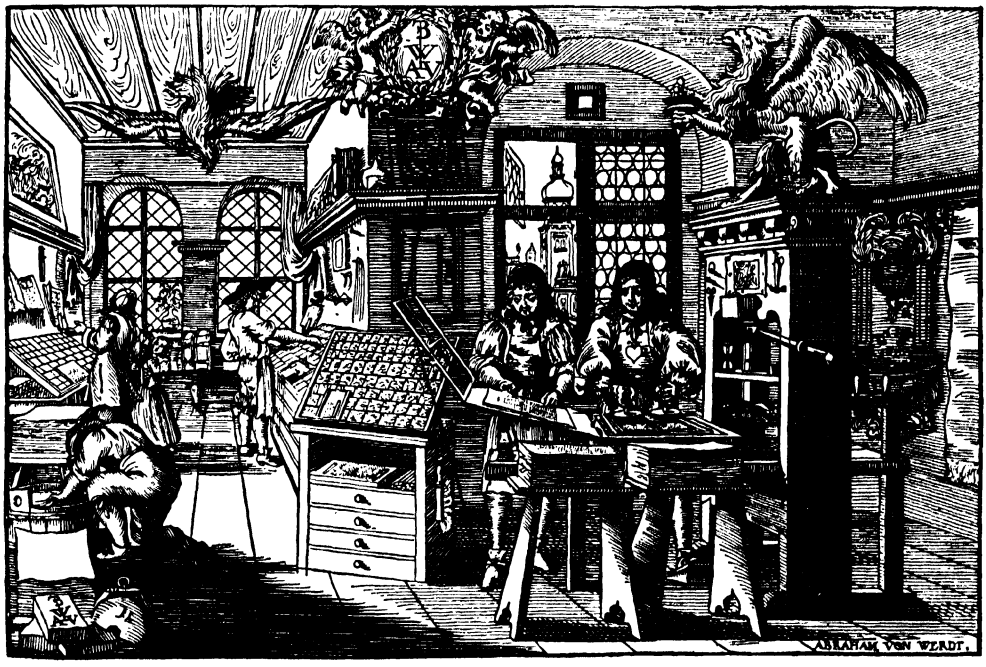
In an early Dutch printing office. The young man at the right screws down the press. The other man is reading proof. Printed sheets are hung up to dry.

stereotyping began to be used. In this process the type was set up in page form, then a mold was made from it. From this mold a type-metal casting was made of the whole page. The casting, or plate, was put in the press and the printing was done from it. Later a much more satisfactory method came into use by the electrotyping method.

In this a sheet of special wax is pressed down on the type faces and engravings in page form. The side of the wax that holds the impression is then dusted with very fine graphite to make the surface an electrical conductor. It is then put into an electro-



This picture of a printer's shop in the seventeenth century was taken from a woodcut by Abraham von Werdt, a German engraver. Then, as now, plenty of light was needed for the printers to do their work well.

plating bath, and a thin shell of copper is deposited upon it. This shell has the exact form of all the type and engravings. It is mounted on a thick layer of metal, making a solid plate like the old stereotype plates, only more durable and clear-cut. Any number of these plates can be made from one wax impression. They can be made flat, or they can be curved to fit on the cylinders of rotary presses.

This solved one problem to save type and also labor, but another more serious problem arose in the latter part of the nineteenth century. Up to this time much of the type-setting had had to be done by hand, and after being used in the press the type had to be carefully sorted out and each separate letter placed in its box in the type case. It took long training to be a fast and expert compositor, or typesetter, and a newspapers and periodicals came to have more and more pages, hand composing could not keep up with the need. Several kinds of typesetting and type-distributing machines were invented and used as early as 1842; but they did not entirely do away with the problem. This was finally solved by Ottmar Mergenthaler toward the end of the century.

Ottmar Mergenthaler was born in Württemberg, Germany, in 1854, and died in Baltimore, Maryland, in 1899. He was a watchmaker by trade, and went to the United States when he was eighteen years old. He entered the employ of the United States Government at Washington, where he kept in order the clocks and electric bells throughout the government buildings. He also made improvements in apparatus used in the signal service. In 1876 he went to Baltimore, where he spent several years developing a new kind of typesetting machine, the linotype machine. In 1886 he placed the first

machine in THE NEW YORK TRIBUNE office.

The linotype machine, which is now in general use in America and many other countries, does not set or distribute individual pieces of type, but sets up the molds in lines of words and then casts the lines in a solid piece. It has a keyboard like a typewriter, and the compositor uses it to spell out the words of one line after another, just as he would on a typewriter. The machine does all the rest. It assembles the molds of each type into a line which is held together while the machine pours type-metal into it. After the line of type has been cast the machine delivers the molds back to their proper places. If the compositor makes a mistake he sets up a correct line in place of the one that had the mistake in it.

Two of the elements that perfected this machine were invented by T. W. Smith, of the Caslon Type Foundry, and Jacob Schuckers, of Washington. The machine is run by one man and can do more work than five or six hand compositors. It is used for most general large-scale printing, though hand setting is still done for special kinds of work.

The T. F. Healy Collection

This Bible belonged to King Charles I of England.

Lithography, as we have said, literally means stone-writing, and until recent years all the designs for this kind of printing were engraved or drawn on stone. While stone lithography is still used for some special and finer classes of work, it has been superseded in commercial printing by what is known as offset printing. It is worth while to describe lithography, because the basic principles of offset printing are largely the same.

The principle involved in these processes is based on the well-known fact that grease, or oil, and water will not mix. The lines or areas that form the design to be printed are laid upon the stone, or metal, plate with thick, greasy ink, and during the process of printing the remaining surface is kept dampened with water. As the ink roller which carries the same greasy ink passes over the surface, the ink from the roller sticks to the greasy lines of the design, but will not stick to the rest of the surface, which is wet. The paper to be printed is placed on the stone or plate, and pressure is applied to print it. The surface of the stone or plate is then redampened and re-inked for each impression. For more than one color, separate plates are used and separate impressions are made.

The invention of lithography is credited to Aloys Senefelder, who was born in Prague, Bohemia, in 1771. He died in Munich, Bavaria, in 1834. His father was a well-known actor, but the son was not a success at acting. He did have artistic talents of another sort, and he turned to experimenting with engraving. He happened to discover lithography when, in grinding and mixing colors, he used a soft porous kind of limestone in that region and was known as Kellheim stone. He happened to mark the surface of the smooth stone with a greasy crayon, and found that the marks would not wash off. The grease had soaked into the surface of the stone. He also found that water would soak into the blank areas of the stone, and that then the greasy crayon could not mark it.

This was the beginning of experiments that led to the process of using greasy ink of any color to make a design on the dry stone, and then to run water over the surface. The surfaces outside the design would not take the greasy ink; the effect was the same as if they had been cut away. Senefelder proceeded to make a hand press, patented his process and became very successful. Later he was made lithographer to the King of Bavaria, and published a book on the elements of lithography, illustrating it with lithographic prints, and translating it into French and English.

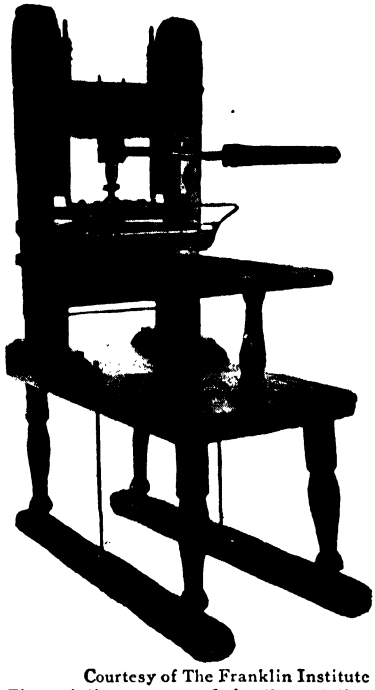
In recent times it was discovered that a zinc or aluminum plate could be used in much the same way as the stone. The plate is polished, then sharp sand is ground on the surface. The sand makes innumerable fine pits which will hold water or grease just as

Prepared by Master Typo Company

A few of the many types from which the modern printer can choose. Type should suit the subject-matter.

the porous stone does. This method has a great advantage over the heavy stone, and the metal can be curved to fit on the cylinder of a rotary press. This made it possible to use lithography in the multiple presses for printing newspapers, books, magazines and so on. This led to the development of the offset printing process, in which two or more colors could be printed on the same press by having several cylinders and transferring the colors to a wide rubber belt, or "blanket," as it is called, and from the blanket to the paper. Many ingenious improvements have been made in this offset process, so as to make designs by a photographic process and to etch the plates.

Photomechanical engraving, including line etchings, halftones and color photography, date from the discoveries of William Henry Fox Talbot, an Englishman. He was born in 1800 and died in 1877. He was a graduate of Cambridge University and became a scientist famous in mathematical and optical researches. He developed the process of instantaneous photography, and other processes that formed the beginnings of modern photography. Photography is now an absolutely essential part of the great printing industry.



Courtesy of The Franklin Institute
The printing-press used in the printing shop of Benjamin Franklin in Philadelphia.

The man who did most to develop modern color printing was Frederick Eugene Ives, who was born at Litchfield, Connecticut, in 1856. He received a public-school education; became interested in photography, and rose to be director of the photographic laboratory at Cornell University in 1874-76. He lectured before scientific societies in the United States and in Europe. His great invention was the process of making halftone engravings. These are used for illustrations in every kind of printed matter. You will find many of them in The Book of Knowledge; and we describe the process in the article The Wonder of a Book. This invention was completed in 1878.

Later Ives invented the three-color printing process. This process was afterward more highly developed, and is in universal use. A still later development of the color process is the "polychrome" process used in moving pictures. The work of Ives is the chief basis of color photography. He died in 1928.

It has been explained that there are two kinds of engraving. First and oldest is the intaglio engraving in which the letters or designs are cut or engraved beneath the surface, and the ink is applied and wiped off the surface, leaving only that in the engraved lines to be taken up by the paper which is pressed down upon it. Many devices have been invented to lighten the tedious work of this kind of engraving. Photoengraving has been so well developed that it has greatly lessened the demand for this highly artistic kind of engraving. In printing paper money, a machine called the geometric lathe is used. This makes the fine scroll work that forms the borders and corners of the bills, leaving the portraits and other designs to be cut by hand. In some forms of commercial intaglio engraving the border and more or less of the background are etched by acid instead of traced in by hand.

The process known as photogravure is intaglio printing and is made by a photographic process. It differs from halftone engraving, which is relief printing, and in which the plate is etched in relief by allowing the light to pass through a screen. In photogravure, instead of a screen, a fine dust or grain is used, invisible to the eye. This grain is deposited on the copper plate itself. It resists the etching fluid in proportion to the strength or weakness of the light coming through the negative. The tiny spaces between the grains are eaten in by the etching acid and become tiny holes which hold the ink. The process takes a great deal of skill and care, but it gives fine detail in shading and soft effects. Photogravure is used for

book illustrations, portrait reproductions, fine Christmas cards, reproductions of wash drawings, water colors and the like. This is flat copper-plate work.

Rotary photogravure is printing from a copper plate which is cylindrical in form and can be used on fast rotary presses. Technically it also is intaglio printing. It is produced under various names, such as "rotogravure," "rotary photogravure," "rotary gravure," "roto print," "rotaglio," etc. The process was originated by Karl Klick in England. He founded a company for its development in 1895. Manufacturers of calico, silk, wallpaper and linoleum have made use of practically the same process for many years—as far back as 1785 for calico.

The T. F. Healy Collection
Richard Hoe, the great inventor.

The uses of this process are many: the reproduction of paintings, pictures, illustrations for newspaper supplements, inserts for magazines and books, color work or any printed matter that is to have a large edition. It can reproduce line drawings and type matter. In fact, books and magazines are often printed by this method, including the reading matter as well as the illustrations. Although a screen is used in making the plate, it is practically invisible, and the reproductions have great softness and delicacy in the shadows. It not only works well on high-speed rotary presses, it also prints well on poor paper. Anything that can be printed by the photogravure or halftone process can be done by this method.

From the very start of printing, the invention and improvement of type faces has been of importance. We have seen that the great inventions and improvements in presses and machinery, and in illustrations, had their beginnings in the nineteenth century, but new type designs began being used very soon after the printing of Gutenberg's Bibles. The early type designers began by copying as closely as possible the

The printing office of the Victoria Press in London, in 1861. Women were employed in this shop as typesetters, an unusual occupation for women in those days—and even today.

The greatest of modern type designers, Frederic W. Goudy. In his long career he designed 122 different types.

style of lettering in the old hand-written manuscripts. Gutenberg's printings were made with a variety of Gothic type of the pointed or angular style which is similar to the modern German script. This has been called a Church Type, as Bibles and many religious printings have used this kind of type until recent times. It is still used in many varieties in formal printings.

The Roman style of type, adapted from Latin writings, has an enormous number of varieties, and is used for every purpose you can think of. It is by far the easiest type to read as it is clear-cut and stands out distinctly on the paper. The reading matter in this book is printed in a variety of Roman type.

Roman type was first used by a printer in Strassburg about 1464. It was greatly improved by the Italians a few years later, and was introduced into England in 1518 by Richard Pynson. He became printer to the King of England, and did a great service in establishing this style of type as the leading one for reading matter.

In Italy Aldus Manutius (1450-1515) established the famous Aldine Press which was carried on for three generations. He printed Greek and Latin classics and many notable Italian writings. He also originated the style of type known today as italic, and now used chiefly to give emphasis to words or sentences in reading matter. This type was said to have been copied from the beautiful handwriting of the great Italian poet Petrarch.

William Caxton, born in England in 1422, gave the start to printing in the English language. As a young man he went to Bruges, in what is now Belgium, and stayed there about thirty years. In the year 1471, while visiting Cologne, he learned the art of printing, and decided to carry the art to England after he had done some printing at Bruges. He arrived in England in 1476 and set up his press near Westminster Abbey. He brought with him, from Belgium, Wynken de Worde and Richard Pynson as his assistants. They made many improvements in type, and after the death of Caxton in 1491, both stayed in England and carried on the work that Caxton had started. The fame of Caxton rests not so much on the improvements he made in printing, although he and his assistants greatly improved the type that they designed, but rather on the books that he printed. We tell you more about this in the department of Literature.

There have been many famous designers of type whose styles have come down to us. Here we shall mention the names of a few of the most outstanding ones.

John Baskerville (1706-75), an English printer and type-founder, who was also printer for Cambridge University and publisher of the works of Milton. His styles of type are famous for their elegance and distinction.

William Caslon (1692-1766) started out as an engraver and tool-cutter, and later became the first of a famous family of type-founders who made types for many British and European printers. His styles and names of types are used today.

Giambattista Bodoni (1740-1813), an Italian printer and engraver, was also an Oriental linguist. He invented a large number of beautiful type faces, including some for the Greek alphabet. A vast collection of his types were shown in a book called THE MANUAL OF TYPOGRAPHY, published after his death.

One of the most remarkable of modern type designers was Frederic W. Goudy (1865-1947). His designs are famous for their clearness, beauty and simplicity. He produced 122 designs, while no other designer is known to have produced as many as 100. Some of his outstanding designs are Goudy Old Style, Trojan, Kennerly, Garamond and Tory.

THE NEXT STORY OF MEN AND WOMEN IS ON PAGE 3486.

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VOLUME X

The Book of Knowledge

The Children's Encyclopedia

THAT LEADS TO LOVE OF LEARNING

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With an Introduction by

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This is a guide to the principal contents of this volume. It is not possible to give all of the questions in the Department of Wonder, but the pages are given where such sections begin. The big Index in Volume 20 is a guide to your whole set. There you will find every subject that is in THE BOOK OF KNOWLEDGE.

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THE UNITED STATES OF AMERICA

SOME OF THE WAYS IN WHICH OUR COUNTRY IS GREAT

IT is natural for us to think that our country, the United States of America, is the best and greatest of all. We should always be certain, however, how we rank among the many countries of the world before we begin to make extravagant claims. We must take many things into consideration—area, population, natural resources, agriculture, manufactures and the opportunities that are offered to all citizens.

Two leading factors in determining the importance of a country are area, or size, and population, or the total number of inhabitants. Judged from this point of view, the United States is not the foremost country in the world. The Commonwealth of Nations (formerly the British Commonwealth of Nations), Soviet Russia and China are all larger in area and have more people than we have. The French Union, formed after the end of World War II, has more square miles of land than the United States, but the population of the Union is somewhat smaller than that of the United States.

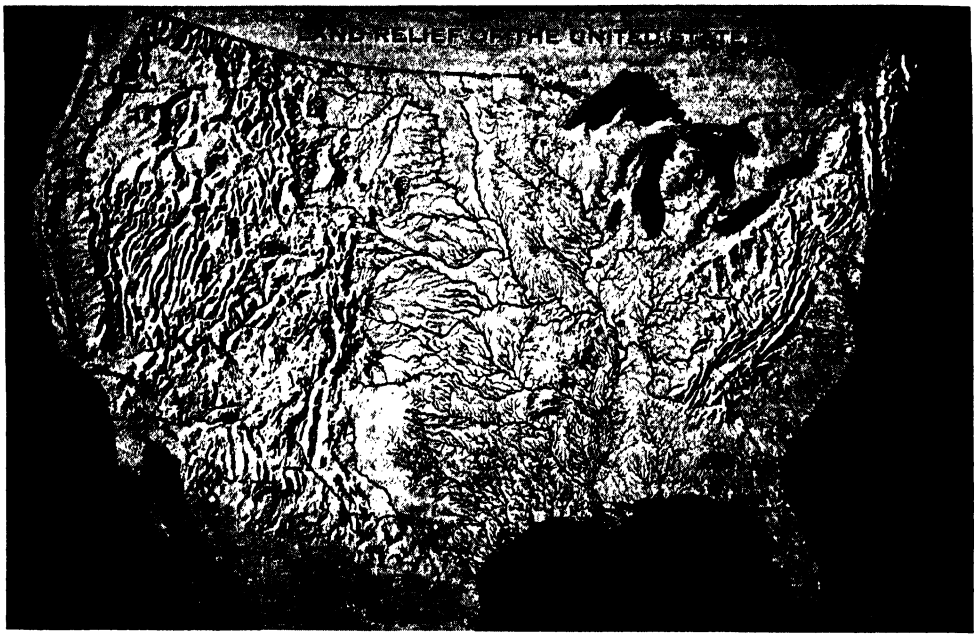
When we are comparing the areas of the various countries, the amount of land suitable for cultivation should be considered. Soviet Russia has the largest area of productive land; the British Empire and the United States come next. Less than one-half of our entire area is considered suitable for the production of crops. Some of our area does not have enough rain for crops and is given over to sheep- and cattle-raising. Large portions are mountainous and ill-suited for farming, and other sections are swampy. However, lest you consider that nature has not favored us, remember that we are much better off in this respect than most countries. For example, the land suitable for crops in Finland

Courtesy, National Park Service

The Statue of Liberty, on Bedloe's Island in New York harbor. This famous statue, designed by the French sculptor, Bartholdi, was unveiled in 1886.

comprises only about 6.6 per cent of the total area, while Norway has only 3.6 per cent of its area under cultivation.

Although our country stands third among the countries of the world in area of productive land, we stand first in the total amount of our crops. Our country grows about half of the total corn crop of the world. We grow more wheat than any other country. In rice-growing we fall behind many other countries. We grow only a small part of the sugar beets and sugar cane of the world, but we grow, most years, almost half of the cotton of the world. We also produce much of the world's hay, tobacco, oats, flaxseed and barley. As for livestock, the latest available figures show that we have more horses than any other country except Russia; more cattle than any other country except India; more sheep than any other country except Aus-



Courtesy, U. S. Department of Agriculture

Relief map of the United States, showing its mountains, rivers and lakes. The natural divisions you can see in this map follow rather closely the divisions that we have adopted in discussing the various parts of the United States—Northeastern, Southern, North Central and Western. Compare this map with the one given on page 3402.

tralia and Russia; more swine than any other country except China.

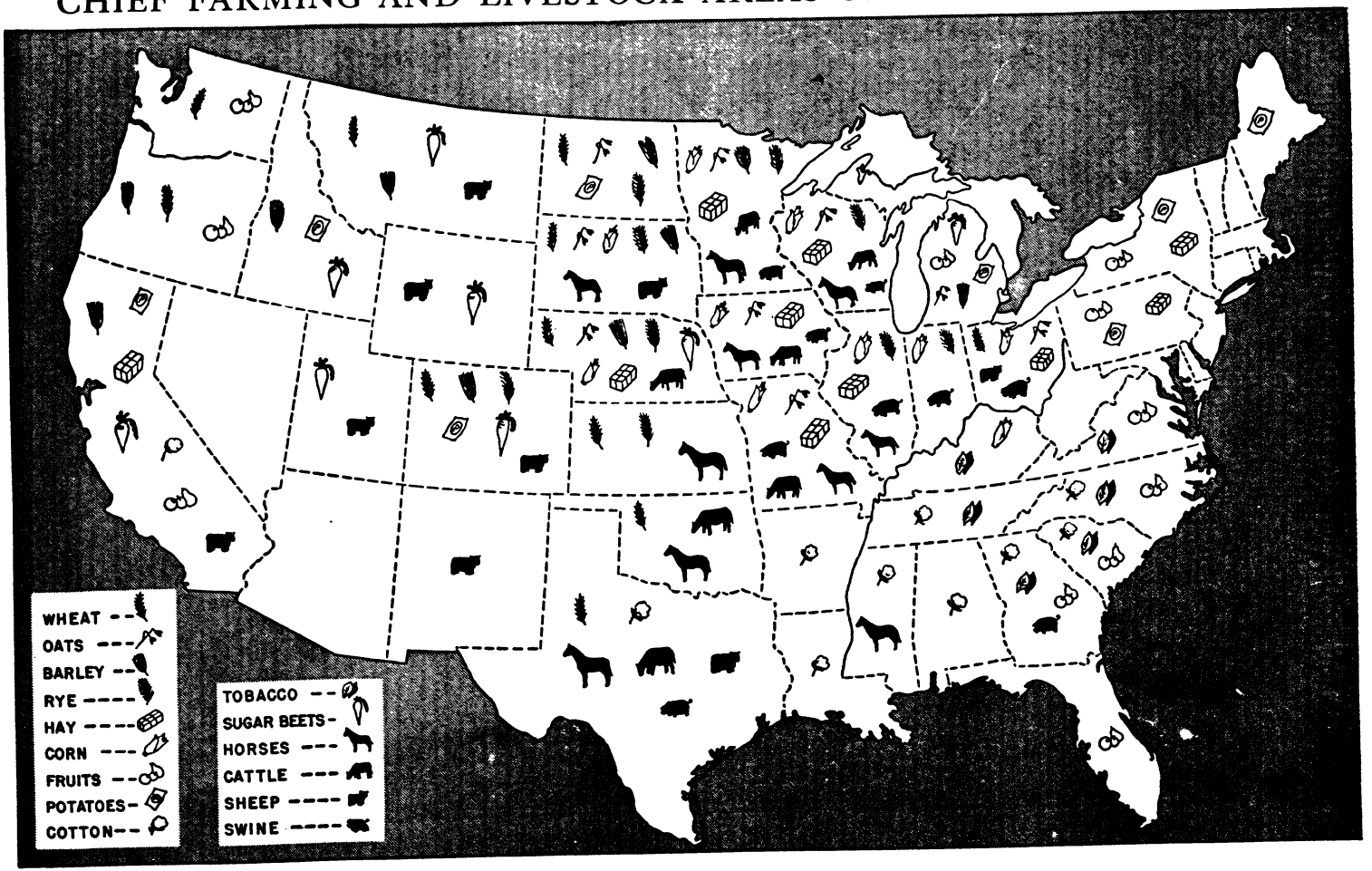
In short, the United States may be considered the greatest agricultural country in the world. To fully appreciate our remarkable farming record, we should bear in mind that the United States has only about one-twentieth of the farmers and farm laborers in the world. We do not cultivate our land so carefully as do the people of Japan, China, India or most of the European countries. By the use of machinery, however, each American farmer multiples his energy and even his time many times over, and is able to produce far more than a farmer in any of the other countries. Another reason for our great success in farming is that so many of our farmers own their own land and are anxious to improve their farms and keep them in good order.

Farms in general are large enough to yield an income that enables most American farmers to build good barns, outbuildings and houses and equip their farms with the necessary livestock. The farmers of our country have easier lives than those of other countries. The extensive use of farm machinery in the United States not only enables our farmers to produce more, but it also does away with a good deal of the drudgery in farmwork. Our farmers live in better houses and have more modern conveniences than in any of the other countries in the world. In no other country does so large a proportion of the farmers have automobiles, telephones, pianos, radios, daily papers, magazines and books.

The United States is the greatest manufacturing country in the world. In World War II America's powerful industrial machine contributed greatly to victory. We not only equipped our own armies but we sent vast stores of military supplies to our allies. We lead the world in the smelting of iron ores, in cotton manufacturing, in the manufacture of rayon goods. We also lead in the making of automobiles, agricultural machinery, railroad equipment, typewriters, sewing machines, electrical goods and scores of other things.

Our prominence in manufacturing is due to many causes, one of which is the great amount of coal we mine—far more than any other country in the world. We also pump far more petroleum (oil) than any other country. No country in the world is using as much water power as we are, and we have a great amount yet to be developed.

CHIEF FARMING AND LIVESTOCK AREAS OF THE UNITED STATES



THE POLITICAL DIVISIONS OF THE UNITED STATES

The forty-eight states of the Union and some of their leading cities are shown here. State capitals are indicated by a dot set within a white circle.

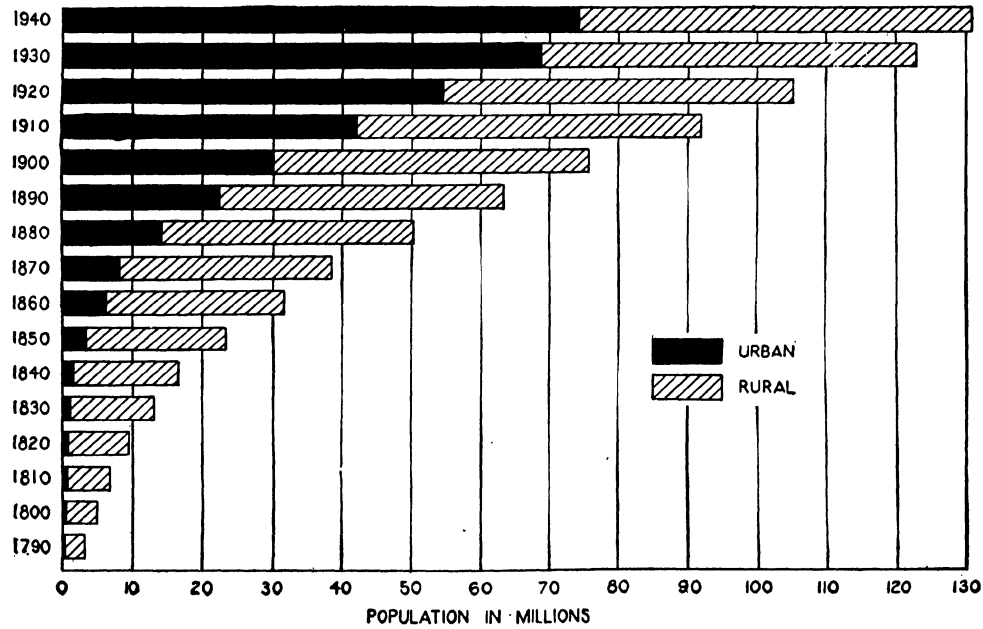
We have seen that the United States is probably the greatest agricultural country in the world. Many agricultural products pass through some form of manufacturing before they are ready for the consumers. We lead the world in the production of lumber, furniture and planing mill products. While we have been using our forests faster than they are growing, we still have more standing timber than any other country except Soviet Russia, the British Empire and, probably, Brazil.

All these great developments in agriculture and manufacturing could not have been brought about except for the great number and great mileage of railroads. We have more than one-third of the world's railroads. The railroads of the United States, put end to end, would form about ten parallel tracks around the world. We have some 235,000 miles of railroads, far, far more than any other country. In the miles of telegraph and telephone wire, too, we lead by a very wide margin.

Formerly we were behind various European countries in such important matters as education, literature, music, art and architecture. Many students used to go to European universities to do graduate work. Many American artists, musicians and architects received advanced training in Europe's great cultural centres, such as Paris, Vienna and Rome. The situation has changed greatly within the present century.

Our great universities—Harvard, Yale, Columbia, Princeton, the University of Chicago, the University of California and many others—now provide excellent training, and not only American students but many foreigners flock to their courses. American scholars are outstanding in science, in mathematics, in literary studies. American writers are making notable contributions to the literature of the world. American musicians can now complete their training in such renowned musical centres as New York, Boston, Philadelphia and Chicago with the assurance that they will have as fine musical instruction as exists in the world. Americans are now included among the world's leading violinists, pianists and singers. The great American symphony orchestras—the Philharmonic-Symphony Society of New York, the Boston Symphony Orchestra, the Philadelphia Orchestra Association, the Chicago Symphony Orchestra and others—rank

POPULATION OF THE UNITED STATES CLASSIFIED AS URBAN AND RURAL: 1790 TO 1940



Courtesy, Bureau of the Census, U. S. Dep't of Commerce

Note how much more rapidly the urban (city) population has increased than the rural (country) population.

among the finest of the great musical organizations of the world.

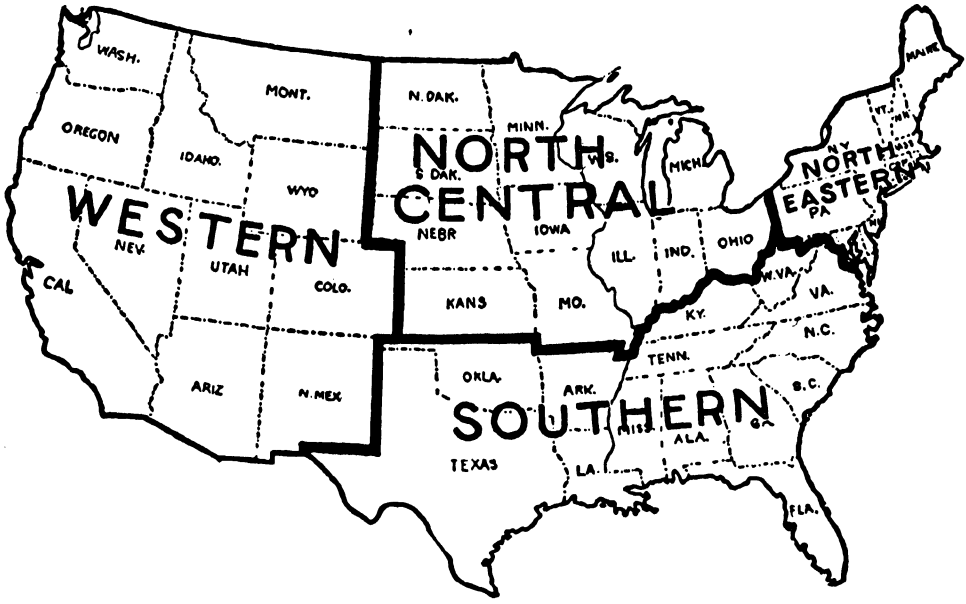
In art, too, Americans have made remarkable advances. In the early years of the country most people were too busy getting a living to bother much about art. As we prospered, and as education became more general, we took more interest in painting, sculpture and the other arts. At present, Americans in increasing numbers understand something about art, and throng the galleries and exhibitions where great works of the past, and of recent times, are to be seen. Creative art, too, is flourishing as never before. Many prizes are offered annually to encourage the artists of this country—apprentice artists and mature artists alike. There is now being developed a native American school of art that has its roots in this country. It is for the boys and girls of to-day, when they have become men and women, to see that the rapid progress of the past generation is maintained in the future.

When we compare our country in all respects with other great countries of the world, we can be proud of it and we should be glad that we are Americans. Some countries may surpass us in some things, but in most of the things that go to make a country great we lead or hold a high rank. In no other country do the people in general have so many of the good things of life and have so much to look forward to as in the United States.

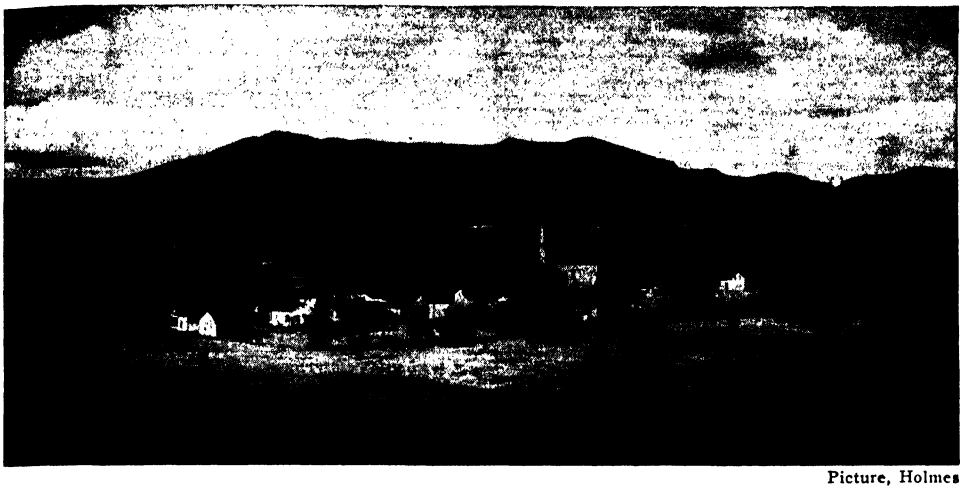
In the pages that follow you will learn more about the various sections of our country—what the people do for a living, what industries there are in each section and what each section contributes toward making our country great. Some sections excel in the production of lumber, some in grain; others in fruit, dairy products, cotton, tobacco, coal or iron ore. What the people work at in any region is nearly always determined by the opportunities which that region offers.

Different geographers group the states of the Union in different ways. A convenient grouping is Northeastern, Southern, North Central and Western. We shall follow the division, shown in the map on this page, in our stories of the various sections.

As you read about these sections, you will acquire a more intimate knowledge of your country's geography. You will learn to think of the United States not only in terms of battles and treaties and political campaigns but also in terms of boundless mountains and plains, great harbors and rivers, great national resources and the industries that flourish because of them. Boys and girls who learn these things will be better Americans —they will be proud of their country because they will know *why* it is great.



The four divisions of the United States that we shall follow in our descriptions of the various parts of the country. Although some students of geography group the states differently (the Census Bureau, for example, makes nine divisions) the above grouping will be found convenient in studying the geography of the country.



Picture, Holmes

The highest point in Vermont is Mount Mansfield, 4,393 feet, seen here in the left background.

THE NORTHEASTERN STATES

PART I

WE shall begin our study of the states of the Union with the section that we have decided to call the Northeastern states. This group includes the six New England states—Maine, New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island; the three states sometimes called Middle Atlantic—New York, New Jersey and Pennsylvania; and two states, Maryland and Delaware, which are sometimes classed as South Atlantic; eleven states in all. This section is one of the most important of the Union. Though it includes less than six per cent of the area, it has almost thirty per cent of the population and a large proportion of the wealth. Rhode Island is the most densely populated state of the Union, New Jersey is next, and Massachusetts is third.

Nine of these states—all except Maine and Vermont—were among the original thirteen, and through their ports the greater part of those who came to settle the country have arrived, from the days of Henry Hudson onward. Except for Virginia and the Spanish settlements to the south, this was the earliest area of our country settled by white men. The earlier pioneers, after crossing the Atlantic Ocean, were willing to turn their backs to the sea and to set to work to gain a living from the land. But they found the conditions different from what they had known in Europe: the soil in most places would not yield so abundantly, and the climate was more severe. After periods of suffering and privation, especially in New England, it became evident that agriculture would not support a large number of people. Some of the people moved westward in search of more promising lands; others turned back to the sea and began to build ships; and others continued to till the soil.

The difficulty of making a living from the soil had taught them to be economical. Those who went out into the West, going farther and farther as the settlements advanced, carried their New England ideas of thrift and industry with them. Wherever they went they set up little bits of New England. Hundreds of villages and cities in the West show the influence of their New England founders to-day, not only in these things we have mentioned, but also in their attitude toward religion and morality, and in the high value they set on education.

After the War of 1812 many men who had accumulated wealth by trading turned to manufacturing. The falls and rapids so common in this area became a valuable resource as power for turning water-wheels. Manufacturing became, and remains to-day, the dominant industry of the region. Though New England has been prosperous since she turned away from agriculture to manufacturing, nevertheless the children of New England have continued to wander down to the present day. Wherever they have gone they have made themselves felt. There is no means of knowing how many people of

Courtesy, New England Council, Boston, Mass.

Mount Washington, 6,288 feet, in the White Mountains of New Hampshire is the highest peak in Northeastern United States. A cog railway zigzags up to the top, but many visitors enjoy climbing on foot.

New England ancestry are to be found in other sections.

Southward from New York City conditions for settlers were somewhat easier. The extended lowlands of the Coastal Plain offered better fields for cultivation, and fewer people went West. Before the Revolution, however, there was a great movement southward from Pennsylvania. Though the early settlers of New England were chiefly English, many Germans and Protestant Irish came to settle in Pennsylvania, and it is chiefly these who went southward through the valley to Virginia, North Carolina and South Carolina, though many remained, and their descendants live in the state to-day.

However, many restless pioneers did turn their backs upon the Middle Atlantic states to try their fortunes in the West. Away from the Coastal Plain conditions similar to those in New England prevailed, and here, when the opportunity offered, the people turned from agriculture to manufacturing. Since about the year 1800 agriculture has declined and manufacturing has increased in this group of states, with the exception of one Census year, 1880. The financial panic of 1873 and the hard years following closed many banks, and there was much failure and closing of mills. The people turned again to agriculture, and in the 1880 Census there is noted an increase in agriculture. But before 1890 conditions had been adjusted, manufacturing was again increasing, and the people deserted the fields and went back to the shops.

Centuries ago most of this part of the United States was invaded by a great glacier. This ice-cap pushed as far south as central New Jersey and central Pennsylvania. It scraped practically all the soil from the hill-tops. When finally warmer weather prevailed, and the glacier melted, the boulders and soil which the glacier carried were dumped here and there over the land. This material, which contained every grade of soil, from boulders of considerable size to clay, is known as boulder-clay. Most of the hill-tops received only a scanty supply, from six to ten inches at most, while in many cases ledges were left bare. To be of permanent value for agriculture land must have, besides a top soil of from ten to twelve inches, a subsoil of from five to eight feet to hold a reserve supply of water.

Much of the soil on the hill-tops left by the glacier does not have this subsoil. The moisture that is received from the frequent rains is evaporated by a few days of sunshine. This soil will yield little, and trees that try to grow upon it are stunted because of the lack of moisture. Berries, however, thrive in such localities, and the land may eventually be devoted to this purpose.

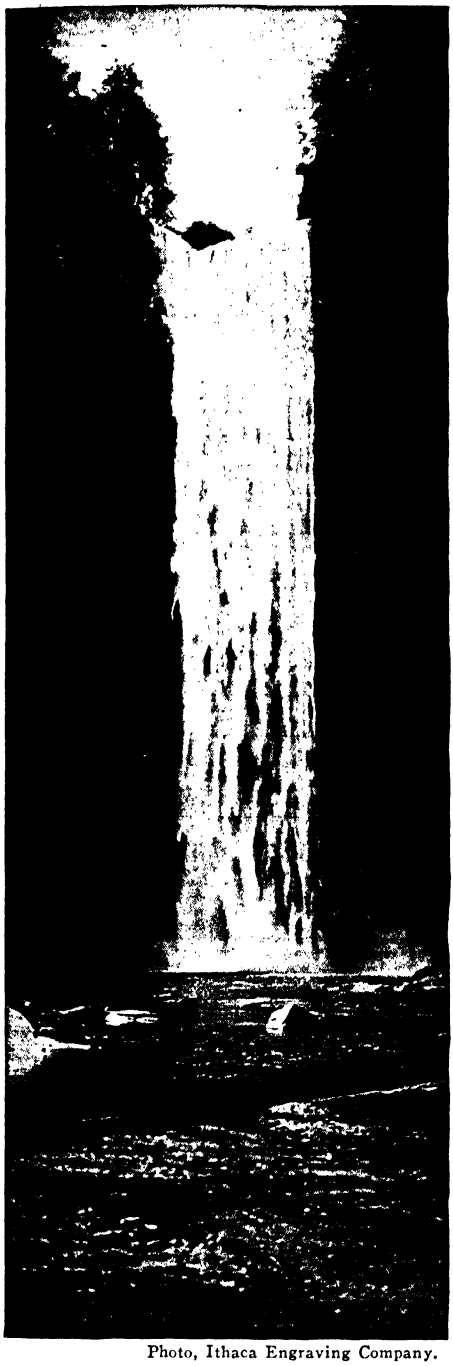
WHY THE MANY STONE WALLS WERE BUILT ON THE FARMS

Again, this glacier dumped over part of this area great quantities of boulders. The pioneer farmer had to clear his fields of these. Since he did not wish to carry them far, he piled them up into the stone walls which help to make the landscape so attractive to-day. In some areas walls of this character are so numerous that it is difficult to cultivate the fields; in others the walls are built five feet thick. If Lincoln had been born in New England he might have gained a reputation as a stone-piler rather than as a rail-splitter. It was frequently said by way of a joke in earlier days, before the stones were picked up, that it was necessary "to sharpen the sheep's noses" so that they could graze.

THE LAND ALONE COULD NOT SUPPORT A LARGE POPULATION

All these were discouraging features, and if agriculture was to be the main industry, the population, it was certain, could never be large. In the petition to the General Court of Massachusetts for permission to found a village on the present site of Worcester it was stated that the land in the vicinity would support about thirty families, and the petition was granted for that number. Worcester to-day has a population of 193,694. How can you account for the difference? Again, the land as a whole is hilly. Certain areas

THE WORK OF RUSHING WATER



Photo, Ithaca Engraving Company.

Pinnacle Rock in Buttermilk Falls Glen, now a state park. Photo, Ithaca Engraving Company.

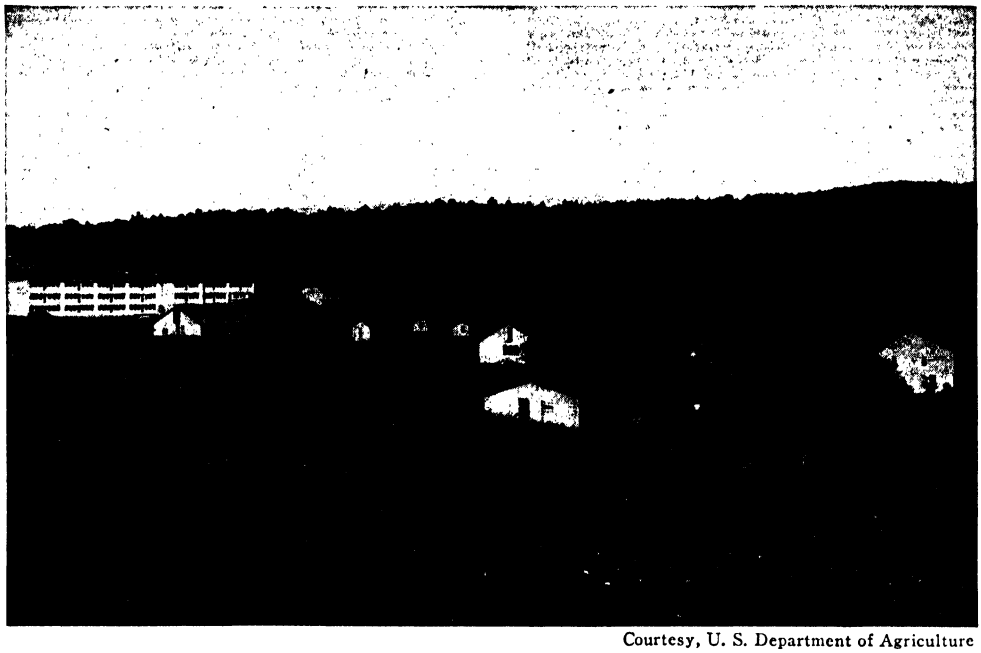
Photo, courtesy Horace H. Nye.

These pictures of rocks and falls in northern and central New York show how water wears away stone. Taughannock Falls, 212 feet in height, are the highest sheer falls east of the Rocky Mountains. Niagara Falls, in the same state, are among the wonders of the world because of their grandeur, but the height of Niagara Falls is only 158 feet. The Ausable Chasm in the Adirondacks, shown at the right, is a picturesque sight.

of level land exist, especially along the banks of the larger rivers and along the Coastal Plain in New Jersey, Delaware and Maryland, but apart from these there are comparatively few extended level stretches. A hillside farm is very often attractive to look upon, but it is likely to be unprofitable if the farmer must compete with farmers in the prairie regions, where much of the farmwork may be done by machines. Tractors are desirable for a farmer to-day, but the upland fields of thin soil, the steep slopes of the hillsides, and the rocky character of much of the soil make the use of these machines difficult.

Again, most farms are small, and tractors pay only on large farms of level land. Think of a tractor in an area where every fifty or one hundred feet the pioneer farmer has built a stone wall of the boulders which he took from the soil. When it is realized that practically all of New England is upland territory or mountainous, that New York is largely covered by the Catskill Mountains and the Adirondack Mountains, that there is little left of Pennsylvania after the Piedmont Belt and the Appalachian Highlands are eliminated, that all of the western part of Maryland is in the Highland region, there appears little space left for profitable agriculture. Yet there are some good farm areas in this region.

The failure of many attempts to farm this upland area is shown by the number of abandoned farms in this section. New Hampshire and Vermont are covered with these abandoned farms; in one town in Rhode Island 35 per cent of the entire area was advertised as abandoned a few years ago.



Courtesy, U. S. Department of Agriculture

Though Connecticut is known chiefly for its great industrial cities, there are many tidy farms on its rolling hills. Poultry is the "money crop" on this farm, as you can tell from the modern poultry houses in the picture.

Nevertheless, some types of farming are successful. For many years the State of Maine has led all the states in the production of potatoes. Potatoes are bulky, and shipping is expensive. Consequently they are generally consumed near where they are raised. Aroostook County, Maine, however, is one of the most noted potato-raising regions in the country. It is situated in northern Maine, far from the cities of the coast. Raising potatoes here would have been an impossible enterprise in the early days had not factories for converting the potatoes into starch used up the bulk of the supply.

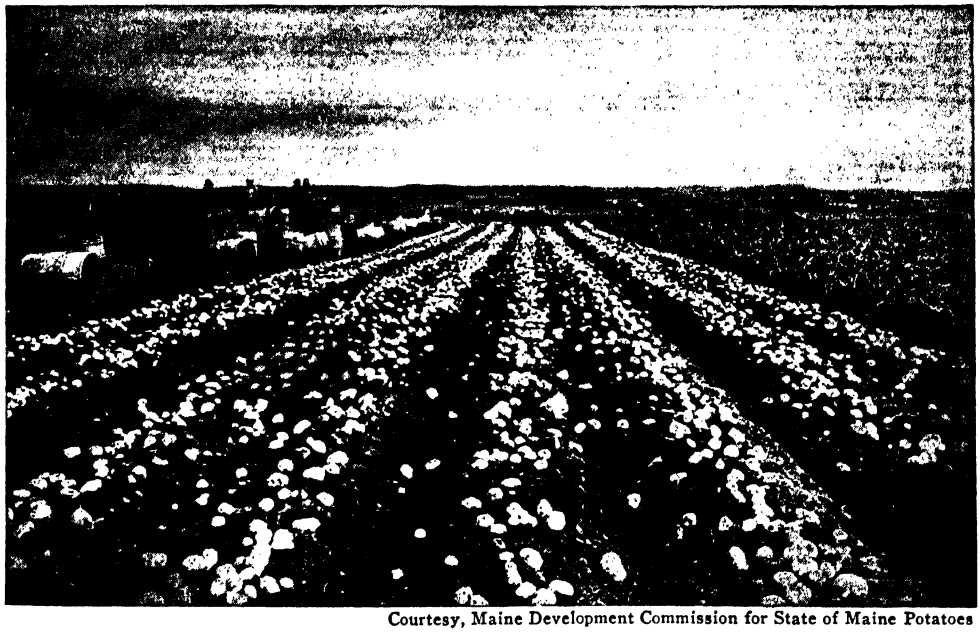
Dairy products, especially milk, demand a large population close at hand. New York and Pennsylvania are among the leading states in the number of milk cows. In 1937 New York was fourth among the states in

the number of milk cows, and Pennsylvania was tenth. The entire area has a high record in this respect. The hillsides make good pasturage, and hay may be grown with little difficulty. In fact, hay is one of the most valuable crops of the section, and in some states it is the leading crop. Frequently we do not think of hay as a farm product, because most people probably think that grass will grow anywhere and anyway, but, as a matter of fact, it is cultivated to a degree. Land is selected for it, and the return from the hay crop is as definite as the return from the corn crops of the Middle West.

Possibly the best and most extensive agricultural area in the Northeast is the Coastal Plain section, which extends from Long Island southward to Florida. This is a strip of lowland bordering the Atlantic Ocean, about fifty miles wide in New Jersey, but widening in the south to about two hundred miles. Acre for acre it does not compare favorably with the rich limestone soils of Pennsylvania or the flood plain of the Connecticut River, but as a whole it will outclass any other region, such as the Piedmont and plateau and mountain regions. Near the great centres of population truck farming is a profitable industry. Long Island and New Jersey, near New York City, have a market for vegetables and small fruits.

Nearly every state in this section has some special type of agriculture. Some of these are not important, but others are. The cranberries on Cape Cod, in Massachusetts, and in New Jersey; the apples in New York and Pennsylvania; the tobacco in the Connecticut valley and in Pennsylvania and Maryland—all these, and others, speak of considerable activity in agriculture. They are all money crops, that is, crops raised for selling, in contrast to food crops, which are raised primarily to feed the family occupying the area. It is the food-crops farmer, the descendant of the age when everyone cultivated the land for his own food, shelter and clothing, that is losing ground and abandoning his farm. The money-crop farmers are increasing in number, and are to-day the successful agriculturists.

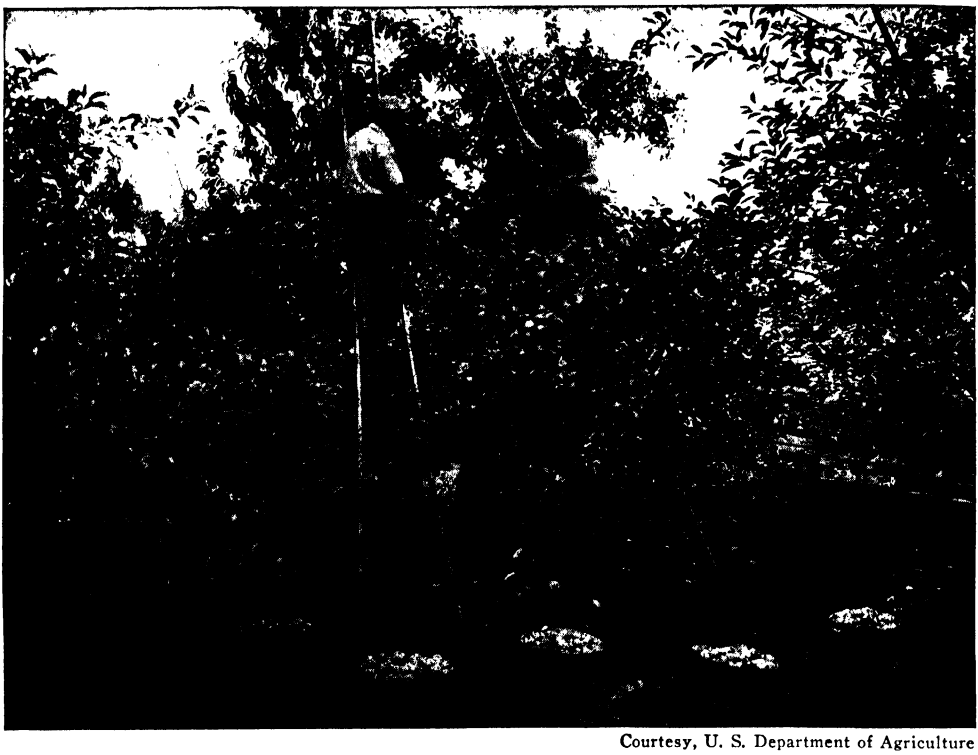
In spite of all the disadvantages that we have mentioned, the value of the agricultural products of the eleven Northeastern states is large. New York and Pennsylvania especially are important agricultural states.



Courtesy, Maine Development Commission for State of Maine Potatoes

Potatoes form a very important part of Maine's agricultural crop. Around 45,000,000 bushels are raised each year. The total potato crop in the United States is around 360,000,000 bushels.

Now let us turn to another product of the land which is just as much a crop as hay, namely, trees. Besides their usefulness for lumber, their beauty makes them worthwhile.



Courtesy, U. S. Department of Agriculture

Picking apples in Dutchess County, New York. Around 15,000,000 bushels of this fruit are raised in the state each year. New York and Washington are the leading apple states.

Originally the Northeast was covered with forests. The early settlers found them a great hindrance to the cultivation of the soil. The clearing of the land of these forests began at once, and it has gone on steadily. There was a time when it looked as if no forests would remain in the Northeast, but now a halt of the wasteful cutting has been made and more scientific tree-harvesting has been introduced. The northern part of this area is in the Northern Forest belt, which yields spruces, hemlocks, birches and sugar maples; to the south of this belt, including all of Rhode Island and Connecticut and parts of New Jersey, Pennsylvania, Delaware and Maryland, is the Hardwood Forest belt, containing oaks, elms, hickories and chestnuts; and a small section of the Coastal Plain is in the Southern Forest belt, which yields in great quantities the yellow pine.

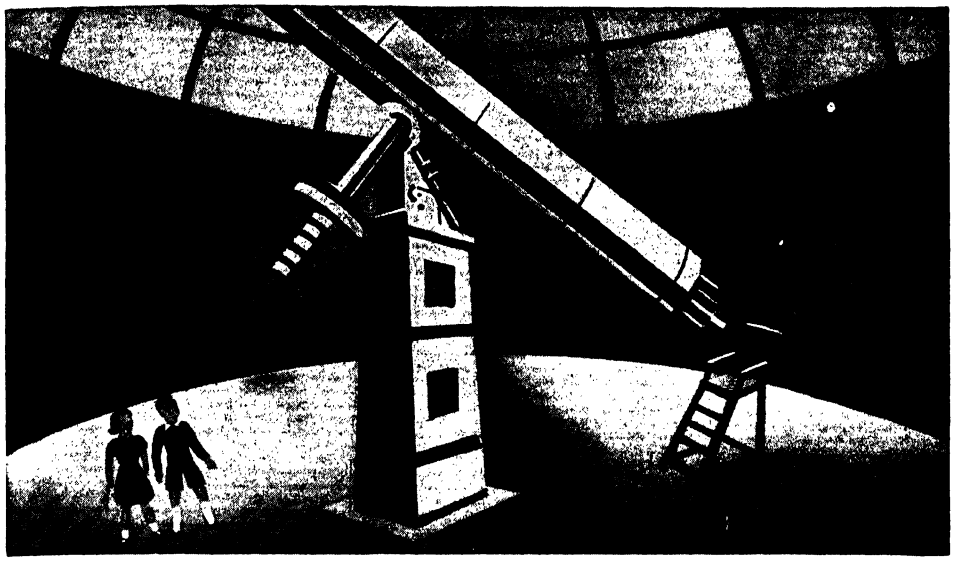
In 1850 New York led the states in lumber production, followed in turn by Pennsylvania and Maine. Massachusetts was in seventh place. Since 1900 no state in the Northeast has been included in the first eight states arranged in order of production. The products of the lumber industry are still important, however. Some of the furniture factories located in early days near timber supplies are still in operation. Furniture manufacturing is particularly important in New York.

A second extensive use of timber in this section is for pulp which is turned into paper. On page 2445 we tell you how logs are cut, floated down rivers to paper mills and then made into paper.

Much wood is still used for fuel, especially in rural communities, and much goes into building. It would be hard to get along without our forests, but we are using them much faster than they are growing; and unless we use less and grow more, our children will have little wood. It would be difficult to think how we could get along without wood.

The sugar maple yields maple-sap, from which come maple-syrup and maple-sugar, and the stories of this enterprise make fascinating reading. Vermont and New York lead the country in this industry as you will read in the story of Sugar. (See Index.)

THE NEXT STORY OF THE UNITED STATES IS ON PAGE 3583.



A telescope is a giant spyglass by means of which we pierce the secrets of our universe.

THE GIANT PLANETS

JUPITER, SATURN, URANUS, AND NEPTUNE

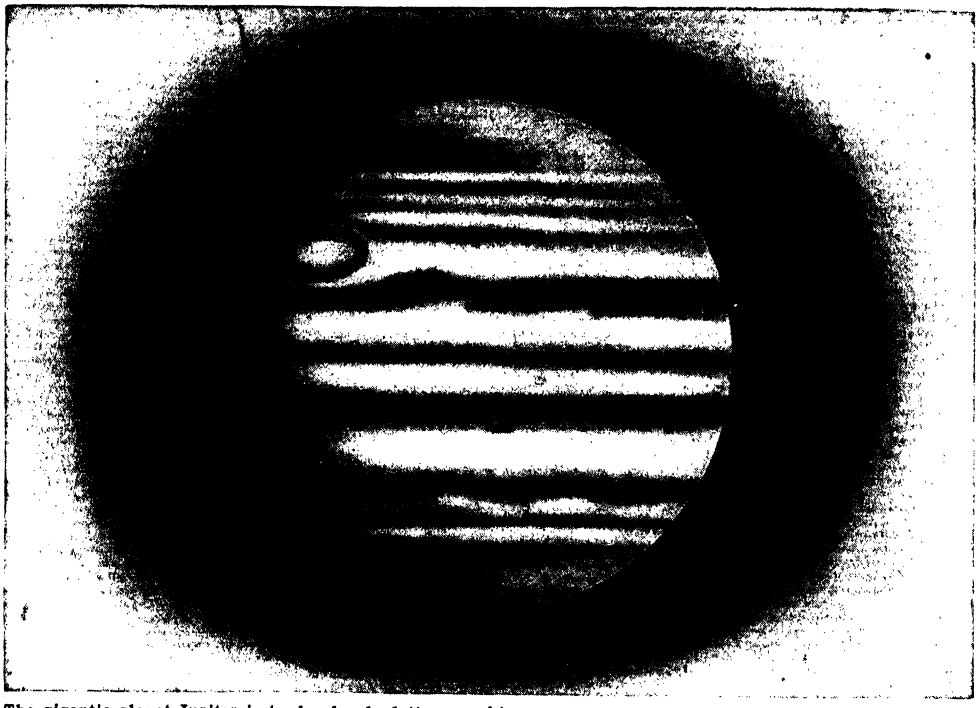
AS we continue our celestial journey out beyond Mars and away from the sun, we come upon a group of four giant planets —Jupiter, Saturn, Uranus and Neptune. Perhaps we should not speak of these planets as a group because they are widely separated, but they are so very different from the terrestrial planets and have so many physical characteristics in common that they are often thought of almost as a special group in the solar system. They differ from the more compact terrestrial (earth-like) planets in many ways, but especially in size and in type of atmosphere. When we come to these giant planets we reach a realm where we can say definitely, "Here there can be no life as we know it!"

Beyond Mars comes Jupiter, the fifth planet from the sun. It is well named after the king of the gods, for it is the largest of all the planets, more than 88,000 miles in diameter. It is not only larger; it also weighs more—more than all the other planets together. Jupiter's size is so vast that if you wanted to create a globe the size of this giant out of building blocks the size of the earth, more than 1,200 earths would be required.

You might imagine that it would take such a large body a long time to spin around on its axis, but that is not true. This giant ball rotates in the amazingly short period of 9 hours and 55 minutes, considerably less than half of one earth-day. Let us see how that rotational speed compares in miles per hour with that of the earth. If you were at the earth's Equator, the earth's rotational speed would carry you along at a rate of about a thousand miles an hour. On Jupiter the speed is 25,000 miles an hour at its Equator.

The year—the period of time in which a planet travels around the sun—is much longer on Jupiter than on any of the planets so far observed. Moving at an average speed of eight miles a second, Jupiter requires nearly twelve of our years to travel once around the sun. Because Jupiter moves so slowly around the sun and because its orbit is so large, we notice very little change in its position in the sky from night to night. Roughly speaking, it remains in one constellation of the zodiac for nearly one year.

Through the binoculars or telescope Jupiter shows a definite disc, but we never see it as a crescent, as we do both Mercury and



The gigantic planet Jupiter is twelve hundred times as big as our earth, and it takes so long to move around the sun that its year is nearly twelve times as long as ours. Through the telescope Jupiter shows light and dark bands which are probably the cloud belts in its atmosphere. Note the Great Red Spot in the upper left of the planet.

Venus. The outer planets, farther from the sun than is the earth, do not go through a series of phases, but are seen always at or close to the full phase. This is because their orbits lie outside our own, and also because of their great distance from us.

What does Jupiter look like? To the naked eye, unaided by any optical instrument, it appears as a very bright star, sometimes five or six times as bright as the brightest star, Sirius, and outshone usually only by the planet Venus. Through the telescope Jupiter is a fascinating and mysterious object. First of all, one notices the light and dark bands, or belts, parallel to the planet's equator, undoubtedly bands of clouds in the planet's atmosphere. Jupiter is a symphony in color, with tan, brown, red and yellow colors predominating.

Individual markings stand out clearly, also, when the "seeing" is good. One of the most interesting of these markings is the Great Red Spot which has been observed more or less continuously since 1857, and which has constantly varied in size and position. It is sometimes described as a gigantic storm in the atmosphere of Jupiter, and an amazing storm it is, at its height about 30,000 miles long and over 7,000 miles in width. Because they did not know how to account for its red color, astronomers used to believe that the red spot transmitted the red color of a hot surface below it, and therefore Jupiter was described as a hot planet. Today we still do not understand very clearly the cause of the red color of the spot, but we do know that Jupiter is far from hot. Its surface temperature, as measured with delicate astronomical instruments, is about —216 degrees F., so cold that we have no basis of comparison.

With the aid of the spectroscope, the wonderful instrument which helps us to analyze light and to discover what the stars and other heavenly bodies are really like, we have learned that the atmosphere of Jupiter is largely composed of ammonia and methane. Since ammonia freezes at —108 degrees F., we know that the ammonia in the atmosphere must be in the form of frozen crystals, held perhaps in the atmosphere as water in the form of ice crystals is held in our clouds. Since methane, which is a gas poisonous to human beings, freezes at the low temperature of

—300 degrees F., we know that it must be in gaseous form in Jupiter's atmosphere.

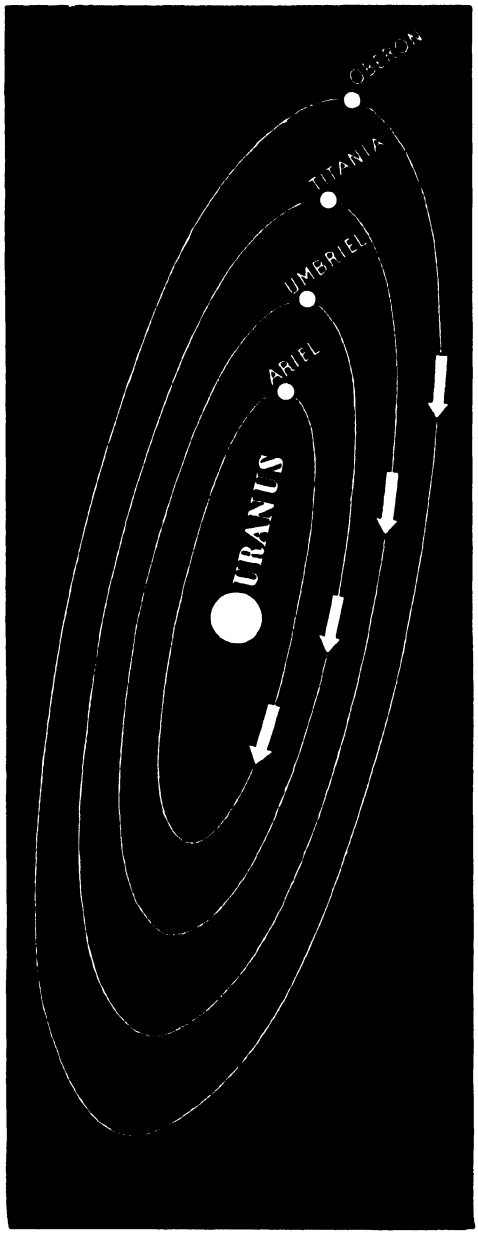
While we can not be certain as to the composition of the big planet, it is interesting to note the features of the schematic diagram deduced by Wildt, an authority on these matters. Wildt believes that the ammonia clouds and methane form the outermost layers of the planet's atmosphere. Below this he believes there exists a layer of hydrogen, about 18 per cent of the planet's radius. Below this comes an ice layer taking up about 39 per cent of the radius, and then a metallic rocky core for the remainder. This picture of Jupiter presents a rather unstable and unsolid planet. From the constant changes occurring in the atmosphere as we can observe it from the earth, it is evident that the outer layers are in a great state of turbulence, with storms and constant disturbances.

Jupiter has, as is fitting for such a large body, a big family of moons, eleven in all. Four of these were discovered by Galileo over three hundred years ago through his first little telescope, and for this reason they are called the Galilean moons. If a proper time for observing is chosen, these four larger moons can be seen with the aid of high-power binoculars. Of Jupiter's eleven satellites those which are numbered VIII, IX and XI are of particular interest to the astronomer because they travel backward, or with retrograde motion, in their orbits, contrary to the usual direction of rotation and revolution of the planets and their moons. The retrograde motion of these and a few other moons in the solar system is one of the unsolved mysteries of astronomy.

Saturn, the most beautiful and the strangest of all the planets when viewed through a telescope, comes next beyond Jupiter. It is smaller in size, about 75,000 miles in diameter, but still a giant in its own right. While Jupiter is almost 500,000,000 miles from the sun, Saturn is, on an average, nearly 900,000,000 miles from that body. You have probably often seen Saturn looking very much like a bright yellow star, moving so very slowly in its course against the background of the stars that you have not noticed any change from night to night. Over a longer period of time, however, its change in position can easily be seen. Since this yellow planet takes nearly 30 years to travel once around the sun, it is understandable why its nightly motion in the sky amounts to very little. Saturn's period of rotation is about 10 hours and 14 minutes, less than half an hour longer than Jupiter's day.

Although the outer planets as well as the inner planets actually travel eastward around

Saturn is, so far as we know, the only planet in our solar system to be surrounded by rings. The three broad, flat-looking rings are made up of millions of tiny bodies, like little moons, reflecting the light of the sun.



Here we see Uranus with four of its five satellites circling slowly around it, each in its separate path or orbit. The names of the satellites shown here—Ariel, Umbriel, Titania and Oberon—were taken from fairy lore. The satellites seem to us to be moving backward, for they revolve in the opposite direction from that in which the earth, the moon and most other members of the solar system revolve. This planet is extremely difficult to find with the naked eye, and it was not discovered until 1781, when it was at first thought to be a comet. Lonely Uranus is the seventh planet from the sun.

the sun and usually appear to be moving in that direction in the sky, occasionally they are seen to loop backward for a while toward the west. In the case of the planets beyond the earth this happens—the earth, traveling more rapidly than those planets which are farther from the sun, passes by one of them. Then we have somewhat the same situation as when an express train passes a local, bound in the same direction. To the observer on the express train the local seems to be going backward, or in the opposite direction. To the observer on the "express-earth" the "local-planet" seems to be going backward.

GALILEO'S DISCOVERY OF THE "EARS" OF SATURN

When Galileo first saw Saturn through his telescope he could hardly believe his eyes, for he thought he must have discovered a planet with "wings" or "ears," for he could not, with his poor telescope, see clearly enough to interpret correctly the strange sight before his eyes. What he saw so indistinctly was a large planet with a series of three broad flat rings surrounding it. Saturn, so far as we know, is the only planet in our solar system having rings.

Early astronomers believed that the rings of Saturn were flaming and fiery, but in the last hundred years it has been discovered through the aid of the spectroscope that the rings are composed of countless millions of tiny cold, dark bodies—we can call them tiny moonlets if we choose—each one shining by the reflected light of the sun as the great planet itself does.

CONDITIONS ON SATURN ARE MUCH LIKE THOSE ON JUPITER

In constructing as true a picture as possible of Saturn, its rings and its moons, let us first consider the globe of the planet itself, which is in many ways like its greater neighbor, Jupiter. While Saturn, too, is surrounded by belts of clouds in its atmosphere, these bands are not so pronounced as Jupiter's, and not so clearly defined. Here, too, we find violent disturbances in the upper atmosphere which must indicate great and cataclysmic changes occurring below in the unstable body of Saturn. Ammonia and methane are found in the upper clouds, as on Jupiter. The surface temperature is about 27 degrees lower than that of Jupiter, or about —243 degrees F., so we should expect to find, as on Jupiter, the ammonia in the form of crystals in the atmosphere and the methane in gaseous form.

If you can imagine yourself existing for

a moment on the surface of this precarious and quaking planet, with its poisonous atmosphere, you will in your mind's eye see one of the most glorious and majestic sights ever called to the attention of man. For stretching out into space, reaching away like a triple bridge of light from the surface of Saturn, is the great system of rings. The inner edge of the inner one of the three rings, known as the crape ring because of its veil-like thinness, is at a distance of about 6,000 miles from the surface of the planet. This inner ring is about 11,000 miles wide and, like the others, probably only about ten miles thick, less actually, in comparison, than the thickness of a sheet of tissue paper. Ring B, the beautiful and brilliant middle ring, is about 18,000 miles wide, with Ring A (the outermost one) about the same width as the crape ring. The entire ring system, from the inner to the outer edge, is more than 40,000 miles wide, and lies within the plane of the planet's equator. From the earth we sometimes see the ring system as a thin line, hardly perceptible. That is because we are looking at the rim of the system. At other times, the rings seem to "open up," and we see them much more completely. At times these great rings cast wide shadows on the surface of Saturn.

SATURN'S RINGS APPEAR TO US LIKE FILMY SCARFS

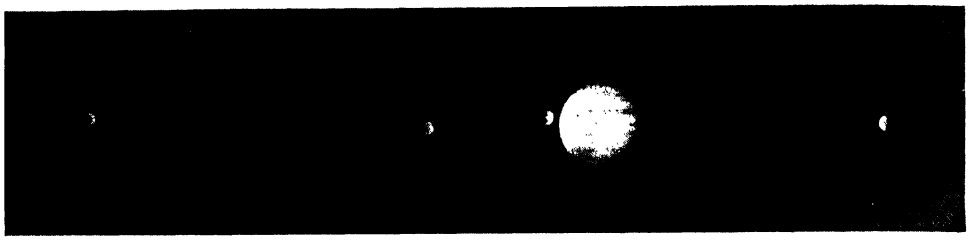
The crape ring is so thin that sometimes the body of the planet can be seen right through it, or sometimes even stars shine through. When the rings are "opened up" Saturn appears more than three times as bright as when we see the rings edge-on.

In addition to this wonderful and spectacular feature, Saturn has nine moons. The largest of these is Titan, about 3,000 miles in diameter. The nearest of these moons to Saturn is about 117,000 miles distant, and the most remote, Phoebe, about 8,000,000 miles. Phoebe revolves around Saturn in retrograde motion as do the three moons of Jupiter—VIII, IX and XI. All of Saturn's moons revolve around the planet outside the rings.

URANUS AND NEPTUNE ARE ALMOST IDENTICAL TWINS

As Jupiter and Saturn are often paired together, so are the next two planets, Uranus and Neptune. In fact, so far as we can tell, they are almost identical twins, being nearly of a size, about four times the diameter of the earth, with Uranus a little bit larger than Neptune. These two planets are so

This diagram shows the speed at which the planets revolve around the sun. The farther away a planet is from the sun the more slowly it moves along its orbit. Thus Neptune, which is much farther out from the sun than is the earth, takes 165 years—as long as from the Declaration of Independence to Pearl Harbor—to complete its journey.



Jupiter and the four satellites discovered by Galileo. From left to right: Callisto, Europa, Io and Ganymede.

far away that we do not know very much about them. Light, which travels at the rate of 186,000 miles a second, requires more than 8 minutes to cross the space between the sun and the earth. Uranus is so much farther away that the journey of a ray of sunlight out that far would take about 2½ hours, and to Neptune about 4 hours and 10 minutes. Because of their greater distance from the source of heat and light, Uranus and Neptune are both colder and fainter than Jupiter and Saturn. They both appear green when viewed through the telescope.

The year of Uranus is long, as we should expect, about 84 of our years. Neptune's year is longer still, some 165 of our years. Both planets rotate more rapidly than the earth, but not with Jupiter's speed. Uranus' day is about 10 hours and 45 minutes long, and Neptune's is nearly 16 hours.

Here again that interesting question of the possibility of life has to be considered, and the answer must be an immediate and emphatic "No." Methane and ammonia are found on these giants, too, though in different proportions from those on Jupiter and Saturn. Uranus and Neptune are so far away from the sun that the temperature is inconceivably low; no life could possibly exist.

Uranus boasts only five moons, though some astronomers suspect that there may be a sixth. All the moons of Uranus revolve around the planet with retrograde motion, and even the planet seems to rotate backward. Neptune has only one moon and that also is retrograde in motion.

When we reach Uranus we have come to the first planet which was not known to the ancient astronomers. They recognized, naturally, only those bodies which could be seen with the naked eye, since the telescope was not invented until 1610. Uranus was discovered, more or less by accident, by William Herschel in 1781. Herschel first thought this moving body, which he had observed against the background of the more or less stationary stars, was a comet; and he reported it as such. Later it was found to be the seventh planet from the sun. Although Uranus is not generally considered a naked-eye object, it can be seen at favorable times without optical aid if one knows just where to look. It then appears of about the brilliance of a sixth-magnitude star.

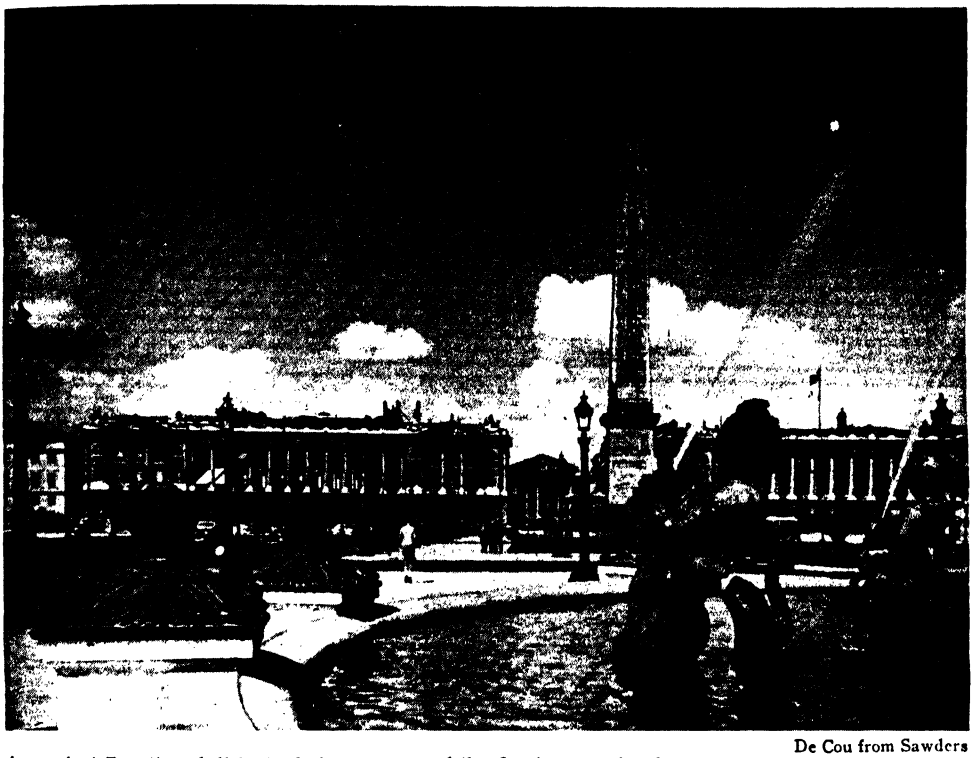
The discovery of Neptune in 1846 was not at all an accident. It had been noted for many years that Uranus did not move in its orbit as astronomers had calculated. It was quite generally felt that the discrepancies between the computed and the observed positions of the recently discovered planet must be due to the presence of another and unknown planet beyond it. At almost the same time two young mathematicians, Adams in England, and Leverrier, a Frenchman, independently of each other, undertook to solve this very difficult problem. Although Adams solved the problem first, giving an approximate position for the unknown planet, Leverrier had the glory of discovery, for the English astronomers would not bother to investigate Adams' work, while a German astronomer, Galle, located the planet quickly at just about the predicted position suggested by Leverrier.

Neptune is the farthest giant, but not the farthest planet. Out beyond Neptune is little Pluto, in some ways like our earth. We tell you about Pluto in the article on The Terrestrial Planets.

No astronomer is wise or farseeing enough to know yet whether there may be other planets beyond Pluto, which may some day be added to the roster of our solar system. Neither can anyone say with absolute certainty whether there are other solar systems moving around other suns than ours. Time alone can solve these great mysteries of the celestial universe—time, and the astronomer's ever increasing ingenuity and consecration to the task before him.

By MARIAN LOCKWOOD.

THE NEXT STORY OF THE EARTH IS ON PAGE 3535.



De Cou from Sawders

An ancient Egyptian obelisk stands in the center of the finest square in all Paris, the Place de la Concorde.

THE pleasant land of France lies in western Europe, in the heart of the Temperate Zone, just halfway between the Equator and the North Pole. It is not among the giants of this earth: approximately 200,000 square miles, or one-sixteenth of the United States. Texas by itself is larger than France, with Belgium, Holland, Luxemburg and Switzerland added for good measure. On the other hand, France has about the same area as the New England states, New York, Pennsylvania and Ohio combined, with about the same population (well over 40,000,000 inhabitants). It is the largest European country west of Russia. The French colonial empire—or, as the French now prefer to call it, the French Community or Federal Union —is larger in area than the United States, and numbers 73,000,000 inhabitants. But we all know that size is not everything.

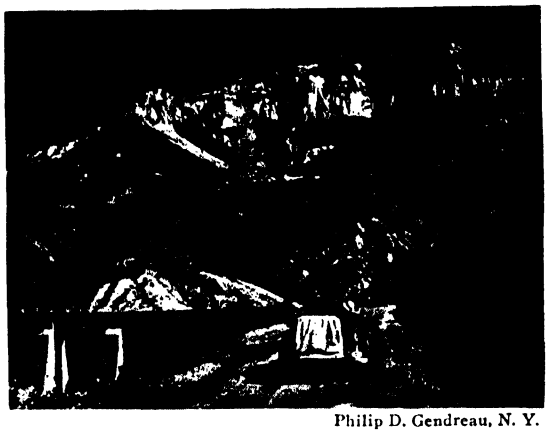
If we glance at our map, we shall see that France borders on the North Sea and the English Channel in the north, the Atlantic Ocean in the west, the Mediterranean Sea in the south. It is thus both a northern country like England and a southern country like Italy. You will find in France both palm and pine. But it belongs much more to the north than to the south, although its language, French, resembles Italian and Spanish: like them, it comes from the speech of the old Romans, Latin. Three of the main rivers, the Seine, the Loire and the Garonne, flow to the north or west. Only the Rhône runs into the Mediterranean.

France is roughly a hexagon, that is to say, a figure with six sides. Of these, three are sea or ocean coasts; two are high mountains, the Pyrenees in the southwest, the Alps in the southeast. The sixth side, in the northeast, is artificial. The boundary, which has been changed many times, cuts right across river valleys, so that the Saar, the Moselle, the Meuse, the Scheldt, have their upper course in France and flow into other countries. That is why there has been so much fighting on that frontier for at least two thousand years.

France is an extremely varied country. Although it is only six hundred miles from

Screen Traveler, from Gendreau

Etretat, near Havre, nestles between the cliffs on the Channel.



Philip D. Gendreau, N. Y.

The French Alps rise gaunt and stern without winter's snows.

Screen Traveler, from Gendreau

Sky and water are vivid blue along the Mediterranean near Nice.

north to south or from east to west—a couple of hours' flight in a fast plane, a day's hard driving in a good automobile—it contains samples of practically everything that you could find in Europe. I spoke of "the pleasant land of France," and it well deserves the name. Many parts of it are like a park or a beautiful garden, with gentle wooded hills, placid rivers and friendly villages clustering round their church spire, fine country houses or châteaux. But that does not tell the whole story. Other parts of France are fine, too, but in a more rugged and wilder fashion. The Pyrenees, between France and Spain, form an enormous and impressive wall. The French parts of the Alps are the highest of all (Mont Blanc, 15,780 feet); and in Savoy, or Dauphiny, they are even grander than the better known Swiss Alps. The Central Mountains, or Monts d'Auvergne, offer a great variety of aspects. There are strange volcanic landscapes that look like the dead craters of the moon. One of the rivers in this region, the Tarn, has a canyon, or deeply encased valley which resembles, on a small scale, that of the Colorado. The mighty river Rhône rushes furiously between mountain spurs, crowned with ruined feudal castles like those of the Rhine. The granite coast of Brittany has been carved into fantastic shapes by the pounding waves of the Atlantic.

The climate of France is not smiling all the time. Canadian and United States soldiers during World War I and again during World War II found that it could be dismally wet and cold. When you get farther away from the sea, the climate gets more extreme: in the eastern parts of the country, the winters are very sharp, the summers are brief and very hot. Still, on the whole, the climate is temperate, a little drier and sunnier than that of England. No French port is ever ice-bound; and it is exceedingly rare for the Seine in Paris to be frozen over. The Riviera, the coast along the Mediterranean, well protected from the northern winds, is a winter paradise.

We think of France, naturally enough, as a great agricultural country.

THE MAP OF FRANCE

Copyright by HAGSTROM CO., N. Y.

If you look carefully at this map you will see that France possesses great natural highways between the Mediterranean and the Atlantic Ocean. One highway follows the valleys of the Rhone and Saône rivers and crosses to the Seine which flows into the English Channel. Another highway, skirting the Cevennes Mountains, gains the Atlantic by way of the valley of the Garonne River. France has good inland waterways, with the principal rivers and their tributaries all connected by a series of canals. Almost all the big cities are on, or near, a waterway.

Philip Gendreau, N. Y.

No hardier stock exists than the Brittany fishermen, who for generations have made their living from the perilous sea.

It produces many kinds of food, and of very high quality. Much wheat is grown: the French are great bread-eaters. They use corn very little, and do not rely on the potato quite so much as we do. French bread is famous all over the world. The people like to eat cake, too, and you must have enjoyed French pastry, for we have it in our country.

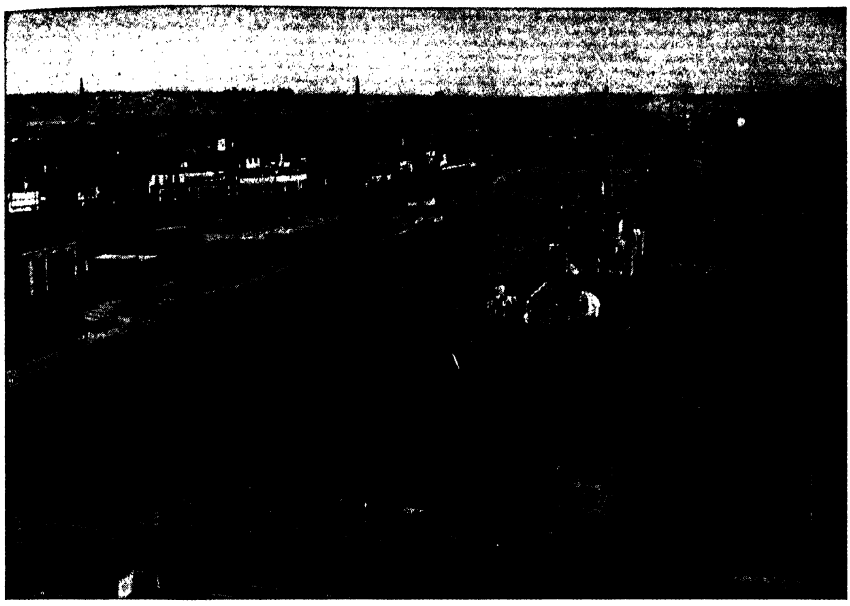
The French have a wonderful assortment of salads and cheeses: Camembert, Port-Salut, Brie, Roquefort, are well worth trying. They grow excellent fruit—from the apples, plums and cherries of the north to the oranges of the south. Although fruit may grow more abundantly in other countries, there is nothing that can match a perfect French peach or pear: it is a work of art. Of course, the crowning glory of agricultural France is her wine. You know of sparkling Champagne, with which ships are christened; of Burgundy, both red and white; of Bordeaux (claret and Sauterne). These wines are all named for the regions where the grapes are grown, and there are many other regions that produce excellent wines and liquors.

The French are not heavy meat-eaters, although their *filets mignons* (small steaks) and *gigots rôtis* (roast leg of lamb) are not to be despised. They favor veal and chicken: good King Henry IV wanted "every peasant to have a chicken in the pot on Sunday." It is a fact that on rare occasions they do eat snails and frogs' legs; but do not imagine that they make a steady diet of these quaint delicacies.

On the whole, although France is a good country for agriculture, the soil is not miraculously rich. It produces enough only because it is tilled with obstinate and loving care; even in favorable years, the country just manages to feed itself. The French live well, but frugally; they hate waste, and they have the art of making cheaper cuts and leftovers palatable. You have heard of the Land of Cockaigne, where rich, well-cooked food simply hangs on trees. Well, it is not in France that you will find that fabulous country.

Of the industrial crops, the only important one is beet, in the north, used for making sugar. The Riviera, with Nice as

GATEWAYS TO THE SEA, NORTH AND SOUTH



Miles of piers jut out into the harbor of Le Hâvre. They are able to accommodate huge ocean-going liners and freighters. The port suffered terrific bombardment in World War II, but its former usefulness is being restored.

Both pictures, James Sawders

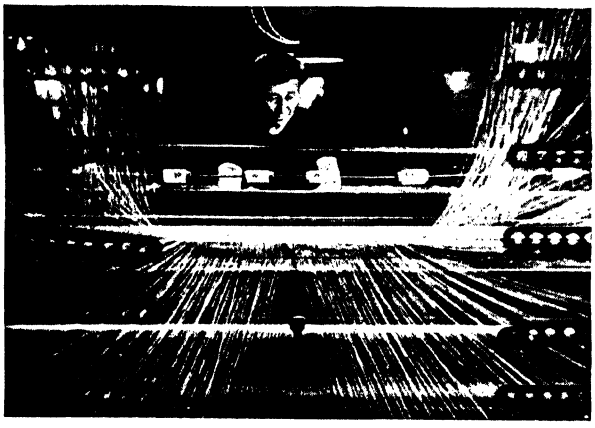
A breakwater gives ships safe harbor in the old port of Marseilles. The cathedral is built in Byzantine style.

French Press and Information Service

These blithesome figures are dolls, wearing miniature copies of Paris-designed clothes.

James Sawders

An iron-and-steel manufacturing plant in Lorraine. There are rich iron mines near by, the most important mineral resource of France.



Both pictures, French Press and Information Service

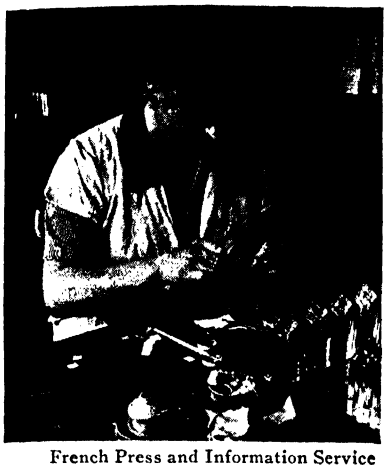
Hundreds of threads—to weave a fabric with an intricate texture. For centuries beautiful silk and woolen textiles have been woven in France.

An exquisite porcelain vase in the making. French "china" is an important export.

the center, grows flowers for perfumery. Flax and hemp are grown, but France has no cotton. The French forests are still large, although at one time they were cut down rather ruthlessly; now France has to import wood, particularly from Norway.

From the industrial point of view, the resources of France are not so well balanced. She has an abundance of iron and considerable coal deposits, but little oil, no precious metals to speak of, no copper, tin or zinc. She has big potash deposits in Alsace, and a good supply of bauxite, from which aluminum can be extracted. As a substitute for coal, the French have plenty of water power, "white coal," and with its aid they generate electricity. Thanks to falling water, that natural source of energy, there are regions in the Alps, the Pyrenees and the Central Mountains which are becoming industrialized. If it had not been for the war, all the main lines of French railroads would by this time be run by electricity.

The chief asset of France is not the natural wealth of the soil, but the cleverness and hard work of the people. They have been good craftsmen for centuries, and have not lost their skill. Their chief resource is to be resourceful. When the silkworm business suffered from a disease of the mulberry tree, Lyons remained a great manufacturing center, importing raw silk from the Orient; and the French were among the inventors of artificial silk. They are at their best in those



French Press and Information Service
Making fine perfume is an art of which the French are masters.

James Sawders
Strasbourg, in Alsace, is a busy river port. It is on the Ill River, only two miles from where the Ill joins the Rhine.

James Sawders
Beets being planted next to a field of rye. The land is carefully tilled, but in many regions the methods are still old-fashioned.

French Press and Information Service
A draftsman works on a new design for a French automobile.

trades that require a great deal of taste and finish: jewelry, watches, precision machinery, printing, decoration, fine clothing. The Rue de la Paix (a short street) in Paris is the center of feminine fashion. The fine furniture of the Faubourg Saint Antoine (another street in Paris), the artistic rugs from Beauvais and Aubusson, Gobelins tapestries, China from Sèvres and Limoges, crystal wares from Baccarat and Saint Gobain, are among the lovely things in our civilization, and I hope you will get acquainted with them.

The French were among the pioneers in automobile construction, aviation, radio and the movies; they are still doing outstanding work in these fields. Perhaps the best symbol of French industry and art combined was the magnificent ship Normandie: enormous and graceful, smooth and swift, a triumph of engineering, a floating museum, and a home of refined living. America fell in love with that ship, and mourned when she burned at her pier in New York.

The main ports of France are Dunkirk on the North Sea; Rouen and Le Hâvre on the Seine; Cherbourg, a port of call for transatlantic liners; Nantes and Saint Nazaire on the Loire; Bordeaux on the Garonne; and the oldest and most active of all, Marseilles on the Mediterranean, near the delta of the Rhône. Brest and Toulon are the main naval bases. Of inland cities, the principal ones, after Paris, are Lyons, Lille, a textile center in the north, Toulouse on the Garonne, and Strasbourg on the Rhine. But most charming perhaps are the innumerable old provincial towns with less than 100,000

Culver Service
The baptism of Clovis, first Frankish king.

inhabitants, like Amiens, Tours, Angers, Dijon and Grenoble.

And above all, there is Paris, seat of the French government, greatest industrial, communication and banking center in the country, with over 2,800,000 inhabitants; Paris, with the accumulated memories and monuments of twenty centuries; Paris, hard-working and gay, a Mecca for artists, writers, scholars, with a university which is the oldest in the Western world. Paris is not France: but it draws its brightest minds from all countries, and it imposes its style upon the most distant lands. Many great events have taken place in Paris, and will be mentioned at the proper time. The liberation of the city by its own people, in August, 1944, showed that the Parisians had lost nothing of their indomitable spirit. Versailles, the famous residence of the Bourbon kings, is a fine suburb about twelve miles from Paris.

Who are the French people who live and work and play in that fair and busy land? Why, like ourselves, they are "just folks." There is no French race: all the families of man living in Europe are represented in France. As in the case of Canada and the United States, many famous citizens bear foreign names. The average Frenchman is "average": neither very blond nor very dark, neither very stocky nor very slender. A tall Frenchman like De Gaulle is just as French as a short Frenchman like Napoleon. Of two great writers, both extremely French in spirit, one, Voltaire, was a bag of bones; the other, Ernest Renan, was a ball of fat. The stage Frenchman, very short, very shrill and gesticulating, is a caricature, or at any rate, an exception. The best way to tell a Frenchman is by his smile. That smile is not childlike and bland; but it is not malicious either. A smile shows, not that a Frenchman approves, but that he understands.

THE PREHISTORIC CRO-MAGNONS, THE VERY FIRST "FRENCHMEN"

The country we now call France has been lived in, without interruption, for ages and ages. Axes and other instruments of chipped stone, and later ones of polished stone, are found almost everywhere. About 20,000 years ago—ten times the span of years between the birth of Christ and the present day—there lived in France a race fully as tall and well built as we are. From the place where their remains were found, the name of Cro-Magnon was given to them. In those days, the country must have been much colder than it is today, and the reindeer was the most important animal. In the deepest and darkest parts of their cave-dwellings, the Cro-Magnons painted wonderful pictures: animals are sketched with a few sure strokes, as simple, as lifelike as a Walt Disney cartoon. People thought that the Cro-Magnons had all died out long ago. Then it was discovered that peasants living in that region had the same peculiar head-shape as the Cro-Magnons: indeed, they are real, live Cro-Magnons. So there are families in France who have dwelt on the same spot for 20,000 years! Other ancient men left as their monuments long lines and circles of enormous standing stones, the best preserved of which are at Carnac in Brittany.

About 400 years before Christ, the country was invaded by wandering tribes, called

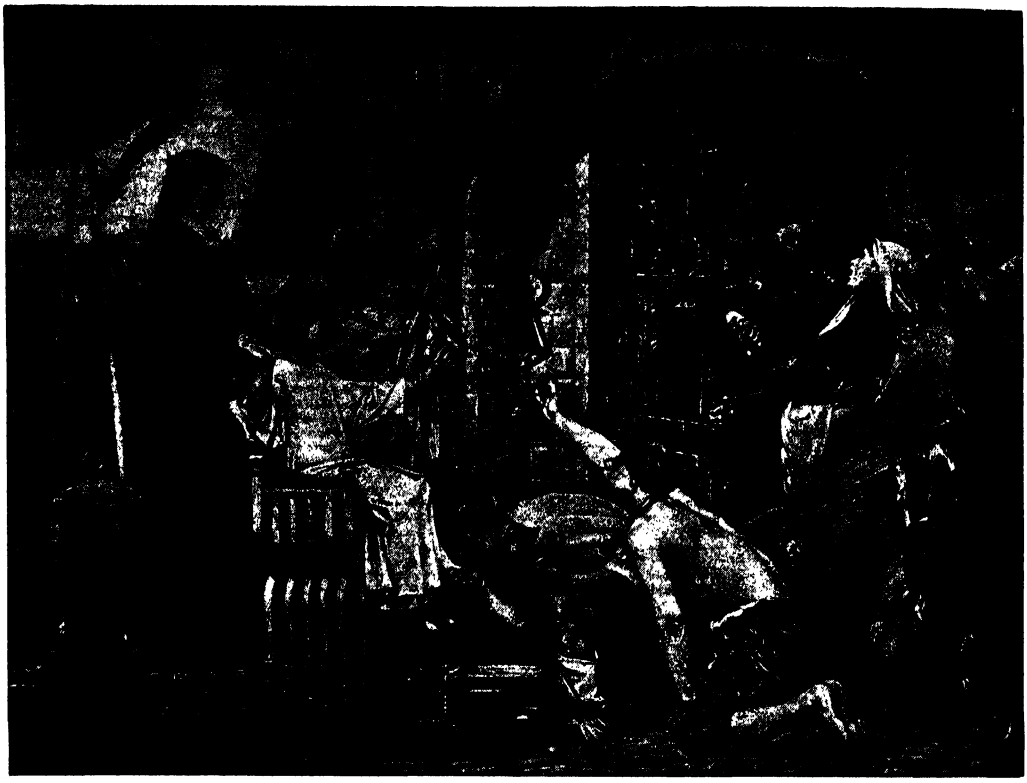
Charlemagne (on white horse) receives the surrender of Wittekind, a Saxon leader. Wittekind was the last of the Saxon chiefs to yield to Charlemagne. This event occurred in 785, fifteen years before Charlemagne became emperor.

the Gauls or Celts. They roamed over an enormous territory: that is why we find such names as Gaels, Wales, Galicia in Spain, Galicia in the Ukraine, Galatia in Asia Minor. We know very little about these Gauls. They were blond or reddish, great fighters, armed with long iron swords. They had priests called Druids. They worshiped natural forces in a natural setting: a clearing in the deep forest, or a bald mountain top.

But though they were madly brave, "fearing nothing except that the heavens should fall," they did not know how to organize themselves. Their many tribes formed rival leagues, constantly shifting and always at war. So Caesar, the Roman statesman and general, took advantage of their divisions. But although his legions were well armed and well disciplined, and although he was one of the ablest war leaders of all times, it took him seven long years to subdue the Gauls (58-51 B.C.). The last Gallic chieftain to oppose him, Vercingetorix, is considered by the French as their first national hero.

After Gaul was conquered, it became a peaceful and prosperous part of the Roman world. The Celtic language disappeared, and Latin took its place. Throughout France, and especially in the south, there are impressive ruins of Roman monuments: triumphal arches, temples, aqueducts, theaters. Even Paris, which at that time was but a fishing village called Lutetia, had a stadium and great public hot baths. The capital was Lyons. There were universities at Toulouse, Bordeaux and Autun. Marseilles, founded by the Greeks long before the Romans came, remained a free Greek city allied with the Romans.

But in time the barbarians from northern and eastern Europe pressed on the Roman world; and the Roman Empire, corrupt and torn by quarrels between rivals for the throne, was unable to defend itself. In the third century after Christ, the barbarians burst into Gaul. They were finally driven back, but the country was ruined, and had lost spirit. In the fifth century, the wild



Culver Service

The good Louis IX begins his reign, at the age of twelve, by releasing the many innocent people unjustly imprisoned.

hordes of barbarians came back with greater violence, wave after wave. The last and the fiercest, the Huns, under Attila, were stopped by the Romans, the Gauls and the earlier invaders banded together at Catalaunian Fields. It was one of the decisive battles of the world (451); but we do not know for certain where it took place. Perhaps Catalaunian Fields was Châlons in Champagne.

Although the Huns were checked in Gaul, Rome could not recover. The Roman Empire of the West ended in 476, and Gaul was left to shift for herself. The new invaders were Teutonic, or Germanic, tribes—Ostrogoths, Visigoths, Vandals, Burgunds. Some went through Gaul on their way to Italy, Spain and North Africa; some settled in the country.

It was one of the lesser tribes that finally won the upper hand: the Franks, moving south from Belgium. The earlier barbarians had become Christians: but, not knowing the difference, they had accepted what is known as a heresy, or false belief. The Franks, who had remained pagans longer, became members of the Holy Roman Catholic Church.

Now the Roman Gauls, or Gallo-Romans, were Catholics already. So they and the Franks united against the heretics, and eventually the small tribe of the Franks conquered the whole of Gaul. The leader under whom this was achieved was Clovis, who lived from about 465 to 511. Clovis belonged to the Merovingian family. He was baptized at Reims in 496, and his office assumed a sacred character: he was "the Lord's Anointed." In memory of this, most French kings later were crowned in the beautiful cathedral of Reims. The most famous of such coronations was the one which Joan of Arc made possible, in 1429. The last was that of Charles X in 1825.

It was these Franks who gave France the name she now bears. Although converted, the Merovingians remained barbarians, and their chronicles are a dreary tale of crimes. They even lost their fighting qualities, and at the last were known as the Lazy, or Do-Nothing, Kings. The men who did the real work of governing were officials named Mayors of the Palace, or General Managers. One of them, Charles Martel (i.e., the Ham-

mer) stopped the Mohammedans, or Saracens, who were pressing into Gaul, in a great battle somewhere between Tours and Poitiers (732). His son Pepin the Short removed the Do-Nothing King, who was shorn of his royal locks and made a monk.

The son of Pepin was Charles, who fought the Saxons, the Lombards, the Saracens. He was much more than a warrior: he fought barbarism at home. He tried to climb the slow, painful way back to law, order, civilization. He held courts of justice, he sent agents to enforce his decrees, he started schools. The Pope, whom he protected with his sword, rewarded him by proclaiming him Emperor of the West (Christmas, 800); and the world still knows him as Charles the Great, or Charlemagne. The French revere him as a saint. Charlemagne lived from 742 to 814.

But even Charlemagne could not check the slow decay that had come with the weakening of Rome. He could not prevent the Norsemen from raiding the coasts of the Empire and the river banks as far as their long dragon-boats could reach. One of his successors, in despair, was to "give" them the country at the mouth of the Seine, which is called by their name, Normandy.

Francis I, who was almost constantly at war.

Charlemagne was also unable to impose his rule upon all his lords. Each strong man with an armed band and a fortified castle became practically an independent sovereign, ruling the countryside. Each lord swore loyalty to an overlord, and he to one still higher, from degree to degree; in theory, the King-Emperor was lord of all. This pyramid of loyalties or "fealties" was later called the feudal system or regime. But it never was a system: it was a condition, and a very confused one at that.

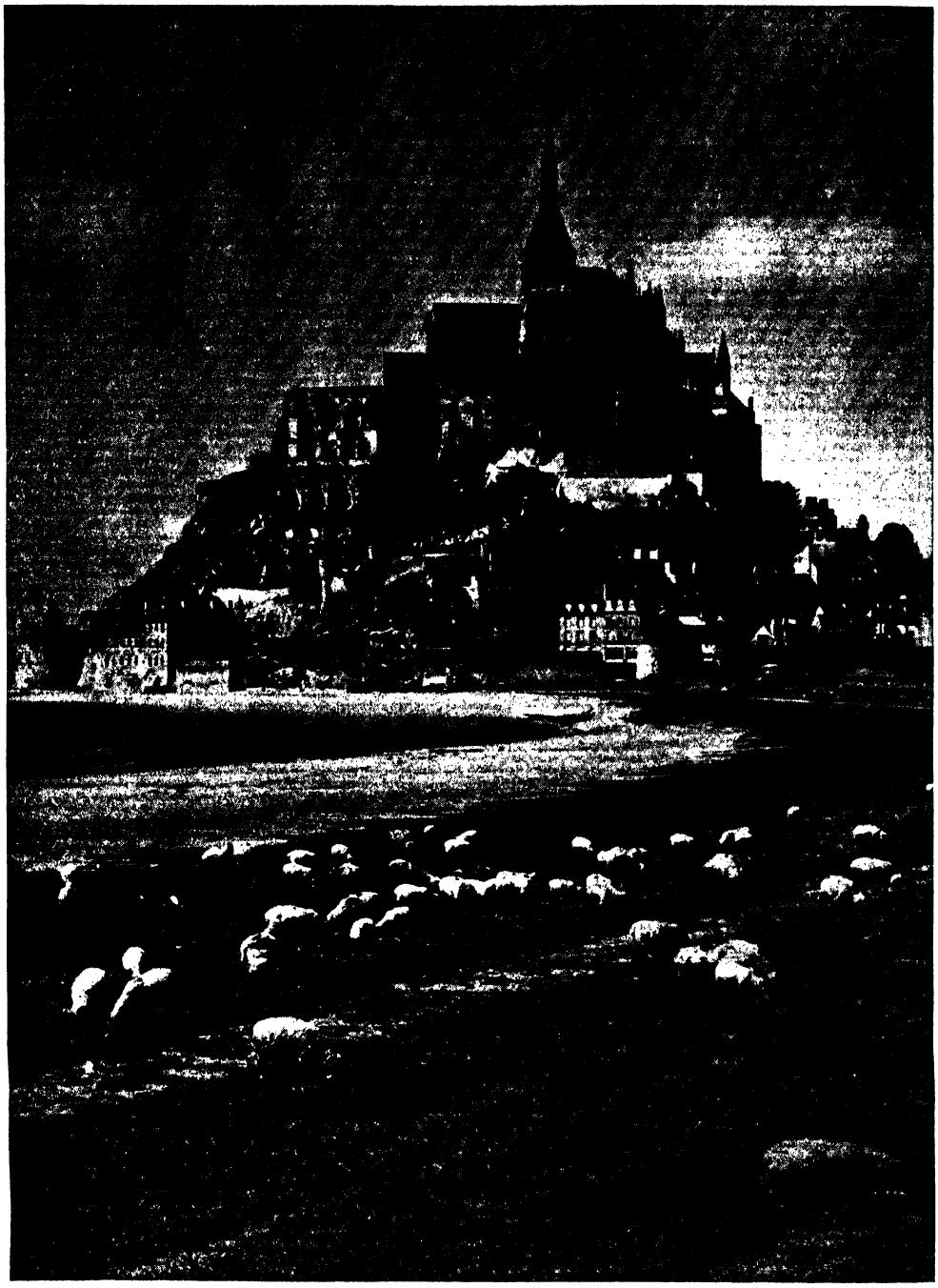
Charlemagne's grandsons fought among themselves, and the Empire was broken up. For the first time, "France" and "Germany" were clearly separated. Two of the brothers, allied against the eldest, took oaths in French and in German, so as to be understood by both armies. (Oaths of Strasbourg, 842.) The Empire was divided into three parts in 843, by the Treaty of Verdun. Charles the Bald had France, Louis had Germany, and for the eldest, Lothair, they created a long band of territory called after him Lotharingia, Lothringen, Lorraine. A province in eastern France is still known by that name. Strasbourg! Verdun! Lorraine! Exactly eleven centuries later, in 1943, the French and the Germans were still fighting for those very places.

The successors of Charlemagne, called the Carolingians, went the way of the Merovingians: incapable, they had to be removed. Because a Count of Paris, Odo, defended the city against the Normans, while the Carolingian emperor, Charles the Fat, could only appease and bribe them, the French made Odo their king. For a hundred years, the situation was uncertain. Finally, a descendant of Odo, Hugh (Hugues), was elected king (987). He was nicknamed Capet (Hugh with the Hood), and his descendants were known as Capetians. There is still a Count of Paris who, after nearly a thousand years, traces his ancestry to Hugh Capet.

With the Carolingians, the Frankish period of French history ended. The barbarians had brought little into Gaul except their barbarism. If the last Romans were corrupt, the Franks were worse. Few words of their language have survived into French, and only faint traces of their customs. "Gothic" architecture had nothing to do with the Goths; it was created in Royal France, some 700 years after the invasions.

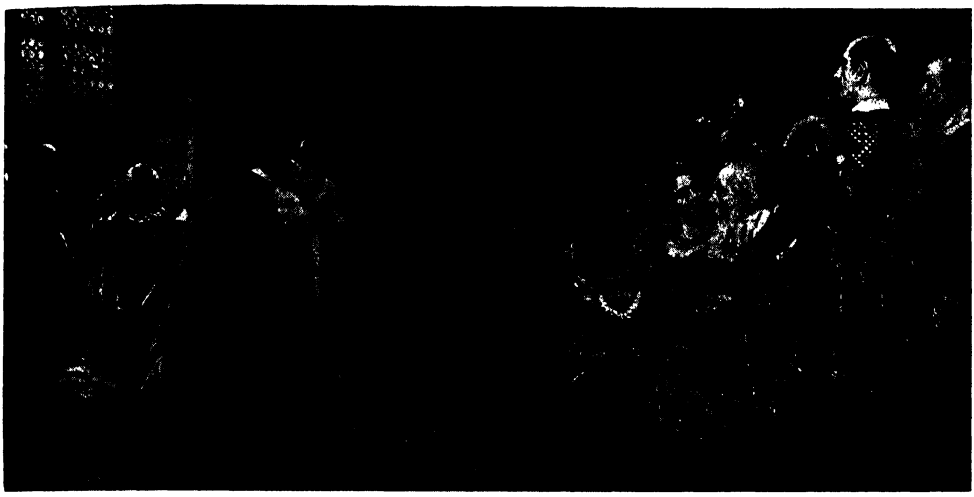
The early Capetian kings were not powerful. They ruled directly only their own duchy, some sixty miles around Paris; and even there they could be defied by any baron with a stout fortress. But in theory, they

"THE MOUNT IN DANGER OF THE SEA"



Philip Gendreau, N. Y.

Mont Saint Michel is an island in the inner part of the bay between Normandy and Brittany. A mile-long dike, which is under water at high tide, connects it with the mainland. Ancient fortifications, with deep dungeons and crypts, encircle the base. A tiny village clings to the foot of the rock. Above are cloisters and a beautiful thirteenth-century abbey. At the very top is a superb Gothic church, with a statue of the Archangel Michael capping its tall spire. The island survived World War II undamaged.



The young Richelieu is presented to Henry IV. Later, as Cardinal Richelieu, he was to wield great power. Richelieu, as chief adviser to Henry's son and heir, Louis XIII, helped to make France a strong nation.

were the heirs of Clovis and of Rome. They were closely allied with the Church. In the eyes of the people, they represented law, order, unity, against the confusion and violence of the feudal lords. So, for centuries, France and the Capetian dynasty grew together. The kings added to their domain, as a landed family adds to its estate. Instead of being just a lord with a more pretentious title than the rest, the king became really the living law of his kingdom, the sovereign.

This progress was shown in the prestige of Philip II (he reigned 1180 to 1223), who so impressed his contemporaries that they called him Augustus, like the first Roman emperor. He defeated an alliance of the King of England, the Count of Flanders and the German Emperor, with the help of the militia of the free cities (Battle of Bouvines, 1214). He extended the royal domain at the expense of the English. He had the main streets of Paris paved. He started rebuilding the Louvre, that immense palace on the banks of the Seine which, after a thousand years, is not yet completed. It was under his reign that the Cathedral of Notre Dame of Paris was built and the university was organized.

Greater still was Louis IX, known as Saint Louis (reigned 1226-70). Pious and gentle he was, a friend of the common people, a lover of justice. He was also a good administrator, a diplomat and a war leader. His virtues increased the power of his dynasty even more than the cunning and vigor of Philip Augustus. He was respected as the first king in Christendom. He died on the second of his Crusades, at Carthage, near Tunis. Many churches and many cities, in America as well as in France, bear the name of this king who was at the same time a judge, a knight and a saint.

The twelfth and thirteenth centuries form a great age, one of the finest in history. But that splendor was not due to the Capetian kings. The Church was then the leading power. It was the time of the Crusades for the liberation of the Holy Land; the time of the monks clearing the wilderness and preserving ancient learning, the time of the friars preaching to the common people. It was the time when the universities were created: thousands of students flocked eagerly to hear Peter Abélard in Paris; they all spoke Latin, and to the present day the students' district in Paris is known as the Latin Quarter. Nor was Abélard the only great scholar; there was St. Thomas Aquinas and there were many others.

It was the time of the lovely Gothic churches. France possesses scores of majestic cathedrals—the best known of which are in Paris, Amiens, Reims and Chartres—and literally hundreds of lesser churches and chapels, jewels of stained glass and chiseled stone. In the Normandy campaign of 1944, it was difficult for armies to move without damaging some masterpiece of Gothic art.

When we think of those days, we have first in mind the Church, the king, the barons in their feudal castles, the knights "in shining armor"; but the common people showed

AN END AND A BEGINNING OF POWER

Marie Antoinette had been a frivolous, extravagant queen, earning the hatred of her subjects. But when she was tried during the Revolution, she faced her judges bravely and accepted the sentence of death with calm dignity.

Josephine, crowned empress by her husband, Napoleon I, only a few minutes after he had placed the emperor's crown on his own head. Pope Pius VII conducted the ceremonies, but Napoleon did the crowning with his own hands. Five years after the crowning of Josephine, Napoleon divorced her and married an Austrian princess.

the same vigor of life. The towns won for themselves liberties, at times through very hard struggles. When they had secured a charter, they became communes. A commune was like a collective feudal estate; its fortified walls were its castle; it had its armed forces or militia, its banner, its coat-of-arms; it took pride in the city hall with a proud soaring belfry. Within the cities, the trades organized themselves into unions, known as crafts, guilds and brotherhoods. There was nothing dark and primitive about these turbulent and lusty days.

French literature was already well started, and the French language in the thirteenth century was more generally used than any other in Europe. We find poems of fighting, with a touch of the crusading spirit, like the SONG OF ROLAND; poems of adventure and love, the finest of which is the story of Tristan and Isolt; delicate lyrics by minstrels known as *troubadours* in the south, *trouvères* in the north; a charming romance interspersed with songs, AUCASSIN AND NICOLETTE; a graceful allegory of love, THE ROMANCE OF THE ROSE; stories or dramas about the Blessed Virgin and the saints. But side by side we find the sturdy, mocking spirit of the city people: THE ROMANCE OF REYNARD THE FOX, which is a take-off on the lords and the knights; jolly tales and farces of rogues and tricksters, not very different from some of our modern comics and movies.

Empress Eugenie, wife of Napoleon III.

It is difficult to tell what caused this teeming, virile, colorful civilization of the Middle Ages to sicken in the fourteenth and fifteenth centuries. But sicken it did. Gothic art, the universities, the cities, the guilds, all lost their vitality. Knighthood became a show instead of an ideal. In addition, France was devastated by an interminable war which, by fits and starts, raged for more than a hundred years.

When the direct line of the Capetians died out in 1328, the king of England, Edward III, put forth his claims as next of kin. England, as you know, had been ruled by French (Norman and Angevin) dynasties and by a French aristocracy since 1066. Another pretender, Philip of Valois, was preferred to the English king; but that left a rancor between the two houses. With a single exception, the French kings during that period had neither political nor military sense. They relied in battle on their feudal cavalry, which was brave, well armed, but careless and unruly. The English kings were shrewder; and they knew how to use newer methods, the long-bow of their well-disciplined yeomen. (It was in the Hundred Years' War that artillery first appeared; but it was very crude and, for a while, made little difference.)

So the French, decade after decade, lost decisive battles: Crécy (Cressy), 1346; Poitiers, 1356; Agincourt (Azincourt), 1415. One French king was made a prisoner; another went mad. The land was overrun with armed bands, brigands rather than soldiers. The peasants rose in wild rebellion. To complete the tale of horror, a plague, the Black Death, killed many of the people.

The nobles on the French side fought among themselves: the two factions were known as Armagnacs and Bourguignons (i.e., Burgundians). Finally, the Queen of France herself betrayed the country and agreed to the treaty of Troyes (1420): by this the English king was recognized as heir to the French throne. It was the darkest hour in France's long history.

France had been ruined by the folly and treason of the great; she was redeemed by a daughter of the common people. Little Joan of Arc, a peasant girl of the Lorraine border, was tending her sheep when she heard angel voices bidding her go to the true king and lead him to victory. She believed in her miraculous mission. She went to the French heir to the throne, the dauphin (i.e., crown prince), Charles. He was helpless and indifferent; but she managed to rouse him. He gave her a small army, with which she at once liberated Orleans, at the bend of the Loire, a point of commanding importance in

the war. Then she took the dauphin to Reims and had him crowned Charles VII, king of France, according to the ancient rites (1429). These two events made a tremendous difference. The partisans of the English lost faith, the French took heart. Joan herself was captured by the Burgundy men, sold to the English, condemned by a Church court and burnt at the stake in Rouen (1431); but her spirit was marching on. Within a few years, the English had nothing left of their French possessions except the city of Calais.

FRANCE IN TRANSITION BETWEEN FEUDAL TIMES AND THE RENAISSANCE

You will certainly read some day THE HUNCHBACK OF NOTRE DAME, by Victor Hugo. It shows France and Paris in a strange twilight: the Middle Ages fading, the new dawn still very faint. The king at that time was Louis XI: crafty and cruel (they called him King Spider), superstitious and ailing; but also a clever schemer and a very able administrator. In those days also lived the vagabond poet François Villon, whose ballads are better worth remembering than the deeds of kings. Louis XI reigned from 1461 to 1483.

If France had partly lost her way in the fourteenth and fifteenth centuries, Italy had forged ahead. By 1500, she was by far the most brilliant center of European civilization. Her fame for wealth and luxury attracted foreign sovereigns, particularly the French. For sixty years, under four kings, the French were constantly crossing the Alps into Italy, under pretext that they had some claims on the Duchy of Milan or the Kingdom of Naples. Out of these Italian wars came European wars, in which Spain, Austria and England were involved. The best remembered of these four French kings is Francis I (reigned 1515-47); and his great rival was the King of Spain, Archduke of Austria and German Emperor, Charles V.

These wars were disastrous for Italy: they did the French no good. No doubt the arts, learning and refinement of Italy spread north of the Alps. But the French could have bought pictures and books and borrowed scholars and artists from Italy without fighting for sixty years.

In spite of the wars, there was an admirable spirit of renewed power, adventure and joy throughout Europe in those days. It was shown in great inventions (the printing-press), in daring voyages (Vasco da Gama, Columbus, Magellan), in the expansion of

Victorious Germans enter Paris—March, 1871.

industry, as well as in a revived interest in the arts and thought of Greece and Rome. That spirit of confidence and daring was known as Humanism, a desire to fill human life to the brim; it was also called the Renaissance, which means a new birth. In France, this spirit found its best expression in François Rabelais. This learned man told with great gusto fantastic popular tales of giants with ravenous appetites; but the true meaning of his enormous jollity is hunger for knowledge and experience. At that time were built beautiful castles and palaces, particularly in Paris (Louvre, Tuileries, City Hall), in the Loire region (Blois, Chambord, Chenonceaux), and at Fontainebleau.

The same restless, adventurous spirit was evident in religion also. Many felt that reforms were needed; but people could not agree how far these reforms should go. In Germany, the leader of the reformers was Martin Luther; in France, John Calvin, who later established himself in Geneva. Unfortunately, religious differences served as a pretext for political quarrels. There were in France nearly forty years of so-called Religious Wars (1560-98). As a matter of fact, these were civil wars, led by rival

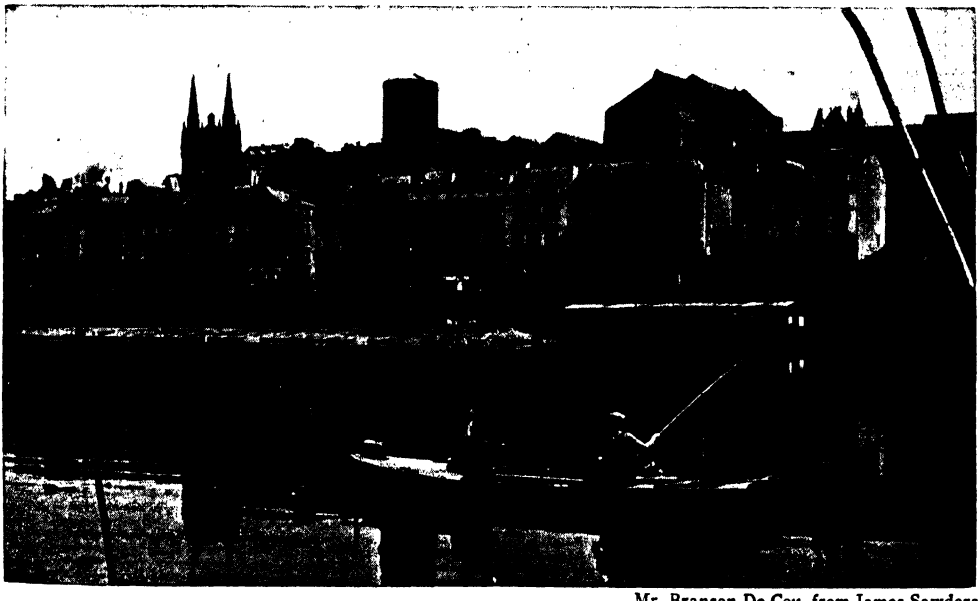
princely families, the Guises (Catholics) and the Bourbons (Protestants or Huguenots), just like the Armagnacs and Bourguignons during the Hundred Years' War. The kings, caught between the two, did not know which way to turn. At one time, a king ordered the massacre of all Huguenots (St. Bartholomew's Night, 1572). But the next king caught the Catholic leader in a trap, and had him assassinated—only to be stabbed to death in his turn (1589).

The age was almost as dark as at the worst moment of the Hundred Years' War. But France emerged again from that horrible anarchy. In 1589, the heir to the throne was Henry of Bourbon, king of Navarre. He was the next of kin, but he was a Huguenot, and many of his Catholic subjects refused to recognize him. So for several years, he had to fight for the crown. At first, he was hardly more than the leader of a desperate armed band, with his capital Paris in the hands of his sworn enemies. But he was an able general and, above all, he was shrewd, kindly, tolerant. He could fight very bravely, but he could also win people with a smile. The sensible, moderate element rallied round him.

The long struggle ended in a compromise. Henry of Navarre became the undisputed king of France, as Henry IV. He was converted to Catholicism; but he secured ample liberties and full protection for his faithful comrades at arms, the Huguenots. A Huguenot, Sully, remained his chief adviser. That compromise was registered in the Edict of Nantes (1598), one of the first and greatest victories of tolerance.

Henry IV reigned until 1610, restoring order and promoting prosperity. He had seen the distress of the countryside, and he wanted the people to have an easier time, with a bit of luxury, "a chicken in the pot every Sunday." He had a good sense of fun, and could be familiar without loss of dignity. He is remembered by the French and the world with an affectionate smile, as good King Henry. Yet he too was murdered by a fanatic (1610).

As soon as he died, the nobles were at it again, plundering the state and quarreling among themselves. Henry's son, Louis XIII, was a small child, and his widow a rather weak and stupid woman. Henry's true successor was Cardinal de Richelieu. Richelieu, very different from Henry, could not smile; his whole life was a triumph of inflexible will. King Louis XIII, when he came of age, had the good sense to recognize the greatness of Richelieu, and let him have his way. Richelieu restored order through the only instrument available at the time: royal power. The Protestants, who had tried to form a state within the state, lost their politi-



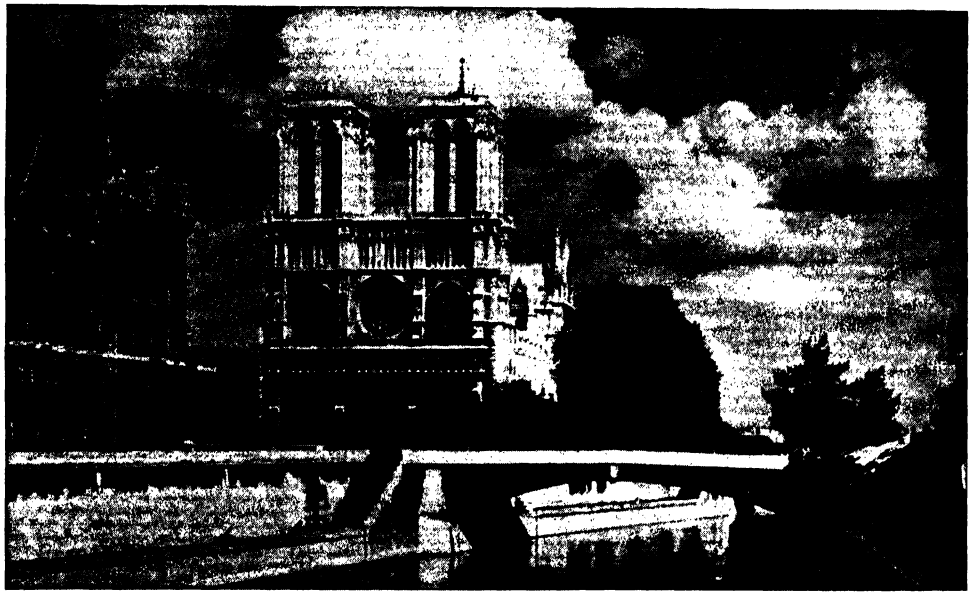
Mr. Branson De Cou, from James Sawders

Behind the river houses of Angers can be seen the tower of its medieval castle and the cathedral spires.

cal privileges when their chief fortress, the port of La Rochelle, was captured; but they preserved their religious liberty.

The nobles tried to defy Richelieu's authority. They were fond of dueling ("defending their honor," they called it), as a memory of the time when every baron had his private army. Richelieu told them: "If you want so much to be killed, let me do it in an orderly fashion"; so he had a few of them beheaded. The nobles soon had to acknowledge that the king's minister was world. Henceforth France was acknowledged as the greatest power on the Continent.

Louis XIII died in 1643, soon after his somber and all-powerful minister. Again the new king, Louis XIV, was a child; again the nobles rebelled; again a cardinal, Mazarin, managed to restore order in the name of the monarchy. Mazarin, an Italian, was very different from Richelieu. He did not fill people with terror, but he cleverly tripped his enemies one after the other; and when he died in 1661, the kingdom was at peace.



James Sawders

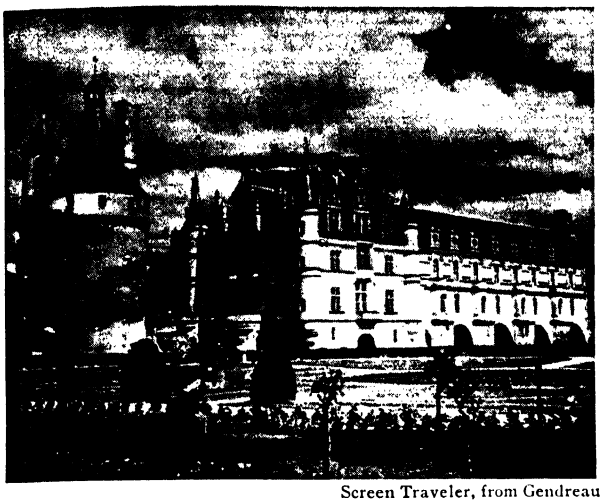
The magnificent façade (face) of Notre Dame Cathedral. It is in the heart of Paris, on the "city island."

their master. Richelieu also pulled down those castles which were fortified and might be an obstacle to the king's justice. The stern Cardinal-Duke was dreaded rather than beloved. But he made the law a reality.

I told you that in the sixteenth century Francis I of France and Charles V of Spain and Austria had been great rivals. That quarrel had never completely ceased. It was one of Richelieu's aims to humble the House of Austria, which was attempting to dominate Europe. So he took part in the great central European conflict, both religious and political, known as the Thirty Years' War. Although he was a cardinal, he sided with the Protestants. Richelieu died (1642) before the issue of the war was fully decided. But the treaties of Westphalia (1648) ended the Austrian dream of ruling Europe and the

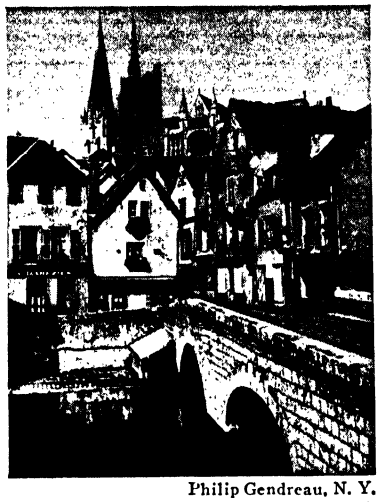
Louis XIV, who was then twenty-three years old, decided to be his own prime minister. For a few years, all went well. The young king was handsome, charming, a good sportsman, an excellent dancer. But he also worked hard at what he called "his business as king." He felt responsible for the greatness of France; he had common sense, and he knew how to pick good ministers such as Colbert.

France was delighted with him; he was called Louis the Great, the Grand Monarch, the Sun King. His court at Versailles was a huge and magnificent affair. It was not all vanity and display: the King's luxury was tasteful and intelligent. All Europe imitated French fashions. Splendid buildings were erected: Versailles, with its noble park; an impressive addition to the eternal Louvre;



Screen Traveler, from Gendreau

The Château Chenonceaux, built by Francis I, near Tours.



Philip Gendreau, N. Y.

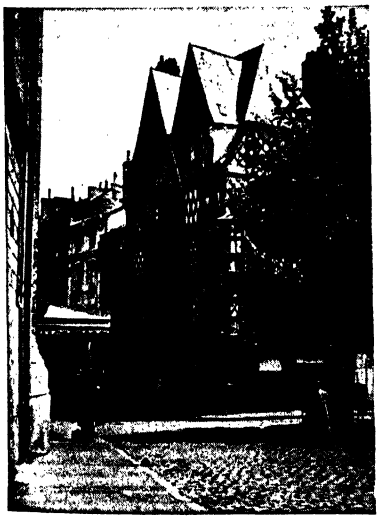
Chartres, famous for its glorious cathedral.

and the gilded dome of the Invalides, which, two centuries later, became the tomb of Napoleon. It was a time of artists and writers—Molière, Racine, Boileau, La Fontaine, Bossuet, all noted for their dignity, their measure, their elegance. It was the point of perfection of the Classical Age.

The King was all-powerful. There is a legend that he once said "I am the State." Perhaps that is just a story. But if he never said "I am the State," it went without saying. And the dangers of absolute rule were soon manifest. The King's luxury, imitated by the nobles, grew reckless, and the common people began to suffer.

The King would admit no opposition, no dissent. He took away from the Protestants their religious liberties, and, in 1685, he repealed the Edict of Nantes, the finest achievement of his grandfather, Henry IV; thousands of Huguenots were driven into exile.

Louis XIV was constantly at war to maintain the glory of his crown. For nearly forty years he could hold his own against many enemies; finally, they joined against him and, united, they proved too strong for him.



Both pictures, De Cou from James Sawders

Steep gables and cobbled street in Angers.

Barbizon, near Paris. Many artists have lived and worked here.

France was exhausted, and the old king barely managed to escape complete disaster. When he died in 1715, people sang and drank gaily on the route of his funeral procession. Louis XIV had been king for seventy-three years, the longest reign in Europe's history.

Once more a small child came to the throne, Louis XV, a great-grandson of Louis XIV. Those who ruled for him in his infancy did not have too much trouble with the nobles, for the nobles had been thoroughly tamed: they squabbled and intrigued, they did not rebel. Louis XV was not a good king. He was far from stupid, and he was not thoroughly bad; but he was bored with the kingly show and he allowed ministers and favorites to rule for him. At times, he liked to play tricks on them, as if he had been a mischievous schoolboy and not the king of France. So the official story of France in those days is far from admirable: the French fought one long indecisive war, and lost another, without quite knowing what the fuss was about; and the finances of the state were in absolute confusion.

But if we turn from the government to the country itself, the picture brightens. France was hard at work and prosperous; there were no civil wars and no rebellions. The minds of the people were extremely active: the period was called "the Enlightenment," for men attempted to follow the light of Reason, and to free themselves from prejudices and superstitious fears.

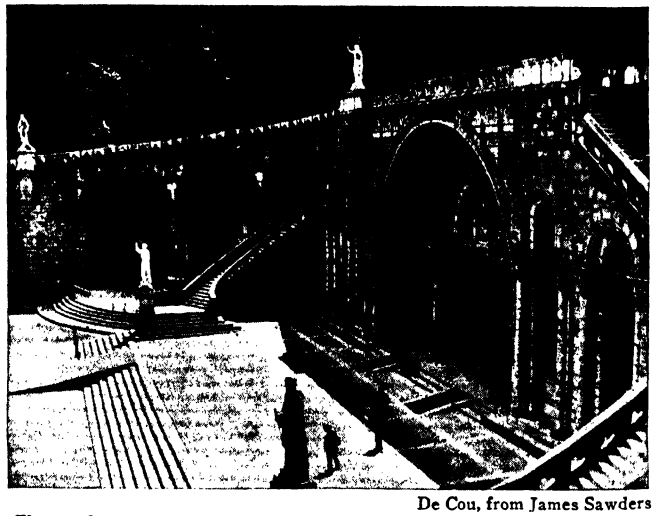
The great writers were fighting battles for liberty. They summed up their knowledge and their hope in a vast dictionary called THE ENCYCLOPEDIA. The best known of them—very different, and, in fact, enemies—were Voltaire and Rousseau. Freedom of thought did not spoil social graces. Never had the drawing-rooms (salons) of Paris been so attractive. There was a blend of daring and of taste which we still find charming.

Louis XV died in 1774, unregretted, even hated, although he had been nicknamed The Well-Beloved. The French expected great things of Louis XVI and Marie Antoinette; and, indeed, although he was a little dull and she was rather frivolous, they were full of good intentions. It was at that time that Lafayette volunteered to help the American Revolution. Soon Louis XVI became formally the ally of the colonies; and the French Lafayette, Rochambeau and De Grasse helped in defeating the English.

It seemed like a new spring for the old Bourbon monarchy. Unfortunately, the French kings had never learned how to keep accounts. So there was great waste at court; the financiers, who collected the taxes, kept as much for themselves as they dared; and the nobles haughtily refused to pay. Aiding the war of American Independence had been very honorable, but also very costly.

After many shifts had been tried, everybody agreed that sweeping reforms were needed. It was decided to revive an old institution, a sort of parliament, called the States General. Started by Philip the Fair in 1302, it had never worked very regularly; and it had not been summoned since 1614, that is to say, for 175 years.

This vague phantom of the Middle Ages was soon left behind; French public opinion was keenly alive to the need for radical reform. The French, in 1789, did not want to abolish the monarchy; but they wanted a liberal constitution. So the States General decided to turn themselves into a National Assembly. Some reactionary elements at court threatened to stop that movement by force. The people of Paris took up the challenge. They rose, and, as a demonstration, they stormed and destroyed the old fortress

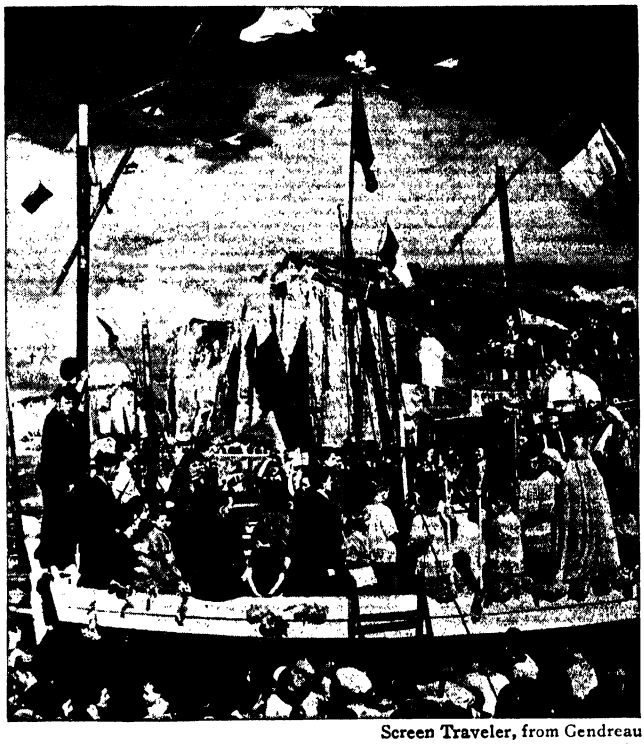


De Cou, from James Sawders

Thousands of pilgrims yearly pass through this entrance to the Lourdes shrine. Lourdes is a town in the Pyrenees, not far from the Spanish border.

in Paris which seemed the symbol of absolute royal power, the Bastille (July 14, 1789). Soon all feudal rights were abolished, and, as a sign of the new era, a new flag, the tricolor, was adopted.

Perhaps Louis XVI might have been resigned to the loss of his absolute power. But Marie Antoinette was unbending. The Assembly passed laws which were not acceptable to some religious people. Louis XVI himself was very pious, and that set him absolutely against the Revolution. He tried to escape from Paris, was caught and put back on the throne; but he felt himself a prisoner.



Screen Traveler, from Gendreau

"Blessing the sea" to keep the fishermen and sailors of Normandy safe.

When France became engaged in a war with Austria and Prussia, it was known that the King and Queen were hoping for a victory of the enemy. So, when the French troops were badly defeated at the very outset, the people felt themselves betrayed. On August 10, 1792, they rose again, and stormed the royal palace. It was practically the end of the monarchy. A new Assembly, the Convention, was elected. As soon as it met (September 21, 1792), it proclaimed France a republic, "One and Indivisible." On January 21, 1793, King Louis XVI was put to death by guillotine as a traitor to his country.

The new republic had a desperate task. All Europe joined in the coalition against her. Half of the country was in rebellion. The Republican deputies fought among themselves, and sent one another in large batches to the guillotine. Of the three most famous leaders, Marat was murdered, Danton and Robespierre were executed. But in spite of all, it was a people's government. A Committee of Public Salvation (the usual mistranslation, Committee of Public Safety, is far too tame) imposed discipline by ruthless means. It was thought necessary to strike terror in the hearts of traitors.

No doubt many innocent victims fell in those pitiless purges. But the end was attained. After three years of superhuman efforts, the Republic was victorious, both within its borders and on all the frontiers. The French troops, organized by Lazare Carnot, had created a new method of war, swift, direct, massive, irresistible; and the spirit of the revolutionary song, THE MARSEILLAISE, urged the French to victory.

The Convention is still a mystery to us: a mixture of heroism, of wise planning, of incompetence, cruelty. When France was triumphant, the need for the Terror disappeared, and Robespierre, its chief apostle, was overthrown and killed. Soon there came in a new government, which was meant to be regular and permanent. It had two chambers, and an Executive Committee, or Directorate, of five (hence called The Directory). But it did not work very well. A revolution is like a dangerous sickness: it takes time to get over it. The French were hard at work as usual, but the Government was reeling and lurching.

Meanwhile, the war was going on. A young general, Napoleon Bonaparte, twenty-seven years old, was winning sensational victories

in Italy. So there was a sharp contrast between the fumbling of the politicians and the efficiency of the army. In 1799, people were tempted to say: "Let Bonaparte clear up this mess!" And he was given full powers, with the title of First Consul. New brooms sweep clean. For a time, all went well. Stocks rose sharply. Revolutionists and royalists worked together for the good of the country. The Church and the state were reconciled. A code of civil laws was drawn up. And above all, peace was made both with Austria and with England.

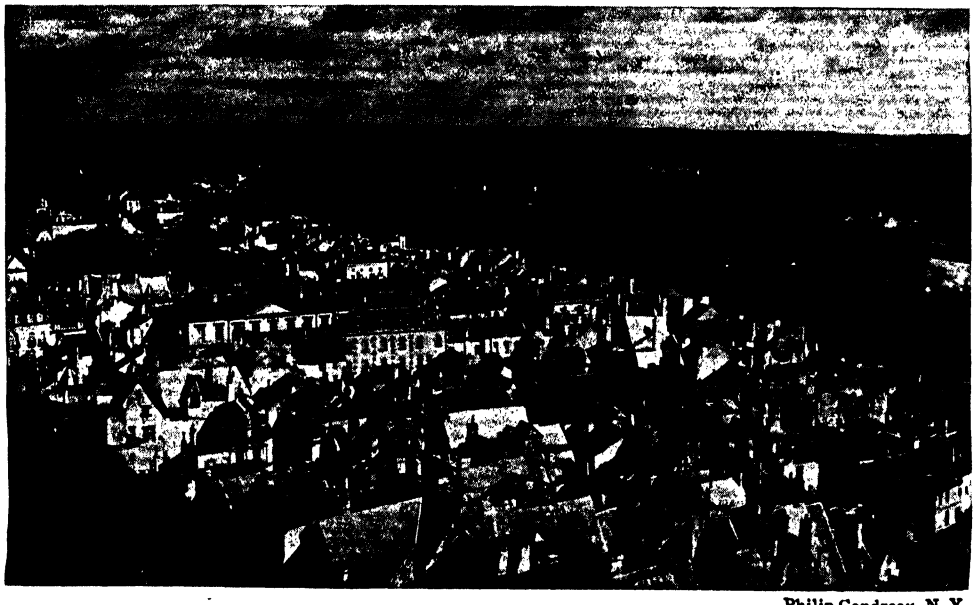
But it is dangerous to turn over all power to one man. Napoleon had a good mind, practical and clear; but he went the way of Louis XIV. He became drunk with power. He could think only of might, prestige, glory. He was made emperor in 1804, and was more despotic than the old kings.

War started again: first with England, then with practically the whole of Europe. For nearly ten years Napoleon led his victorious armies into all the capitals of the Continent. He entered Vienna, Berlin, Madrid. Rome became a French city. His brothers were made kings; his enemies had to become his allies or, rather, his vassals. The only independent sovereign on the Continent, the Tsar of Russia, professed to be his friend.

But a "friendship" based on power alone is a mockery. The two autocrats quarreled; and the result was war. Napoleon took his Grand Army to Moscow (1812). The Russians burnt the city, to save it from Napoleon's soldiers. The French had to retreat, and they suffered horribly. In spite of that appalling disaster, Napoleon, in 1813 and 1814, was still able to put up a good fight. But he had to acknowledge defeat, gave up the throne and was exiled to the island of Elba. He escaped in 1815, was emperor again for just one hundred days and was finally beaten at Waterloo. He surrendered to the English, who imprisoned him at St. Helena, a lonely little island in mid-Atlantic. There he died in 1821.

The victors reorganized Europe at the Congress of Vienna in 1814 and 1815. They did not do it very wisely: they thought of the royal houses, not of the common people. In France, the old Bourbon monarchy was restored with the brothers of Louis XVI, and with the white flag of the ancient regime. In 1830, the French got rid of that ghost. They tried a compromise: a monarchy that would accept the principles of the Revolution. The new king tottered for eighteen years and fell in 1848. A Second Republic was proclaimed (February, 1848).

But if the tradespeople and farmers of France were ready for democracy, they were afraid of socialism. So, after an uprising of



Philip Gendreau, N. Y.

The Vienne River meanders slowly past the old town of Chinon. Here Joan of Arc revealed her mission to the Dauphin.

the Parisian workmen in June, 1848, there was a sharp reaction. The people wanted things that were hard to reconcile: liberty but with strict discipline; democracy, but no socialism; peace, and at the same time glory. A nephew of Napoleon I, Louis Napoleon, promised them what they wanted, and he was elected president (December, 1848). Three years later, as he felt cramped by the Constitution, he swept it aside; a year after that, he became emperor of the French as Napoleon III, "by the grace of God and the will of the people." For the people, consulted through plebiscites, voted, almost to a man, for him as emperor.

James Sawders

The front of the Palace of Fontainebleau, with its horseshoe-shaped staircase.

The strange thing is that for quite a while he kept his promises. He was a well-meaning man, with an open mind. He understood better than most the growing power of industry. So his reign was marked by magnificent public works and by brilliant prosperity. Europe and the world flocked to Paris, which was to a large extent rebuilt on a grander scale, for splendid expositions held in 1855 and 1867. France was the leader of style, as she had been under Louis XIV and Louis XV.

The curse of autocracies is war. Napoleon III loved peace and had promised peace. But he was the heir of the great conqueror, and he always dressed up as a soldier. So, against his own nature, he embarked on wars from which France had nothing to gain: in the Crimea against Russia, in Italy against Austria, in Mexico to establish a preposterous empire. In 1870, when he was old and sick, he allowed himself to be trapped into war by Prussia. Bismarck, the Prussian chancellor (prime minister), knew that his own army was perfectly ready, and that the French army was not. At Sedan, on September 2, 1870, a French army was caught in a net, and the Emperor with it. When the news reached Paris, the Empire fell at once, and the Third Republic was proclaimed, September 4.

The Republic, with Leon Gambetta as the moving spirit, fought bravely to retrieve the disaster. But it could not be done. Paris capitulated to the Germans, an armistice was signed, and by the Treaty of Frankfort (1871), Alsace and part of Lorraine, against their clearly expressed desire, were taken by Germany. Paris, which had suffered terribly during the siege, had a fit of despair: it rebelled against the central government and had to be recaptured in a veritable civil war (March to May, 1871). This insurrection is known as the Commune, although it had little to do with communism.

The new National Assembly, elected in 1871, was conservative and wanted to restore the monarchy. But the deputies could not agree on a candidate for the throne. So they finally made a constitution which was a rather clumsy compromise; it remained in force from 1875 to 1940. The Third Republic, however, was much better than its constitution. There were plenty of squabbles and scandals; but national life, on the whole, was very healthy. There were no more insurrections or civil wars; prosperity increased, moderately but steadily; public education made fine progress; a vast colonial empire was acquired; and above all, the French felt perfectly free.

In 1914, France took part in the first World War. It was not a quarrel of her own making; she was dragged into it as the ally of Russia and the friend of England. The French gave a very good account of themselves. At the first Battle of the Marne, General Joffre stopped and pushed back the German invasion, which had threatened to engulf the whole country. At Verdun, Generals Pétain and Nivelle checked a new desperate effort of the Germans. Just as the French

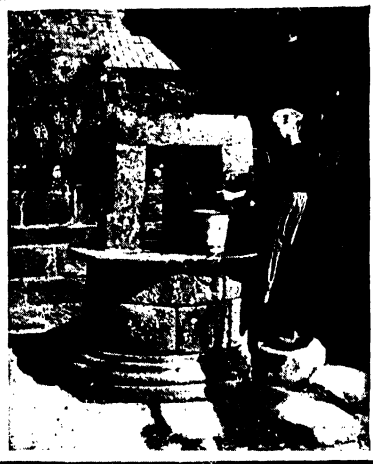
WHERE OLD CUSTOMS STILL LINGER

James Sawders

Narrow, winding streets like this are typical of the little towns of Brittany. The houses look rather bare and grim to our eyes, but they are home to the Breton sailors.

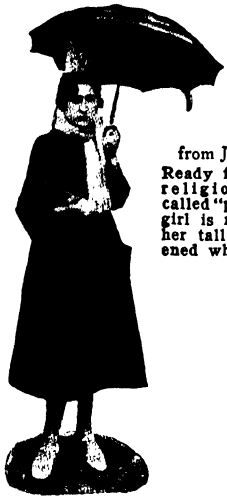
James Sawders

On holidays, a Breton man wears white, pleated breeches, blue waistcoat, black felt hat, leggings and wooden shoes.



Philip Gendreau, N. Y.

Some Breton housewives still draw their water from wells, even as Rachel did in the Bible.



De Cou, from James Sawders

Ready for one of the religious festivals called "pardons." This girl is most proud of her tall cap of stiffened white lace.

Philip Gendreau, N. Y.

Washday means a trip to the river. The women beat the clothes on boards, just as their mothers and grandmothers did before them.

were getting weary of the exhausting indecisive struggle, their hope and energy were revived by two events. Clemenceau, a very old man, but ardent and vigorous, came to power; and the United States, guided by President Wilson, entered the war on the side of the Allies. Under the leadership of Marshal Foch, the armies of Pershing, Haig and Pétain drove back the Germans, who sued for an armistice (November 11, 1918). The Peace Conference was held in Paris, and the treaty was signed at Versailles. Alsace-Lorraine became French again.

DURING THE 1920's, FRANCE AND GERMANY PATCHED UP THEIR ANCIENT QUARREL

In spite of innumerable difficulties, the first ten years of peace were, on the whole, successful. The devastated regions were rebuilt. Though the French quarreled again with the Germans and occupied the industrial basin of the Ruhr, both sides got over it, and signed the Locarno Pact, in which the two old enemies met for the first time as equals and friends. Germany became a member of the League of Nations, with the honors and privileges of a great power. And the statesman who was guiding France's foreign relations, Aristide Briand, could propose to give up war as an instrument of national policy (Briand-Kellogg Pact) and to establish the United States of Europe.

But the recovery of Europe and the world was not complete. There was, after 1929, an economic depression, which started in the United States and reached every part of the globe. This made people irritable and distrustful. In Germany, which was suffering deeply from the depression, despair gave a chance to a party of fanatics, the Nazis (National Socialists), led by Adolf Hitler. From the moment Hitler took power (1933), the cause of peace was lost.

England and France had such a horror of war that they went out of their way to "appease" Hitler. But every concession whetted his appetite. He thought he could conquer the world, because he thought the democratic peoples would not fight. The second World War officially began on September 2, 1939, as a German-Polish quarrel. The democracies were not prepared, morally or materially. They had thought in terms of the old wars, and believed themselves safe behind a great wall of fortresses, the Maginot Line. Worst of all, they were divided in their minds. Many people hated Russia so much that they were at heart with Hitler, who professed to be saving Europe from communism.

Poland fell in three weeks in 1939. After eight weary months of "phoney war," during which operations were at a standstill, the Nazis struck again. Denmark, Norway, Holland, Belgium went down. The French and British armies were shattered. The British managed to get back most of their men who were on the Continent, but they lost all their equipment.

France was thus left alone. Still, many leaders refused to despair. France could keep on fighting from her colonies, with England as an ally. Two old men, Marshal Pétain and General Weygand, who had been called to power in order to resist, chose to bow to the German might. And, in the horrible confusion, Pétain was given a free hand, not only to treat with the Germans, but also to govern the state.

So France was torn asunder. Pétain, established at Vichy, and a politician, Laval, chose to "collaborate" with the Nazis and to accept what Hitler called his "New Order." They took advantage of the tragic plight of France to carry out a reactionary program. They seemed to be trying to destroy every trace of the French Revolution. The national motto, Liberty, Equality, Fraternity, was effaced.

THE FIERCE AND SUCCESSFUL RESISTANCE OF FRENCH PATRIOTS TO THE NAZIS

On the other hand, General Charles de Gaulle, from London, called on all patriotic Frenchmen to keep on fighting. This was the Free French, later called the Fighting French, movement. In France, little groups organized themselves secretly against the Germans and the Vichy collaborationists: this was called the Resistance, or Underground. Later, when Pétain and Laval tried to round up young men and send them to work in German war factories, these men took to the hills and the woods, and formed armed units: this was called the Maquis. Gradually, the Free French, the Resistance and the Maquis worked harmoniously together. When the Allies landed in Normandy (June, 1944), the French Underground helped them tremendously. The Germans could not send a single train to the threatened beaches because the French Forces of the Interior had sabotaged all the railroad lines. Many cities were liberated by their own people, including Paris.

As soon as a part of France was freed from the Germans, it rallied at once to General de Gaulle's banner. He set up a provisional government, and the French people stood

back of it. This showed that Vichy never represented the true feelings of the people. Collaboration was not realism, but treason. In 1945, both Pétain and Laval were brought to trial for having worked with the enemy. Both were sentenced to death; but on account of Pétain's age and of his services in World War I, he was not executed.

Most of France was liberated in 1944, except a few pockets. These were finally cleared up when Germany surrendered in 1945. France found herself one of the victors of World War II; but she was almost completely ruined. Highways, railroads, canals, many factories, had been destroyed by the Germans, or by the Resistance, or by Allied bombardments. For five years, the Nazis had looted. The health of the people was poor because they had not had enough to eat for a long time. But they started working as best they could.

AFTER VICTORY, WHAT OF THE FUTURE?

France held a series of elections in 1945. These showed that the masses were profoundly attached to the Republic and to democracy, but that they had no love for the makeshift constitution of 1875. So they decided to draw up a new one, and this new government is usually called the Fourth Republic. The elections proved also that the French were grateful to General de Gaulle for his splendid leadership, but that they did not want, as the Italians and the Germans had done, to be ruled by one man. The French are a free and a proud people. They have a hard task ahead, but they are not afraid. They have had a long, glorious and tragic history: so when things look darkest, they say: "We have seen worse." They shrug their shoulders, and start working again.

There are many more things I should like to tell you about France, but it would take volumes. Most of these things are really more important than kings and battles. I should like to tell you about French artists and writers, about the poems of Victor Hugo, Baudelaire, Mallarmé, Valéry; about the romances of Hugo and Dumas, the novels of Balzac, Flaubert, Zola and Proust. I should like to tell you about the share of France in world science, with men like Lavoisier, Lamarck, Cuvier, Pasteur. We are all thinking of atomic power now: and Becquerel, Pierre and Marie Curie, Irène and Frédéric Joliot-Curie played a great part in preparing that discovery. I should like to tell you about all the lands under the French flag. They form now, not an empire held by force, but a community or federation, and the French want the spirit of this vast union to be Liberty, Equality, Fraternity.

At the San Francisco Conference (1945), France was recognized as one of the five leading powers. This was a tribute not merely to her glorious past, but to her clear and generous spirit, and to the promise of still greater achievements. So I shall conclude with the words of President Roosevelt at the time when our troops landed in North Africa: "la France éternelle," eternal France.

By ALBERT GUÉRARD.

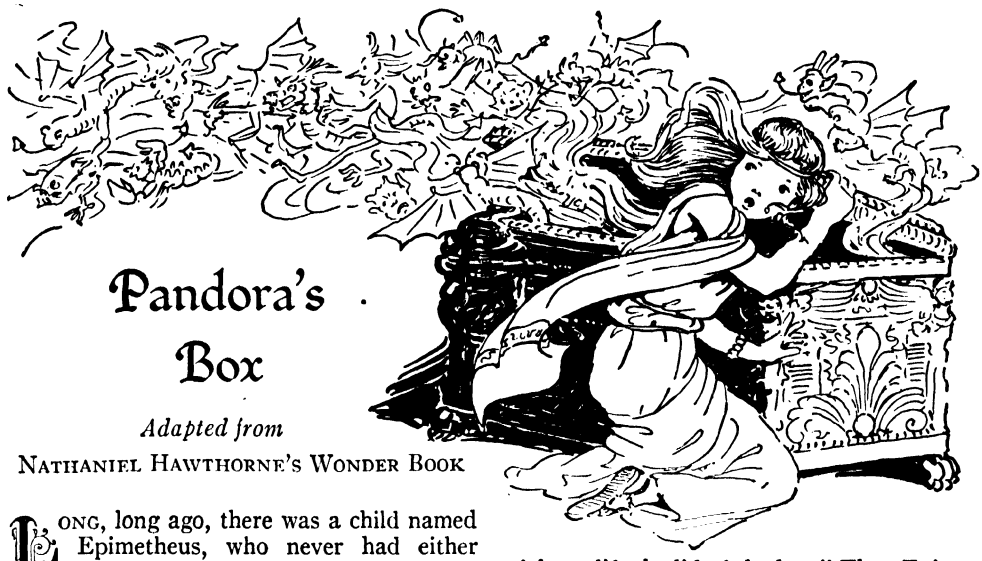
THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 3813.

FRANCE

Area: 212,659 square miles.
Population: 41,518,000.
Chief Cities: Paris, the capital, 2,725,000; Marseilles, 636,000; Lyons, 401,000; Bordeaux, 254,000; Nice, 211,000.
Government: France is a republic. There is a Parliament consisting of a National Assembly and a Council of the Republic. The president is elected by Parliament for a seven-year term. He does not have much power. The chief executive is really the premier, who is assisted by a Cabinet. The Republic forms part of a federation called the French Union. This includes the Overseas Departments and Territories and the Associated Territories and States.
Religion: There is no official religion. Most Frenchmen are Roman Catholics.
Agriculture: Crops include wheat, rye, barley, oats, potatoes and sugar-beets. Cattle, sheep, hogs, horses and mules are raised. The growing of grapes is important. There are extensive fisheries.
Manufactures: Textiles (cotton, rayon and silk), iron and steel, leather and leather goods, chemicals, wines, perfumes.
Transportation: Late figures are not available. Just before World War II France had 26,500 miles of railways, 6,000 miles of rivers and canals and 390,000 miles of highways.

FRANCE OVERSEAS

Overseas Departments (States): Martinique, Guadeloupe, Reunion, French Guiana and three departments in Algeria.
Overseas Territories: *In Africa,* French West Africa, French Equatorial Africa, Madagascar, the Comoro Islands, French Somaliland and the United Nations trusteeships of French Cameroun and French Togo. *In America,* St. Pierre and Miquelon. *In Oceania,* New Caledonia and other islands.
Associated Territories and States: Tunisia, Morocco and the Indochinese Federation (made up of Viet Nam, Laos and Cambodia).
Total area of France overseas: 4,627,760 square miles; total population, 73,000,000.



Pandora's Box

Adapted from
NATHANIEL HAWTHORNE'S WONDER BOOK

LONG, long ago, there was a child named Epimetheus, who never had either father or mother; and that he might not be lonely, another child was sent to live with him and be his playfellow. Her name was Pandora.

The first thing that Pandora saw, when she entered the cottage where Epimetheus dwelt, was a great box.

"Epimetheus," she asked, "what have you in that box?"

"My dear Pandora," answered Epimetheus, "that is a secret. The box was left here to be kept safely, and I myself do not know what it contains."

"But who gave it to you?" asked Pandora.

"It was left at the door," replied Epimetheus, "just before you came, by a person with a very smiling face; he could hardly keep from laughing as he put it down. He was dressed in an odd kind of cloak, and had on a cap that seemed to be made partly of feathers, almost as if it had wings."

"What sort of staff had he?" asked Pandora.

"Oh, the most curious staff you ever saw!" cried Epimetheus. "It was like two serpents twisting around a stick!"

"I know him," said Pandora, thoughtfully. "Nobody else has such a staff. It was Mercury; and he brought me here, as well as the box. No doubt he intended it for me; and probably it contains pretty dresses, or toys."

"Perhaps so," answered Epimetheus, turning away. "But until Mercury comes back and tells us so, we have neither of us any right to lift the lid of the box." Then Epimetheus went out of the cottage.

After Epimetheus was gone, Pandora stood gazing at the box. It was made of a beautiful kind of wood, so highly polished that little Pandora could see her face in it. The edges and corners were carved with wonderful skill. Around the margin there were figures of graceful men and women and the prettiest children you could imagine amid a profusion of flowers and leaves. But here and there, peeping forth from behind the carved foliage, Pandora once or twice fancied that she saw a face not so lovely. Nevertheless, on looking more closely, she could discover nothing of the kind.

The box was fastened, not by a lock, but by a very intricate knot of gold cord. There appeared to be no end to this knot, and no beginning. Never was a knot so cunningly twisted, nor with so many ins and outs. And yet, by its very difficulty Pandora was the more tempted to see if she could untie it.

"I could tie it up again after undoing it," she said to herself. Ah, naughty Pandora!

She took the golden knot in her fingers, and almost without intention, she was soon busily attempting to undo it. Meanwhile, the bright sunshine came through the open window, and the merry voices of children, playing at a distance. Pandora stopped to listen. What a beautiful day it was! Would it not be wiser if she were to let the troublesome knot alone and think no more of the box, but run and

join her playfellows?

But just then, by the merest accident, she gave the knot a twist—and the gold cord untwined itself, as if by magic.

"This is the strangest thing I ever knew!" said Pandora. "How can I possibly tie it up again?"

But it is now time for us to see what Epimetheus was doing. With a hope of giving Pandora pleasure, he had been gathering flowers, and had made them into a wreath which he meant to put upon her head. He entered the cottage softly, for he meant to steal behind Pandora and fling the wreath of flowers over her head. At the moment of his entering, she had put her hand to the lid, and was on the point of opening the mysterious box. Epimetheus beheld her. If he had cried out, Pandora would probably have withdrawn her hand, and the fatal mystery of the box might never have been known.

But Epimetheus, himself, had his own share of curiosity to know what was inside. So he said nothing.

As Pandora raised the lid, the cottage grew very dark and dismal. A black cloud swept over the sun, and there was a low growling and muttering, which all at once broke into a heavy peal of thunder. Then it seemed as if a sudden swarm of winged creatures brushed past Pandora, taking flight out of the box. She heard a disagreeable buzzing, as if a great many huge flies, or gigantic mosquitoes, were darting about. And, as her eyes grew more accustomed to the imperfect light, she saw a crowd of ugly little shapes, with bats' wings, looking abominably spiteful, and armed with terribly long stings in their tails.

"Oh, I am stung!" cried Epimetheus.

Nor was it a great while before Pandora herself began to scream. An odious little monster had settled on her forehead, and would have stung her deeply, if Epimetheus had not run and brushed it away.

Now, if you wish to know what these ugly things might be, I must tell you that they were the whole family of earthly Troubles, of which, before this, there had been none on earth. There were evil Passions; there were a great many species of Cares; there were more than a hundred and fifty Sorrows; there were Diseases, in a vast number of miserable and painful shapes; there were more kinds of Naughtiness than it would be of any use to talk about. In short, everything that has since afflicted the souls and bodies of mankind had been shut up in the mysterious box, and given to Epimetheus and Pandora to be kept safely.

Now the ugly swarm of Troubles flew out the doors and windows of the little cottage to pester and torment people everywhere. Epimetheus sat down sullenly in a corner with his back toward Pandora; while Pandora was crying bitterly.

Suddenly there was a gentle tap on the inside of the lid. It sounded like the tiny knuckles of a fairy's hand, knocking lightly and playfully. A sweet little voice spoke from within: "Lift the lid!"

"No, no," answered Pandora, again beginning to sob. "I have had enough of lifting the lid! You are inside the box and there you shall stay."

"Ah," said the sweet little voice again, "I am not like those creatures that have stings in their tails. Come, come, my pretty Pandora! Let me out!"

There was a kind of cheerful witchery in the tone, and Pandora's heart grew lighter; while Epimetheus, too, though still in the corner, turned half around. Then with one consent the two children again lifted the lid.

Out flew a sunny and smiling little personage and hovered about the room, throwing light wherever she went. She flew to Epimetheus and laid the least touch of her finger on the inflamed spot where Trouble had stung him; then she kissed Pandora on the forehead. And immediately both hurts were cured.

"Who are you?" inquired Pandora.

"I am called Hope!" answered the sunshiny figure. "And I was packed into the box to make amends for that swarm of ugly Troubles."

"Your wings are colored like the rainbow!" exclaimed Pandora.

"That is because, glad as my nature is, I am partly made of tears."

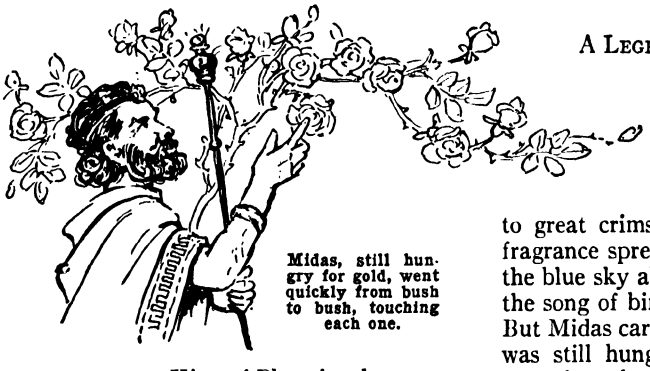
"And will you stay with us," asked Epimetheus, "forever and ever?"

"As long as you need me," said Hope—"and that will be as long as you live."

And so, to tell you the truth, I can not help being glad—(though, to be sure, it was a naughty thing for her to do)—but I can not help being glad that our foolish Pandora peeped into the box. No doubt—no doubt—the Troubles are still flying about the world. But then, that lovely and lightsome little figure of Hope! What could we do without her?

Midas and The Golden Touch

A Legend of Ancient Greece



Midas, still hungry for gold, went quickly from bush to bush, touching each one.

THERE was a King of Phrygia whose name was Midas. One day Midas had the good luck to do a favor for the god Dionysius, whom some call Bacchus. To repay the favor, Dionysius asked Midas to make a wish, and said it would be granted.

Now Midas was a miser. He thought there was nothing in the world better than gold. He thought that the more gold he could own, the happier he would be. So he asked the god for the gift of the golden touch.

Dionysius grew sad when he heard the wish of the King, but he kept his promise. "The gift is yours," he said, then scornfully he turned away.

Midas sank upon his throne, congratulating himself upon his luck, and his wisdom. His hands touched the silken cushions of the throne. They cooled beneath his fingers, a tremor ran through them, the soft silk whispered gently, grew firm and hard. The crimson color fled, leaving a pale sheen, yellow, like the sun. The cushions had turned to gold.

Midas was enchanted. He touched the gold. He rubbed it with the sleeve of his mantle to make it shine more brightly. There was no doubt! It was gold, pure gold, and with growing excitement Midas walked about the hall, touching things here and there as he went, until the great room flashed as the morning sun shone in upon it.

When the hall was finished to his liking, he went out, and stepped down into his garden of roses, leaving golden footprints as he went. The garden was a lovely spot. There were roses on every side, from the blooms of snowy whiteness that his little daughter loved, and flowers of palest pink, to great crimson beauties. Their refreshing fragrance spread around and rose upward to the blue sky above them. The air was full of the song of birds and the busy hum of bees. But Midas cared for none of these things. He was still hungry for gold, and he quickly went from bush to bush, touching each one as he went. At last his work was done, and as he turned away, the golden tinkle of the leaves and flowers, as they waved stiffly in the breeze, seemed to him the sweetest music he had ever heard.

He hastened back to his golden hall and called to his slaves to bring him food. They did so, and he sat down with eager appetite to eat it. But as the morsels touched his lips the food turned to gold, and the wine and water flowed tinkling back into the cups to settle in a solid mass of gold. He sat and looked aghast at his golden treasure, for of what use were golden cups and platters if he must die of hunger? His gloomy thoughts were broken by the sound of bitter childish weeping, and as he raised his eyes, his little daughter came running into the hall, a spray of golden roses in her hand.

"Father," she cried, "someone has killed all our roses!"

"I turned them into gold, my child," said Midas gently; "they are far more beautiful so."

"Ah, no," said the little one; "put them back, father, put them back!" and as she sobbed out the words she flung herself into his arms. Lovingly he put his hand on her head, and began: "My little daughter," when he felt her stiffen in his arms, and in a moment he held only a golden statue.

Horrified, he laid her down on a couch near by and cried aloud for help, but all his servants had fled in terror of their lives, and the King was left alone.

All day the mourning father sat in the silent house beside the statue that had been his child, hoping only that death would come soon and take him too. But as the sun set Dionysius once more appeared, seeming to bring renewed life and joy into the lonely dwelling. Still, his face was stern as he said to Midas: "Are you yet satisfied?"

And Midas answered humbly: "I was wrong. There are many gifts that are better far than gold. I had them, and I did not know it. Is it too late? Will you take back the fatal gift? For myself I ask nothing, only bring my little child to life."

Then Dionysius bade him go to the river flowing by his garden and bathe there, if he wished to lose his hateful power. With a grateful smile the King turned to thank the god, but Dionysius was no longer beside him.

So Midas hastened to the river and let the waters close round him; and as he stepped out upon the bank he left the bed of the stream all bright with sands of gold. Refreshed and light of heart, he carried water from the river to sprinkle upon the roses as he passed between them. Then, returning to the lovely golden form that was his daughter, he poured restoring drops upon her head.

With a little gasp she looked up at him, then down at the spray of roses in her hand. "Father," she said, "I had a horrid dream. I thought that someone had turned our lovely roses into hateful, ugly things of gold."

"Shall we go," said Midas, "and make sure that it is not true?"

Hand in hand Midas and his little daughter went out into the garden where the roses bloomed again.

The Quest of the Golden Fleece

A Legend of Ancient Greece

This Version is from The Age of Fable, by Thomas Bulfinch

In very ancient times there lived in Thessaly a king and queen named Athamas and Nephele. They had two children, a boy and a girl. After a time Athamas grew indifferent to his wife, put her away, and took another. Nephele suspected danger to her children from the influence of the stepmother, and took measures to send them out of her reach. Mercury, the god, assisted her, and gave her a ram with a golden fleece, on which she set the two children, trusting that the ram would convey them to a place of safety. The ram vaulted into the air with the children on his back, taking his course to the East, till, when crossing the strait that divides Europe and Asia, the girl, whose name was Helle, fell from his back into the sea, which from her was called the Hellespont—now the Dardanelles. The ram continued his career till he reached the kingdom of Colchis, on the eastern shore of the Black Sea, where he safely landed the boy Phryxus, who was hospitably received by Æetes, king of the country. Phryxus sacrificed the ram to Jupiter, and gave the Golden Fleece to Æetes, who placed it in a consecrated grove, under the care of a sleepless dragon.

There was another kingdom in Thessaly near to that of Athamas, and ruled over by Æson, a relative of his. The king Æson, being tired of the cares of government, surrendered his crown to his brother Pelias on condition that he should hold it only during the minority of Jason, the son of Æson. When Jason was grown up and came to demand the crown from his uncle, Pelias pretended to be willing to yield it, but at the same time suggested to the young man the glorious adventure of going in quest of the Golden Fleece, which it was well known was in the kingdom of Colchis, and was, as Pelias pretended, the rightful property of their family. Jason was pleased with the thought and forthwith made preparations for the expedition. Jason employed Argus to build him a vessel capable of containing fifty men. The vessel was named Argo, from the name of the builder. Jason found himself at the head of a band of bold youths, many of whom afterward were renowned among the heroes and demigods of Greece. Hercules, Theseus, Orpheus and Nestor were among them. They are called the Argonauts, from the name of their vessel.

The Argo with her crew of heroes left the shores of Thessaly and having touched at the Island of Lemnos, thence crossed to Mysia and thence to Thrace. Here they found the sage Phineus, and from him received instructions as to their future course. It seems the entrance of the Euxine Sea was impeded by two small rocky islands, which floated on the surface, and in their tossings and heavings

occasionally came together, crushing and grinding to atoms any object that might be caught between them. They were called the Symplegades, or Clashing Islands. Phineus instructed the Argonauts how to pass this dangerous strait. When they reached the islands they let go a dove, which took her way between the rocks, and passed in safety, only losing some feathers of her tail. Jason and his men seized the favorable moment of the rebound, plied their oars with vigor, and passed safely through, though the islands closed behind them, and actually grazed their stern. They now rowed along the shore till they arrived at the eastern end of the sea, and landed at the kingdom of Colchis.

Jason made known his message to the Colchian king, Æetes, who consented to give up the Golden Fleece if Jason would yoke to the plough two fire-breathing bulls with brazen feet, and sow the teeth of the dragon which Cadmus had slain, and from which it was well known that a crop of armed men would spring up, who would turn their weapons against their producer. Jason accepted the conditions, and a time was set for making the experiment. Previously, however, he found means to plead his cause to Medea, daughter of the King. He promised her marriage, and as they stood before the altar of Hecate, called the goddess to witness his oath. Medea yielded, and by her aid, for she was a potent sorceress, he was furnished with a charm, by which he could encounter safely the breath of the fire-breathing bulls and the weapons of the armed men.

At the time appointed, the people assembled at the grove of Mars, and the King assumed his royal seat, while the multitude covered the hillsides. The brazen-footed bulls rushed in, breathing fire from their nostrils that burned up the herbage as they passed. The sound was like the roar of a furnace, and the smoke like that of water upon quicklime. Jason advanced boldly to meet them. His friends, the chosen heroes of Greece, trembled to behold him. Regardless of the burning breath, he soothed the rage of the fierce bulls with his voice, patted their necks with fearless hand, and adroitly slipped over them the yoke, and compelled them to drag the plough. The Colchians were amazed; the Greeks shouted for joy. Jason next proceeded to sow the dragon's teeth and plough them in. And soon the crop of armed men sprang up, and wonderful to relate! no sooner had they reached the surface than they began to brandish their weapons and rush upon Jason. The Greeks trembled for their hero, and even she who had provided him a way of safety and taught him how to use it, Medea herself, grew pale with fear. Jason for a time kept his assailants at bay with his sword and shield, till, finding their numbers overwhelming, he resorted to the charm which Medea had taught him, seized a stone and threw it in the midst of his foes. They immediately turned their arms against one another, and soon there was not one of the dragon's brood left alive. The Greeks embraced their hero, and Medea, if she dared, would have embraced him too.

It remained to lull to sleep the dragon that guarded the fleece, and this was done by scattering over him a few drops of a preparation which Medea had supplied. At the smell he relaxed his rage, stood for a moment motionless, then shut those great round eyes, that had never been known to shut before, and turned over on his side fast asleep. Jason seized the fleece and with his friends and Medea accompanying, hastened to their vessel before Æetes the king could arrest their departure, and made the best of their way back to Thessaly, where they arrived safely, and Jason delivered the fleece to Pelias, and dedicated the Argo to Neptune.

THE NEXT STORIES ARE ON PAGE 3597.

PORTRAITS OF GIRLHOOD AND OF AGE

The beautiful picture of the artist's mother, by J. McNeill Whistler.

The White Girl, by Whistler.

Young Woman, by Abbott Thayer.

Harp of the Winds, mistakenly called A view on the Seine, by H. D. Martin.

PAINTING IN THE UNITED STATES

ARTISTS OF THE LATER YEARS

WE may think of the landscapes of the Hudson River school as dry and conventional and out of fashion; but we cannot help respecting and admiring those artists, who, after all, were doing remarkably good work, judged by the standards of their time and in the light of their opportunity. Breadth and ease and freedom they had not. They did, however, give careful and enthusiastic attention to drawing and workmanship in general, and they made graceful and interesting compositions. Above all, "they had glimpses of beauty, of something which they had the taste to cultivate—if only the gods had given them the secret of painting as the true painter knows it."

The man who, more than any other, sets forth in his own career the progress of our landscape art from that time of beginnings to the present, when it has taken its place among the best of contemporary painting, is George Inness. He lived from 1825 until 1894. "His pictures vividly expose the evolution of a man of genius, proceeding step by step in the beating out of a style."

By a devoted study of nature and the poetic rendering of his own impressions of nature's quieter aspects he opened the way for other American painters who have worked in the modern way and have revealed the beauties of landscape lying close around them at home.

Born at Newburgh, New York, and intended by his father for a life in the business world, Inness turned inevitably to art. Studying for only a short time under an engraver and then under a painter, he got his most valuable knowledge of the use of his medium through his own experiment and practice. It was no outside instruction or influence that led him to select the parts of a scene that had most meaning and then to combine them into a harmonious whole, truly suggestive of a feeling in nature. With breadth and simplicity he impresses upon the scene "his own fine way of seeing it." While his earlier landscapes, like Peace and Plenty, in the Metropolitan Museum of Art, show traces of the influence of Cole and his followers, still the bigness of the canvas and the carefulness of detail are so handled as to give a single strong impression. Living far from Barbizon and its painters of the *paysage intime* in France, this American artist was yet one with them in his feelings and conceptions. Like Corot, he loved the mystical effects of morning and eve-

ning light—all of the more tender and spiritual moments of the day; and like Rousseau and Daubigny, he found his joy in interpreting these aspects of nature. And his interpretations have the beauty and the vibrancy of music. During the years he spent in his home at Montclair, New Jersey, Inness painted his most satisfying pictures. His son and pupil, George Inness, Jr., is counted among successful landscape men. In a group with Inness we must think of four others —Alexander Wyant, Homer Martin, Winslow Homer and Dwight Tryon.

The paintings of Alexander H. Wyant (1836–92) are like lyrical poems or like songs—sweet and dreamy, but true and strong. In his calm shadows and softly luminous skies, his quiet tenderness of coloring, there is subtlety of tone and vibrating beauty, yet with no lack of firmness. Trees and rocks, and the earth on which they rest, are drawn with a sure touch, and give evidence that the artist fully knew their forms and settings, their individual ways.

ALEXANDER WYANT, WHOSE LANDSCAPES ARE LIKE SONGS

As a boy living in Ohio Wyant was always drawing, although he had no chance to see good pictures until, when he was about twenty, he went to Cincinnati. That city already had collections that offered satisfaction to the art-thirsty. Among the paintings that the youth saw there, a landscape by Inness awoke in him almost an adoration. Traveling to New York, he went to ask advice of the master, and, encouraged by the kindly criticism he received, went on to study in Europe. But, having gained a start in technical knowledge, he returned to work out in his own way a method of expressing what he felt. To earn money he joined a government party on a trip of exploration in the West, where hardship broke down his health, leaving him partly paralyzed. Placed in a train to go home to Ohio, he courageously kept on the way until he reached New York, determined not to give up painting. Though he partly regained his health, he had thereafter to paint with his left hand and to save up his strength for his beloved work, always counting the time too short to accomplish what he longed to do. For a while his summer painting was done in the Adirondacks, later in the Catskills. His landscapes are examples of sound painting.

Another poet-painter of landscapes that impart a personal message is Homer D. Martin (1836–97). Self-taught and big-natured, full of jollity as a man, full of deep seriousness as a painter, Martin found in nature the things that are essential and forever true. These are the qualities that we feel in his pictures, where the skies vibrate with the light that comes from great depths of distance, and where the landscape is usually modeled in masses. "In his masterpieces there is the evidence of a great mind, for the time being unreservedly consecrated to great ends."

HOMER MARTIN, A PAINTER WHO SAW NATURE IN MASSES

Martin, who was born at Albany, New York, had only a few lessons in painting from William Hart. Because of a weakness of his eyes he saw nature in masses, missing all sharp outlines. For a long time he distrusted his own impressions because of this defect. At the age of forty he went to Europe, visiting Holland, England and France; and in 1881, after a short stay in England, he spent nineteen happy months in a little village of Normandy. There he stored up impressions that later took form in such pictures as Normandy Trees, Old Church in Normandy, and the familiar composition wrongly known as a View on the Seine. One of his best landscapes is Westchester Hills. This was the only one painted entirely out of doors, as Martin, like Corot, usually absorbed his impressions at his ease when out of doors, making notes from which he could reconstruct the scene later in the studio whenever he felt the irresistible impulse to paint. While in the presence of nature he seemed to become one with nature's self.

It is said that the director of the Luxembourg Museum in Paris, when he was looking about among the American paintings in the Metropolitan Museum of Art during a visit, stopped short before a group of Winslow Homer's sea pictures. "Ah! *that*," he exclaimed emphatically, "is an American."

It is generally agreed that Winslow Homer (1836–1910) was "the most intensely American painter of his time," painting American themes because his whole nature was in tune with them, and because he found his greatest satisfaction in giving them expression. Whatever he painted, we feel that it interested him

and aroused his sincere emotion. One critic speaks of "the simple vitality of his art, its fidelity to nature, the wonderful way in which it takes us away from ideas of paint and the like, and makes us rejoice in the salt winds of the sea, the loveliness of sky and water, the fundamental charm of human nature bearing itself bravely and effectively in the face of the elements."

But Homer was well over forty years old before he turned "his inspired attention to the sea," painting his unforgettable pictures of the Maine Coast and its heroic fisher folk.

WINSLOW HOMER'S STIRRING VIEWS OF FISHER FOLK AND THE SEA

The boy Winslow Homer grew up in Cambridge, Massachusetts. As he went upon his way fishing and studying and playing he noticed the forms of nature and made careful drawings of what he saw. After two years in a lithographer's shop, as a young man, followed by a little time in a Boston studio, he decided to be independent and work in his own way. Then, when the Civil War began, he became a member of the Army of the Potomac. From the front he sent to Harper's Weekly drawings of incidents in camp life. Out of these developed paintings of some of the incidents, two of which, Prisoners from the Front and A Rainy Day in Camp, can be seen in the Metropolitan Museum of Art.

Pictures of negroes and country life in the South followed. Then, at last, Homer found the theme that was to be distinctly his own—the ocean, first as a background for the figures of human beings in dangerous and dramatic moments, later as itself the principal motive. As a painter of marines (sea pictures) he has had no equal in America. Of his earlier sea pictures, The Life Line, Eight Bells, and All's Well are familiar examples; of the later ones, the Maine Coast and the Northeaster.

In water color the painter had great skill, using that medium with especial ease and delicacy. As early as 1866 he had part in organizing the American Water Color Society.

In Dwight W. Tryon (1849–1925) New England has had a painter who with understanding sympathy and poetic vision could put upon canvas the very look and atmosphere of her countryside. Born at Hartford, Connecticut, he grew up loving nature and gathering an intimate knowledge of it. "The spirit of the landscape stole into his heart when a boy, and abided with him in his manhood." He had become a man and had married before he was able to gather together enough money to go to Paris to study painting. He and his wife made a home for themselves there while he worked under Daubigny and others.

But beyond the strengthening of his already vigorous art and a gain in technical skill and knowledge he was not changed by the foreign influence. He still worked to solve in his own way the problem of painting the features of his native landscape. For, just as one face differs from another, each part of the country has individual traits by which those who know it can recognize it. In Tyron's landscapes we feel the strength and sometimes the sternness, as well as the delicacy and refinement, of New England—its softened light and tender atmosphere. For, no matter how simple and commonplace the subject may be, he not only truthfully portrays the actual scene, but presents it with poetic suggestion, the result of his own loving association. Nor is there any lack of skill. On the contrary, his technique has the admiration of other painters, who alone can really appreciate its fineness. Early Spring, The Rising Moon, Winter Evening, and After Showers—June, are the names of some of his pictures.

AMERICAN PAINTERS WHO LIVED AND WORKED ABROAD

Some American painters who went abroad to study chose to spend most of their lives in Europe and have been claimed by the lands in which they lived. But they are truly American, not only through the accidents of birth or parentage, but by virtue of characteristics that mark them and distinguish their work. The "basic quality"—the quality underlying all else—in each of them is essentially American.

James A. McNeill Whistler (1834–1903) was born at Lowell, Massachusetts. The son of an able engineer and army officer, young Whistler went to West Point, intending to enter the army, but before long he left to go to Paris, where he studied painting. His sensitive response to the various influences of world art resulted in a style which mingled them all and yet was a distinct expression of his

own personality. In Velasquez he found power of line and a masterly use of blacks and grays. Rossetti and the other Pre-Raphaelites impressed him with their poetic seriousness, their spirituality of feeling. Courbet and the impressionists helped on his naturally delicate perceptions of light and color values. And in the work of the Japanese artists he found a fascinating example of variety and skill in the making of pattern or design, of choosing an unusual point of view, of producing harmonies of tone. In them, too, he found something else which fitted happily into his own way of thinking—the use of form as a symbol to represent what is formless and spiritual. Delicately he selected what he found good in different schools and influences, putting all at the service of his exquisite feeling for beauty and his desire to give this feeling beautiful expression.

WHISTLER'S PAINTING, A PERSONAL AND UNIQUE EXPRESSION

And so we have the record, not of the facts he met, but of his feeling about the facts. His portrait of his mother, in the Luxembourg, Paris, is more than the portrait of one charming elderly woman. It embodies his own devotion to his mother, his thought of the motherhood in her, and so becomes a symbol of universal motherhood. Of his other portraits the most noteworthy are that of Thomas Carlyle, in Glasgow, that of the violinist Sarasate, in Pittsburgh, and the charming little Miss Alexander, in London.

His figure-painting is more elusive in its charm than are the portraits, as may be perceived in The Music Room, The Balcony, and At the Piano. In these we see a rare originality of design. But in his "Nocturnes" and his etchings the originality of his creative genius found fullest play. The former are patterns or harmonies in color that express the artist's sense of some beautiful moments in nature. They are altogether personal and unique, and can best be studied in the Freer Gallery in Washington. As an etcher Whistler has no peer from the days of Rembrandt. He lived in London from the year 1859 until his death. Of his eccentric ways and his egotism you will often hear, but these are peculiarities of the man rather than of the artist.

Another artist who shows remarkable originality of thought and creative faculty is Elihu Vedder (1836–1923). Born in New York, he studied at home and in Paris before going to Italy in 1857. Back in the United States during the years of the Civil War, he could not be admitted to the army because of a defective arm. Before he returned to Europe he was elected to the American Academy of Design. Settling in Rome in 1867, he made his home there for the rest of his life, but frequently visited his native land.

Illustrations for Omar Khayyám, designed in 1884, brought him wide recognition. His intellectual force and imagination—his poet's mind—supported by great skill in draftsmanship, give him a place apart. Figures and color he used with symbolic force instead of realistic truthfulness, and a landscape surrounding his figures he could fill with dramatic meaning. His pictures have literary interest, beauty of idea, as well as charm of design. This you could guess from some of their titles: The Cumæan Sibyl, The Fisherman and the Djinn, The Pleiades, The Keeper of the Threshold. Among his mural decorations are five panels and a mosaic in the Congressional Library at Washington.

Of unusual interest is the career of Mary Cassatt, "painter of children and mothers." A member of a Pennsylvania family, she went to Europe as a girl to study painting; and in 1874, after learning from some of the old masters in galleries of Italy, Spain and Antwerp, she settled in Paris. Always independent in spirit, she joined with great enthusiasm the French impressionist group in their protest against convention in art. It was Degas who invited her into the ranks, and his work and that of Manet influenced her style, although she has always painted in her own vigorous way, never losing her individuality. Paris continued to be her home, but she emphasized her desire to be counted an American.

ABBEY'S GIFT OF TRANSLATING ROMANCE FROM WORDS INTO FORM

Edwin A. Abbey (1852–1911), a native of Philadelphia, like Vedder, first won fame as an illustrator, and, like him, continued to choose literary themes for his pictures. After studying at the Pennsylvania Academy, Abbey became a draftsman for Harper & Brothers, publishers, in New York. His skill and his gift of original expression brought him early success, the first general recognition of

which came when his illustrations for Herrick's Poems were published in 1882. To get a true feeling for the setting and atmosphere of these illustrations the artist had gone to England to catch the spirit of the countryside. There he found exactly the conditions that suited him, so there he chose to make his home from that time until his death.

Successful in water-color painting, pastel and oil, as he had been in pen-and-ink drawing, Abbey became closely associated with the art life of England, and in 1898 was made a member of the Royal Academy. In 1901 he was chosen as the artist to paint the picture of the coronation of King Edward VII. He was the third Pennsylvanian to receive such recognition, since Benjamin West had painted a similar scene for King George III, and Charles Robert Leslie one for Queen Victoria.

But we usually think of Abbey's art as presenting in form and color romantic events that had their beginnings in the minds of poets and other authors or in the old legends of the world. Some of his pictures, for instance, are founded upon Shakespeare's plays. Such is the scene between King Lear and his daughters, which you may see in the Metropolitan Museum of Art.

Although he had the power of "seeing" what never had actually existed, and of picturing or re-creating truly and convincingly scenes that he caught by that power from word-descriptions, Edwin Abbey was the most earnest and caretaking student. He examined all the sources he could reach, and even traveled far to get exact knowledge of places, buildings, costumes and other details to be used in his historical paintings.

There is an interesting story of the trouble he had once in persuading the mayor of a little town in France to let him copy some pillars that were just what he wished for his picture of Sir Galahad's Vision of the Holy Grail. This is one of the panels in his series "The Quest of the Holy Grail," on the walls of the Boston Public Library.

In addition to these famous mural paintings he made another series for the Capitol at Harrisburg, in his native state. He put into these his love for, and loyalty to, Pennsylvania and its history, working on them for the last ten years of his life. In noble groups and symbolic figures he has done honor to his state and his country, and at the same time has most successfully filled the spaces granted him in the architectural plan, adding the right play of color and fine decorative design. Death came before all the paintings planned for the building had been completed.

Abbey presents his figures in masses softened by effects of light and atmosphere, and his composition shows a balancing of color masses.

SARGENT, A GIFTED, SUCCESSFUL AND INDUSTRIOUS ARTIST

A friend of Abbey, another American painter who spent most of his life in Europe and received high honors there, is John Singer Sargent (1856–1925). His is not a story of hardship and struggle, for the conditions of his life were fortunate, and success flooded upon him from his first appearance in the world of painting. Nor is his story one of idle yielding to fortune or of reveling in success. He thought of painting as his special work, as well as his finest satisfaction, and he painted eagerly, conscientiously and industriously all the years of his life.

Sargent's father was a man of culture and a member of an old New England family. He and his wife were living in Florence, Italy, when their son was born; and in that city, where the whole atmosphere breathes of romance and beauty, where art is utterly at home, the boy grew up. His family life and his education developed in his nature breadth of thought and taste. Under his mother's direction his artistic training began.

At the age of eighteen he went, with a bundle of sketches, to Carolus-Duran in Paris and became his pupil—a pupil who in four years exhibited in the Salon and a year later painted a portrait of the master, surpassing the master's own skill. Thus early John Sargent reached maturity in art. Some years later he was given the title of "the only living old master," for long before his death some of his portraits were hung in the British National Gallery, where before that time no work by a living artist had been hung, and his pictures were being gathered into both public and private collections in company with those of Velasquez, Titian, Rembrandt and Hals.

All these masters and others had contributed to the success of this follower of their art. By studying their works he

took into himself something of their knowledge and skill in the control of paint, just as he had taken over from his living French master the qualities that he had to give—especially an understanding of the action of light upon color and outlines. Yet Sargent never lost or dimmed his own quality. Various influences entered into it and became part of it, but his method and his style were his own, based upon the American temperament which was his heritage.

THE MOST FAMOUS OF NINETEENTH-CENTURY PORTRAIT-PAINTERS

From 1884 he made London his home, with frequent excursions into the country and many visits to the United States, of which land he always claimed himself to be a citizen. In 1897 he was given membership in the Royal Academy at London and in the National Academy of Design. Hosts of Europeans and Americans, both distinguished and unimportant, had their portraits painted by Sargent—far the most famous painter of his time. Opinions about those portraits vary. We may claim that in general his first interest is that of a maker of pictures rather than that of a portraitist, that he cared more for the type than for the individual. Yet some of the portraits, like that of Mr. Marquand, show a truly sympathetic understanding of the subject. His paintings of children are exquisite in their delicacy and tenderness. One, called Carnation Lily, Lily Rose, is a lovely composition of two little girls hanging up lanterns in a garden.

Landscapes, pictures giving glimpses of life in various lands, and some admirable water-colors came from the unwearying brush of this painter; nor are they inferior to the portraits. Some rate them higher as more expressive of the man himself.

Much of Sargent's time in his later life was given to painting the familiar mural decorations for the Boston Public Library and others for the Widener Museum of Harvard and for the Boston Museum of Fine Arts.

The story of mural painting in America has not gone far beyond a beginning as yet, and few of the artists who have contributed to it were trained specifically for that kind of work. We have seen how La Farge adapted himself to it, and how Abbey and Vedder and Sargent were called upon to turn their gifts to that use. We shall briefly review several others who have become noted for wall-decorations in the United States.

THE INTERESTING BEGINNINGS OF MURAL PAINTING IN AMERICA

An event which did more than anything else to awaken enthusiasm for beautifying the centres of life and industry was the World's Columbian Fair at Chicago in 1893. The "White City" created there by architects, landscape-designers, sculptors and painters, all working together for one fine and inspiring result, was an object lesson for the whole nation. And at the same time it was, we may say, the opening of the school of mural decoration in the country.

The director of decorations and functions was Francis D. Millet (1846–1912), a man who generously gave himself to many executive works, yet found time to paint highly finished genre pictures and carefully studied decorations for public buildings in Baltimore, Jersey City, Cleveland, St. Paul and other cities. In technical matters he never accepted the newer ideas of impressionism, but remained true to earlier ways of painting.

The wall-paintings of the Library of Congress in Washington, opened in 1897, were done by various artists who found there a second great opportunity.

John W. Alexander (1856–1915), who gave richly of his great ability, his generous and delightful nature, left a special bequest to boys and girls, into whose lives he worked and planned to bring the joys of a knowledge of art. Himself a gifted boy, he had had to strive through hardships and disappointments to reach artistic expression and success. Study in Europe enlarged his view and strengthened his work; yet the character of his art was always truly American. His technique was modern and individual. Leaving out all confusing detail, he gave to each picture a satisfying appearance of completeness, with a decorative effect original, graceful and beautiful. His many noted portraits include those of Rodin and Walt Whitman (p. 4729). Girls and women he portrayed with subtle perception of their charm. His first mural paintings were for the Congressional Library—an interesting series, The Evolution of the Book; his last, a splendid decoration for Carnegie Institute in Pittsburgh, his native city, illustrate The Crowning of Labor.

Kenyon Cox (1856–1919), whose fine imagination and remarkable skill in drawing set him high among illustrators before the Chicago Fair gave him his initiation into mural painting, held to the academic idea. His work is far less effective in color than in decorative design. In the Library of Congress his panels present the Arts and Sciences in the forms of women bearing emblems. He also painted decorations for public buildings in St. Paul, Minnesota; Des Moines, Iowa; Wilkes-Barre, Pennsylvania; and other cities.

The year of the World's Fair (1892–93) is a milestone in the career of Edwin H. Blashfield, born in New York in 1848. Until then he was known as a painter of genre and figure subjects; since, he has become a leader in the ranks of mural painters. The cupola of the Liberal Arts Building at the Chicago Exposition was decorated by his brush; and the dome of the Library of Congress is an example of his ability to make a composition which fits harmoniously into the design and structure planned by the architect. State capitols, in Minnesota, Wisconsin and Iowa, with buildings, public and private, in Baltimore, Pittsburgh, New York and elsewhere, hold evidence of his taste and sincerity, his love of beauty and knowledge of his art.

Some of the same buildings—the Washington Library and the Minnesota Capitol—besides the State House at Boston, the capitols of South Dakota and Iowa, with other edifices scattered about the country—have been beautified by the work of Edward E. Simmons, who also dates his advance in this field from 1893. Charm of color and freedom of style are qualities that distinguish him.

And so we might go on, had we space, to tell of Robert Reid, Will H. Low, Robert Blum, Charles Yardley Turner, Violet Oakley, Albert Herter and other mural painters who have thus been bringing new beauties into many lives.

FIGURE-PAINTING OFFERS ROOM FOR MANY STYLES AND INTERESTS

In the United States, landscape holds the first place, but close beside it stands figure-painting, a province to which American artists have brought a great diversity of styles and interests.

Bridging the gap between the first quarter of the nineteenth century and the opening of the twentieth, Eastman Johnson (1824–1906) painted better genre pictures than had been made before by an American. After studying at Düsseldorf he spent several years in Holland, where, you remember, genre painting reached an excellence that has never been outdone. His own genre studies—Old Kentucky Home, Corn Husking at Nantucket, and others, all very popular thirty or forty years ago—have an air of great naturalness and are painted in a broader way than are his portraits. One of the best of the portraits, which preserve the features of John Quincy Adams, Longfellow, Emerson and other noted Americans, is the interesting group, Two Men, in the Metropolitan Museum of Art.

Thomas Eakins (1844–1916), in spite of academic French training, was a realist and a naturalist in manner, willing to sacrifice grace or picturesque quality to a stern, direct statement of fact. Life and character were the things that interested him above all else. So, whether he painted a portrait or a figure-study, he aimed at presenting an actual record of life. He made one painting of a man that has become increasingly famous. It is called The Thinker, and it seems to set before one's eyes the very performance of a mental act. Feet apart, hands thrust deep in pockets, the man stands in an unconsciously awkward pose—his whole attitude as well as his face showing him to be lost in thought.

For strength and sincerity and knowledge of drawing, well; but for the charm of color and realization of beauty Eakins seems to have had little capacity.

GEORGE DE FOREST BRUSH AND ABBOTT THAYER, IDEALISTS

Two friends who were young men together in Paris in the 1870's, and who continued their friendship through life, are alike in the high idealism and sincere performance of their art, but very different in their manner of painting and in the distinguished types that they created. They are George de Forest Brush, a native of Tennessee, and Abbott Thayer, who was born in Boston but is closely associated with New Hampshire.

The former, while true to the teachings of the great masters of painting, and keeping to the older traditions of color rather than to the new feeling for outdoor, luminous effects, shows originality of mind in making use of his knowledge. His work reflects the Dutch and Italian schools, but does not copy or imitate.

His earlier canvases have for their prevailing theme the life of the Indian, a theme which reaches noble and unusual distinction in his handling. There is quiet dignity in his fine figures set, as a rule, in landscape that seems to live. The Silence Broken, The Indian and the Lily, and Mourning her Brave, are examples of this phase of his work. They are "picture-poems," which take their place beside Longfellow's Hiawatha in making real for us the primitive life of the country. Equally his own are the groups of mother and children which hold a note of calm, serene beauty, serious almost to sadness. There is entire simplicity in the pose and in the folds of the garments. In most of these groups, notably the earlier ones, the color is subdued in key, but warm and mellow. Mastery of drawing and a beautiful dignity of composition mark all of Brush's works.

A LOVER OF NATURE WHO FOUND OUT ONE OF HER LAWS

The memory of Abbott Thayer (1849–1921), "a remarkable spirit and a remarkable painter," shines with the radiance of a personality that impressed all who knew him and that found expression in pictures glowing with vital beauty. There is something almost Greek in the firm, serious, dignified beauty of his figures of goddess-like women—a beauty uplifted and spiritual, but strong, not too delicate for this earth, even when the forms are winged. Their eyes have the light of far visions, but their feet firmly tread upon the ground. In Caritas (Charity) a tall, stately woman seems to protect and bless two small children beside her. In another picture, The Virgin, a lovely girl moves lightly and easily, but steadily, forward leading a child with each hand. Thayer's landscapes show the same understanding and earnest enthusiasm. He loved all beauty and he intimately knew nature.

It was through this knowledge that he was able to explain nature's secret of protective coloring and its relation to the play of light and shade; and by applying the rules he had worked out, now known as Thayer's law, he developed the art of camouflage in the World War.

Very different from the women of Brush and of Thayer are the women on the canvases of Thomas Dewing. His have an ethereal but worldly beauty, while theirs were firmly modeled, yet filled with the light of spiritual beauty. The delicate and subtle creative art of Dewing has made a world of refinement and charm where fair women with grace and composure fit into elegant interiors or dream-like landscapes. There is no movement, no agitation. His color-schemes are subtly modulated harmonies.

GEORGE BELLOWS, WHOSE STROKE PUT LIFE ON THE CANVAS

When the sudden death of George Bellows was announced in 1925 the shock was such as you would feel if you saw a strong runner drop in the middle of a race. At the age of forty-two—an age when many an artist is only beginning to get recognition—this sturdy independent painter, who had always gone his own way, making no efforts for public approval or popularity, had become a figure to be reckoned with in the art of the world.

Before he was thirty he was made an Associate of the National Academy of Design (the youngest painter ever recognized in this way) and had had a picture placed in the Metropolitan Museum of Art. As he never was in Europe, such influence as he felt from works of the world's master painters came to him in American galleries. Holding to his own course in the midst of swirling modern art movements, he painted with zest and with power all manner of things that came into the path of his daily life in New York—the landscape along the Hudson, spring in a city park, a prize fight, a crowd of city boys playing and diving from a board beside the river, kindly old ladies, and again and again his own family household—his wife and his two little girls. To every theme he gave a bold vitality, a touch that made it live, whether he did it in color or in the blacks and grays of the lithograph. His own vigor and enjoyment seemed to flow through his brush into his work.

As a lithographer he is ranked among the masters of the art, and his prints are eagerly sought. What he might have accomplished had he lived longer we shall always wonder. He is rated without question the most "native" American painter—even more notably so than Winslow Homer.

When Bellows arrived in New York, fresh from college in his native Ohio, the strongest influence that touched him was that of his teacher, Robert Henri, who

lived from 1865 until 1929. Henri was long a leading figure among the independent artists of his time, affected by the influence of the French moderns, Manet and Degas, and by Japanese art. His brush was gifted and his style easy and spirited. He and William Glackens, together with George Luks and John Sloan had for their first purpose to present reality of life, gathering up essential qualities and setting them forth in a broad fashion. Details are sunk beneath the all-important general impression.

Charles W. Hawthorne (1872–1930), working with the same object of portraying the real and the same interest in skillful, broad painting, reached something deeper because of an interest in his subsjects as human beings.

MANY VARIETIES OF SUBJECTS AND STYLE IN FIGURE-PAINTING

Another painter who showed healthy and sincere sympathy with the persons he painted—usually young men, women and children of the Dutch peasantry—was Gari Melchers (1860–1932). Independent in style, and modern in method, he never turned in the direction of extreme impressionism. To him details seemed necessary for the presentation of truth. His work has some of the qualities of Flemish painting. His manner is direct; his style vigorous and fresh; his color and design of decorative value.

E. Irving Couse has made interesting studies of the life and pursuits of the Taos Pueblo Indians. Frank W. Benson, known also for his etching, has painted charming figures of women and children in brightly sun-lighted scenes. Frederick C. Friesecke and Richard Miller are concerned almost exclusively with the conquest of light and color, so that their figures can be considered hardly more than studies in color. Another phase of the modern study of light, or lighted atmosphere, can be seen in the figure-paintings in interior settings, by Edmund C. Tarbell and William M. Paxton.

Most of these painters of figures are portraitists as well; and among them, excelling in both fields, stands Cecilia Beaux. With free brushwork and fine sense of values she depicts particularly well women and girls in natural poses. Her pictures are distinguished by a delicate grace and delightful elegance.

Of a very different type, but also graceful and beautiful, are the figures by Lilian Genth set against idyllic green out-of-door backgrounds.

Arthur B. Davies (1862–1928) was a painter using figures and landscapes chiefly to symbolize ideas or express feeling, but he never lost the sense of their value as parts of a decorative scheme. His art, linked with the remote past, has an enchanting lyric beauty. His paintings suggest mystery and romance—a world of dreams, but one founded upon a sure knowledge of the real world.

HOW LANDSCAPES REVEAL THE MINDS OF THEIR PAINTERS

Some painters have done almost equally good work in figures and landscapes. For example, J. Alden Weir, 1852–1919, not only experimented but found success in different sorts of painting. Impressionist in style, he felt the subtle gradations of light and tone, and presents the actual appearance of a landscape, a figure or a group with the understanding of a man of fine perceptions. He painted some charming pictures of his children with their pets, one of which is called The Donkey Ride.

William Gedney Bunce (1843–1916) was held by the fascination of painting Venice; while William Sartain (1843–1924), genre and landscape painter, is known chiefly through his scenes of Algeria and the life of its people. On the other hand, their contemporary Ralph Blakelock (1847–1919), an artist with no training beyond what he gained from experience, summoned out of nowhere, as if by magic, a land of his own creating. The actual shapes of things did not count so much as his imaginative vision of them. While his tone is often heavy and his paint thickly spread, he could at times get most delicate shades of tone. Sunset and moonlight scenes and Indian encampments in the forest are some of his themes.

In the pictures of Albert Ryder (1847–1917) it is again the imaginative thought, the poet feeling, that we care for. These overbalance a lack of accuracy in form and faults of color-handling. The atmosphere of beauty clings around the scene, whether the theme be taken from a homely stable incident or lifted to a lofty dramatic or religious plane. Mending the Harness, Siegfried and the Rhine Maidens, and Pegasus are some of his suggestive subjects.

In distinct contrast with such canvases

let us think of the fresh, joyously painted "portraits of landscapes" made by Willard Metcalf (1858–1925)—sometimes intimate bits of nature, sometimes broader sweeps. Here skill of workmanship and a fine sense of design are added to beauty of color. Nor is this all. There is a vitality—a feeling of air and of sunshine, or perhaps of the silence of night—that comes from the artist's own attitude.

Francis Murphy (1853–1921), while he caught the true atmosphere of certain phases of nature and made fine records of tree life in his tender-hued landscapes, was more limited in theme and mood.

The Dust Storm by John Sloan, in the Metropolitan Museum of Art.

Metcalf belonged to that group of men who came from Paris bringing the first impulse of the plein-air movement—the practice of studying the effects of light on nature in the open air. As we know, all painting from that time has been affected in some fashion by this new way of looking at nature. In general we may say that the later work is less concerned with pictorial effects—the making of graceful pictures—than was the older. It aims more at giving an impression of the very appearance of things—their aspect; or its first object may be to make a beautiful and interesting decorative effect.

John H. Twachtman (1853–1902) in his experience spanned the two ideals, for he laid strong foundations as a student under Duveneck and then at Munich. Yet no other has left canvases that have more exquisitely caught an expression of nature's essential abstract meaning—that elusive, charming "spirit of place." He discloses it equally in the opalescent shimmer of a snowy landscape or the broad-spread beauty of his farm in the summer time.

His later methods were the modern methods of France, and while methods alone cannot make painting live, they count largely toward the desired results. Childe Hassam (1859-1935), using Monet's way of painting to produce color pure and vibrant—color infused with light—seemed to imagine in color. Best of all, among the varied themes he chose, shine his vivid coast scenes; but through all his work we feel his love of beauty and the sense of his joy in painting.

THE NEXT STORY OF THE FINE ARTS IS ON PAGE 3511.

PAINTINGS BY AMERICAN ARTISTS

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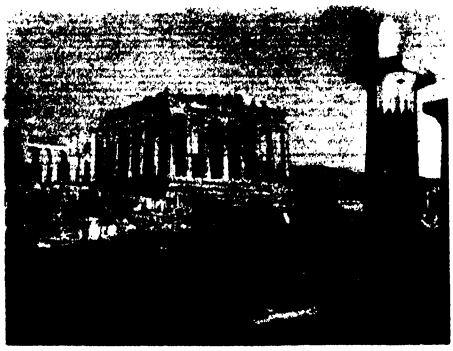
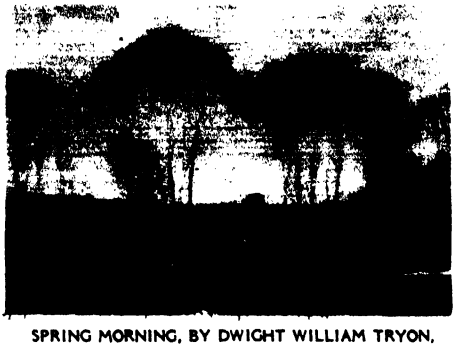
CARITAS, BY ABBOTT H. THAYER, IN THE MUSEUM OF FINE ARTS, BOSTON



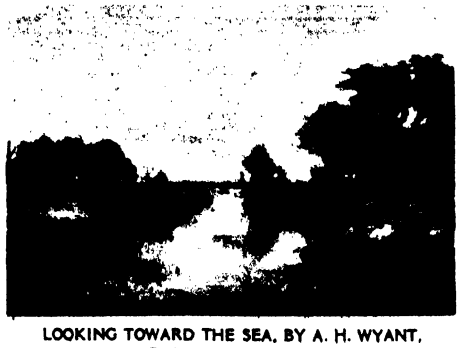
THE PARTHENON, BY FREDERIC E. CHURCH,
IN THE METROPOLITAN MUSEUM OF ART

THE MOUNTAIN FORD, BY THOMAS COLE,
IN THE METROPOLITAN MUSEUM OF ART

BRINGING HOME THE CATTLE, BY THOMAS MORAN, IN THE ALBRIGHT ART GALLERY



SPRING MORNING, BY DWIGHT WILLIAM TRYON,
IN THE TOLEDO ART MUSEUM



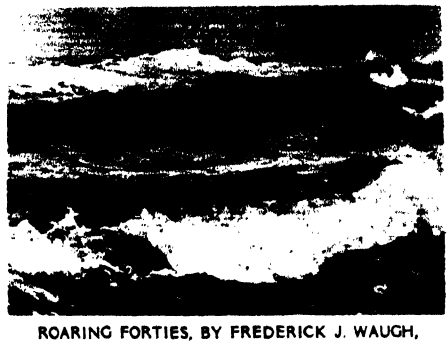
LOOKING TOWARD THE SEA, BY A. H. WYANT,
IN THE METROPOLITAN MUSEUM OF ART

SAND DUNES, BY HOMER MARTIN,
IN THE METROPOLITAN MUSEUM OF ART

SNOW, BY JOHN H. TWACHTMAN,
IN THE WORCESTER ART MUSEUM

THE WRECK, BY WINSLOW HOMER, IN THE CARNEGIE INSTITUTE AT PITTSBURGH

NORTHEASTER, BY WINSLOW HOMER,
IN THE METROPOLITAN MUSEUM OF ART



ROARING FORTIES, BY FREDERICK J. WAUGH,
IN THE METROPOLITAN MUSEUM OF ART

LA CARMENCITA, BY JOHN SARGENT

LORD RIBBLESDALE, BY JOHN SARGENT

HENRY G. MARQUAND, BY JOHN SARGENT

MRS. WERTHEIMER, BY JOHN SARGENT

BLACK AND GREEN, BY JOHN W. ALEXANDER,
IN THE METROPOLITAN MUSEUM OF ART

GIRL IN WHITE, ERNESTA, BY CECILIA BEAUX,
IN THE METROPOLITAN MUSEUM OF ART

WINIFRED DYSART, BY GEORGE FULLER,
IN THE WORCESTER ART MUSEUM

MY DAUGHTER, BY FRANK W. BENSON, IN THE
CORCORAN GALLERY OF ART, WASHINGTON

TOILERS OF THE SEA, BY ALBERT P. RYDER,
IN THE METROPOLITAN MUSEUM OF ART

INDIAN ENCAMPMENT, BY RALPH A. BLAKELOCK
IN THE METROPOLITAN MUSEUM OF ART

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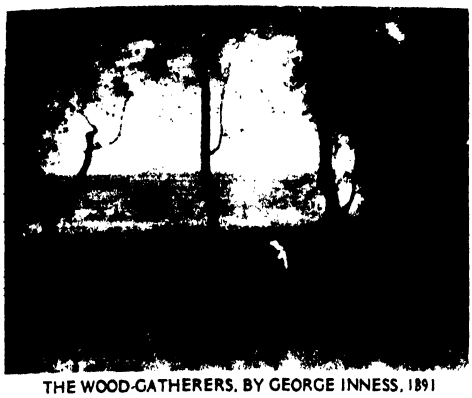
THE FLIGHT OF NIGHT, BY WILLIAM MORRIS HUNT, IN THE PENNSYLVANIA ACADEMY OF THE FINE ARTS

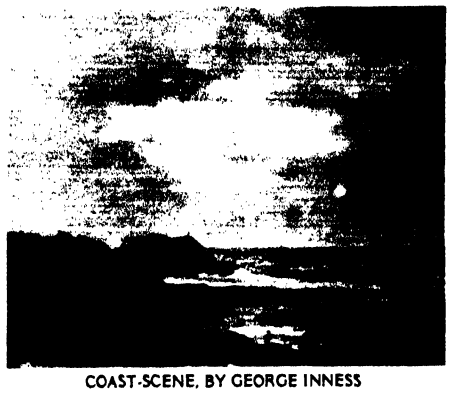
THE MUSE OF PAINTING,
BY JOHN LA FARGE

ACADEMIA,
BY EDWIN H. BLASHFIELD

THE LOST MIND,
BY ELIHU VEDDER



THE WOOD-GATHERERS, BY GEORGE INNESS, 1891



COAST-SCENE, BY GEORGE INNESS

PEACE AND PLENTY, BY GEORGE INNESS, 1865, IN THE METROPOLITAN MUSEUM OF ART

UP THE HUDSON, BY GEORGE BELLOWS,
IN THE METROPOLITAN MUSEUM OF ART

ISLE OF SHOALS, BY CHILDE HASSAM,
IN THE METROPOLITAN MUSEUM OF ART

IN THE GARDEN,
BY GEORGE DE FOREST BRUSH

MOTHER AND CHILD, BY GARI MELCHERS,
FROM THE COLLECTION OF J. F. BRAUN

LADY JEAN,
BY GEORGE W. BELLOWS

THE NEW BONNET, BY EASTMAN JOHNSON,
IN THE METROPOLITAN MUSEUM OF ART

CHESS-PLAYERS, BY THOMAS EAKINS,
IN THE METROPOLITAN MUSEUM OF ART

MOTHER FEEDING HER CHILD, BY MARY CASSATT

THE EVENING MEAL, BY MAX BOHM

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When Albert Lacombe left an affectionate family for the wilderness, he carried his boyhood faith with him.

BLACK ROBE and WHITE HEART

THE stories of the missionaries to the American Indians in the early days are full of examples of bravery, particularly in Canada. The Indians of the colonies to the south were not, generally speaking, so fierce. After a long time the Indians learned the power of the white man and ceased to torture the men who brought them the story of Christianity. The good priest whose story is told below was not in danger of his life or of physical torture; nevertheless, he endured all manner of hardships in looking after his people. This is a story of heroism day by day.

On New Year's Eve, 1839, Albert Lacombe, almost twelve, stood at midnight in the raftered kitchen of his house near St. Sulpice, Quebec. Very proud and very happy was he, for he was to repeat to his father the New Year's wishes that his mother had taught him. This is one of the olden customs that has not died out in French-Canadian homes.

The night air was so frosty and still that the joyful chimes from the cathedral in Montreal, twenty miles away, blended with the peals from the gray-towered church around which the little parish of St. Sulpice clustered.

The lad's heart was filled with something like awe as he listened and waited for the music of the bells to die away. He noted that the vivid blaze from the wide fireplace, heaped with logs, flamed brightest on his brothers and sisters as they knelt about their father's knee. His mother stood in the deep shadows of the low room. She was thinking, he believed, of her ancestress who many years before had been captured by an Ojibwa chief and was rescued by her *voyageur* uncle, who had brought her and her half-breed children back to her childhood home.

As the chimes rang out, the little formal speech was given. It closed with a request for their father's blessing, but to Albert's boyish loyalty his mother seemed left out. Turning to her, he cried impetuously: "And, Maman, you know how we love you!"

This unpremeditated outburst gives us the keynote of Father Lacombe's whole life. He traveled thousands of miles over the great high plains of the Canadian Northwest, over oceans and foreign countries, and always his cry was, to those who were within reach of his voice or influence, were they Indians or white men, "And you know how I love you!"

Albert and his brothers and sisters lived with their father and mother on the farm in St. Sulpice. When not at school the boy was kept closely at work on the farm. He enjoyed making sugar when "sugaring-off time" followed the snowy winters in Quebec, but picking up stones on new land, feeding

A welcome for the Indians at Edmonton House.

pigs, driving a plow—these were duties not so pleasant, and his thoughts were busy with plans for the future. Should he be a *voyageur* like his grand-uncle Joseph Lacombe, and go to the far, far West, where the fur companies sent men who were brave? His parents were so poor that he could not hope for their assistance in gaining an education.

One day a wonderful thing happened. The *curé*, driving a fat old horse, came to make a call. He spoke of the weather and of the crops. Suddenly he turned to the shy lad standing near. "My little Indian," he said, for he was fond of Albert and knew the story of Madame Lacombe's ancestress, "what are you going to do?" Albert was speechless. He knew what he wanted; but how could he tell so grand a man as "Monsieur le Curé"? He looked up desperately at his father. So the kindly father explained that he could not afford to send his eldest child to school, although the boy longed for books and knowledge. The *curé* nodded, but made no further reference to his question until he was leaving. Then he called back, as he clambered into his old cariole, "You send him to college and I will pay his way. Who knows? Some day our little Indian may be a priest for the Indians."

For years Albert Lacombe studied. He enjoyed school and college. But he grew to feel that school life and indoor life were not for him, and when he was twenty-two he started for the country he had dreamed of ten years before. Travel was not easy then. His long cassock was often ridiculed, and the trail from Montreal to Pembina, far out on the northwestern prairies as distances were then reckoned, seemed very long indeed, as it was covered by stage and steamer from Montreal to Buffalo, from Buffalo to Dubuque, Iowa, and from there to St. Paul, Minnesota. On the Mississippi steamer the first free air of the wilderness came to young Lacombe. "I began to breathe freely at last," he says of those delightful days. "I felt myself a new man."

When he reached St. Paul the scattered settlement of log houses, that had but recently dropped the name of Pig's Eye, had scant accommodations. His horror at being shown a coffin in which to sleep was genuine, but "It's much better than the floor," the frontier priest remarked. "We made it too short for one of my parishioners; but even so, it serves a good purpose." And, indeed, it did serve as a resting place that night.

From St. Paul on, the trail was harder and lonelier. The oxen drawing the creaking wooden carts moved slowly along the muddy roads. The marshes and creeks were swollen by the recent rains, and sometimes the carts and oxen sank so deep in a swamp that the whole party had to work in harness to drag them out. Pembina was reached at last, and there began Father Lacombe's years of service to the Indians and métis. He learned many Indian languages; went with the Indians on their annual buffalo hunts, when the unnumbered bison roaming the prairies looked like the type on this page, so closely did they feed; taught the children; baptized all who would accept Christianity; worked and loved. That was the Golden Age for the Indians, for the bison supplied them with three great necessities of life—food and clothing and fuel—and they were brave and independent and free.

Finally the missionary was sent farther west. From St. Boniface and Fort Garry to Edmonton House, then the most important trading post of the Hudson's Bay Company west of Fort Garry, he traveled by way of

Cumberland House. From there ten York boats conveyed the party up the Saskatchewan. Alas, Father Lacombe's dreams of the free life of the *voyageur* were not borne out by the reality of their tasks. Canoes had been done away with, and men hauled the heavy boats against the currents as horses hauled the boats on the Erie Canal. Walking in mud, over rocks, through swamps, along cliffs, sometimes in water up to their armpits—small wonder the men were glad when they neared Edmonton House. Then they donned fresh red woolen shirts and knotted kerchiefs around their heads to make a brave appearance as they climbed the green banks of the Saskatchewan. So they came to the fort, trading post, storehouses and the deep roof of "Rowand's Folly," as the governor's house was called.

When the Blackfoot, Blood, Piegan, Strongwood and Plain Crees came to trade in spring and autumn at Edmonton House, Father Lacombe welcomed their coming as another opportunity to get acquainted with more Indians. He watched with interest as the men rode up, wearing skin shields on their arms, full quivers at their sides, eagle feathers in their hair, and startling bright paint on their half-naked bodies. Squaws and children, yelping dogs and clanging iron kettles added color and noise. Ponies drew the *travois*, or Indian wagons, formed of crossed poles on which was piled the camp equipment.

While the men traded their furs and skins for the things they wanted, the squaws put up the lodges and made the camp. Soon every Indian, big and little, knew and loved Father Lacombe.

On and still farther on he traveled. He went to Peace River, Little Slave and Lesser Slave lakes. He went to Jasper House, where Father De Smet, who brought the story of the Cross to the Flathead Indians in Montana in 1840, had gone in 1845 as peacemaker. Sometimes Father Lacombe was in forest fires, in floods, in blizzards. He wandered on foot, by boat, by pony or dog-team, even on snowshoes, and everywhere he went he was cheerful, sunny and hopeful.

When smallpox and scarlet fever came among the Indians, there, too, was Father Lacombe, with medicine and advice, no matter how far away he might have been at the time of the outbreak. When a tribe of Crees attacked a tribe of Blackfoot with whom he was camping, he went around the outside of the palisade holding his crucifix aloft and waving a red and white flag in an appeal for peace. In the noise of the battle the Crees did not hear him, and a low-lying fog shut him out of their vision. He called to the unseen enemy, he waved his flag, but his efforts were unavailing. Suddenly a bullet which had already touched the earth rebounded to his shoulder and, glancing off, struck his forehead. The wound was slight, but the shock was so great that he staggered and fell. The Blackfoot, angered afresh, set up a wild shout, "You have wounded your Blackrobe, Dogs! Have you not done enough?" When the startling word ran through the ranks of the Crees the firing ceased, and without waiting to meet their friend, the Man-of-the-Good-Heart, the Crees withdrew in confusion.

And so the years went on. The Northwest Mounted Police took charge of the country west of Winnipeg. The settlers came. Cattle, horses and wheat fields increased. Railroads crossed the country the missionary had so often traversed. The fur trade diminished, and the buffalo vanished. The métis and Indians, who tried farming, with poor success, were starving. Meanwhile towns multiplied. Father Lacombe's Indians sorely needed his love and aid.

There are but few places in Canada, England and even on the Continent, to which Father Lacombe did not go to gather money and get grants of land for his poor Indians and métis. Queens, diplomats, emperors, even the Pope himself, were interviewed, and never without instant response.

As the years slipped by, Father Lacombe finally settled down, at eighty-six, in a "home" near Calgary which he had founded for the homeless children and homeless poor.

Shrunken and stooped, quieter than in the stirring years of wandering, yet with eyes and heart aflame to want and misery as of old, Father Lacombe's own words may well end his story.

"We are told that in the earlier days of the Church an old white-haired man, bent with age and particularly tried by the labors of a long, painful apostolate, being no longer able to walk by himself, was carried by his disciples into the midst of an assemblage of the faithful, where he did not cease to repeat: 'Little children, love one another.'

"This old man was the apostle St. John. *Eh bien* today you have before you another old man. I will say to you nothing else than what St. John said; like him I shall repeat to you, 'Love one another.' "

The good Blackrobe died soon after.

THE NEXT STORY OF GOLDEN DEEDS IS ON PAGE 3809.

From the T. F. Healy Collection

Tennyson in his library, with its friendly clutter of books, and its view of the outdoors which he loved so well.

TENNYSON AND THE BROWNINGS

THE reign of Queen Victoria (1837-1901) stands out as a Golden Age of progress in England. Science moved forward in great strides. Inventions changed the home life and the workaday life of millions. Wealth piled up. Trade expanded. Education was spread over a wider area. Best of all, democracy blossomed.

Victoria's reign was a Golden Age of art, also. Painters, sculptors, architects, musicians and writers of wonderful genius produced works that are everlasting tributes to the creative skill of man.

The artists of any important age are likely to show in their works the spirit of that age, along with a timeless quality of beauty.

We shall tell you now of three poets who, in different ways, reflected the spirit of nineteenth-century England, yet gave us verse that we may read today with joy. Their names are Alfred Tennyson, Robert Browning and Elizabeth Barrett Browning. The Department of Poetry contains a number of poems by these three. Look under their names in the Poetry Index.

Before the nineteenth century comparatively few people could afford to buy books; and there were even many who could not read. In 1814 a steam printing-press, invented by Frederick Koenig, was brought to London. It lowered the cost of printing and the price of books. More people at this time were learning to read, and for these two reasons the sale of books increased enormously. Reading became a general hobby.

That was a wonderful thing for the writers of Victoria's time—they drew inspiration from the lively, inquiring, forward-looking spirit of the age, and also from their widening circle of readers. Writing is a kind of partnership. This fact is especially true of poetry, and the verse of Alfred Tennyson is

a shining example. He had the poetic genius —he could make music with words, with simple, homely words that everybody can understand. So his poetry was beloved by all, from Queen Victoria to the young mill worker just learning to read. He was the most quoted poet of his day. He received enormous sums of money for poems. He became the poet laureate of England when he was only forty-one years old. From plain Alfred Tennyson he became Lord Tennyson. In return, he gave some of the most exquisite musical lines and some of the loveliest lyrics in the English language. He set a fashion in careful, polished verse-making that was copied for almost half a century by lesser poets in England and America. His fashion was not much copied by the other great writers of his time and later, who followed their own bent; and today only a small fraction of his enormous poetic output is read. Yet that fraction is beautiful beyond compare.

Culver Service

The beautiful home in Somersby, where Tennyson was born.

Alfred Tennyson was born in Somersby, Lincolnshire, on August 6, 1809. During his early years he spent countless hours roaming over the hills near his native town. The quiet countryside, the weed-choked streams and the echoing woods, and also the peaceful sand dunes and crashing sea waters of the near-by coast kindled his imagination. He observed the moods of nature with keen intelligence. He studied the plants and birds and animals. He watched the ever changing clouds and heard the wind as it rustled through the leaves or roared across the fields. He retained their images in his mind, and he changed these mental pictures into musical word-pictures. In 1827 there appeared a book of verse, POEMS BY TWO BROTHERS. The authors were Alfred's two brothers; and poems by Alfred also were in the book. His contributions were mainly vivid descriptions of the Somersby countryside. In almost all his works we find descriptions of nature. In his romances they hold back the story sometimes, but readers of the nineteenth century were not in such a hurry to "get on with the tale" as we are. The Victorian novelists also wrote careful descriptions that slowed down the pace of their tales.

Alfred's love for the out-of-doors made him detest the stuffy atmosphere of the schoolroom. He went to the grammar school at Louth at the age of six and remained there for five years. Some time later he studied at Cambridge University for three years. Both places were dull and monotonous to him. Almost all his knowledge, and he learned a great deal, especially about classical and modern literature, was acquired in his father's excellent library. His broad reading gave him the tools required by a poet—a rich vocabulary, a knowledge of poetic forms, and a knowledge of the history and customs of mankind. His poems show the result of these studies. In IDYLLS OF THE KING, he retells the stories found in the medieval legends written about King Arthur. In THE LOTUS EATERS and ULYSSES he revives tales of ancient Greece. He copied old forms—the sonnet, the ode and the ballad, investing them with new grace.

In 1830 young Alfred met and fell in love with Emily Sellwood; but his poetry was not yet bringing him an income sufficient for marriage. Twenty years passed before he could afford a suitable home for his Emily. During all those years, from the ages of twenty-one to forty-one, he devoted himself to his writing. He saw few people and spent most of his time in thought and composition. In 1833 the death of Arthur Hallam, best friend of his Cambridge days, sent him into almost complete retirement. After Hallam's death Tennyson wrote in a letter, "He was as near perfection as mortal man could be."

In the years that followed, the poet composed 131 poems on grief and loss, on the meaning of life and death and on other broad philosophic themes. Seventeen years after Hallam's death, in May, 1850, Tennyson collected these poems, and they were published under the title IN MEMORIAM. This book has been called by some critics the poet's masterpiece.

You are not to suppose that Tennyson

spent those seventeen years grieving for a lost friend of his boyhood. IN MEMORIAM is dedicated to Arthur Hallam and some of it directly relates to Arthur's death; yet the poems are not closely tied together. They are rather like beads of many colors hung on a chain. They give us the thoughts of a serious young man growing into a happier mature man, yet never forgetting his youth.

WELL-DESERVED HONORS CAME TO TENNYSON IN HIS LATER YEARS

During this century, as we have said, science took a long step forward. Many new theories were brought forward, and found followers who hailed them as absolute truths. Some of the theories were disturbing to devout men and women, for they seemed to deny God. Tennyson, in IN MEMORIAM, suggested that science and religion can not be enemies, since both seek Truth.

Tennyson was praised and rewarded for IN MEMORIAM. A month after it was published, he and Emily Sellwood were married. In the same year Queen Victoria appointed Tennyson poet laureate of England, following Wordsworth. In after years Tennyson was offered a peerage three times. Finally, on March 11, 1884, he accepted this honor and took his seat in the House of Lords as Baron Tennyson of Aldworth and Farringford. He took the position of poet laureate very seriously, and wrote many beautiful poems memorializing patriotic events. The most famous of these is THE CHARGE OF THE LIGHT BRIGADE. The fire and excitement of its lines have moved all who read it. But most of his patriotic poems, while good examples of this type of poetry, have never received the praise bestowed upon his lyrics. The "laureate" works were composed to celebrate single occasions and did not deal with universal human emotions, as did so many of his other poems.

Tennyson wrote a few poetic dramas. His talents as a playwright were mediocre, and the plays had little success.

At the age of eighty-four he still possessed his intellectual faculties, still studied, still wrote poetry. He died on October 6, 1892, with a copy of Shakespeare's CYMBELINE in his hands. The play was buried with him at Westminster Abbey on October 12, 1892. Shortly before he died he had composed the magical song CROSSING THE BAR. It was his farewell to life. We are told that on the day of his funeral, most of the people in London carried a copy of CROSSING THE BAR in their hands.

Victorians almost worshiped Tennyson. Today we find many of his works too sentimental and too overdecorated for our taste. But the interested reader can uncover in Tennyson's longer poems one view of Victorian England; and his lyrics, as we have said, are surpassing examples of word-music.

Among those who recognized Tennyson's genius was a fellow-poet, Robert Browning. These two—Tennyson and Browning—were the greatest poets of their century. Both were English. Their life dates were almost side by side—Tennyson's, 1809-92; Browning's, 1812-89. Both were successful and famous in their chosen careers; and when they died both were buried in Westminster Abbey.

There the resemblance ends. Tennyson was the people's poet. He used simple words and simple poetic forms that please us as soft, tuneful music pleases. His stories have a universal, human appeal. He did not quarrel with life, but accepted life, dimming some of its tragedies behind a veil of beauty.

ROBERT BROWNING: FIERY PEN AND ROMANTIC HEART

Browning was all fire and fight. Not for him the carefully worked harmonies of word-music. His verse is sharp, exciting, swift, even uncouth at times. His words and sentences are heaped up, as if he could not write fast enough. His poems appeal to the mind. Browning had a vast, robust love of human beings—but he thought of each man as a separate, lone soul, thinking hidden thoughts, living an inner secret life.

It is not easy to understand all of Browning's poems. In his own lifetime he won a much smaller following than Tennyson won; the Browning enthusiasts were intellectuals of England and the United States. In America hundreds of Browning Societies sprang up, and the members of these clubs earnestly studied the poet's works. In truth, study is necessary, if some of the poems are to be appreciated, for they are full of learned references to other literatures, history, philosophy and the arts. There are many rare and foreign words; and Browning loved to experiment with unusual verse forms.

Robert Browning was born on May 7, 1812, at Camberwell, London. The arts—literature, music and painting—held a greater fascination for him throughout his life than did the formal studies taught in school. Because of this he did not attend school for very long. Instead, he delved deeply into the literature of France and England. He

studied nature, the paintings of the masters and great music. He became a profound scholar of literature and art; you can tell that, as we have said, by reading his poems.

Before he knew how to write, Browning composed verse. When Robert was twelve years old, he completed a volume of poems. It was never published, and years later he destroyed the only copy of this boyish work.

In 1833 his first published poem, PAULINE, appeared. Displeased with it, the author destroyed every copy that came into his hands. The next year he made his first trip to Italy, the country that was to inspire his greatest works. This visit marked the beginning of Browning's success. His next poems, PARACELSUS and SORDELLO, show his great talent for creating psychological studies and dramatic situations in poetry. There followed STRAFFORD, A BLOT ON THE 'SCUTCHEON and PIPPA PASSES and other poetic plays. These were published in a series of pamphlets called BELLS AND POMEGRANATES.

At this time Robert Browning was struck by the verses of a young woman, Elizabeth Barrett. She had praised his work in one of her own poems, and Browning, much pleased, called to thank her. Now Elizabeth, partially crippled in a fall from a horse and suffering since her childhood from a spinal infection, was a confirmed invalid. She was six years older than Browning (she was born in 1806), and most of her life had been spent in pain. She was confined for years under the morbid care of her father, first in their home near Malvern Hills, later in Devon, and finally at 50 Wimpole Street, London. There Elizabeth missed the peaceful atmosphere of the country, and from 1838 to 1841 she lived in the seaside town of Torquay with her brother. His accidental death by drowning added mental grief to her physical suffering. She returned to London shortly after.

Unable to live a normal life in society, Elizabeth Barrett turned to books. She read and translated Greek classics, studied the works of Dante, Petrarch and Shakespeare; and at last began to write. Her delicate, musical poetry reached an enthusiastic audience. By 1845 her name was well established by the collection of poems she published. In a letter to a friend at this time she wrote, "I had a letter from Browning, the poet, last night which threw me into ecstasies—Browning, the author of Paracelsus, the king of the mystics" Thus began one of the great romances of literature. Elizabeth was thirty-eight. Robert was thirty-two.

The two wrote many letters to each other

Elizabeth Barrett Browning and her husband, Robert Browning. The true story of their lives is one of the most romantic in all literature.

We can read in them the story of the deep love that developed. Many obstacles prevented them from marrying immediately. Mr. Barrett did not believe in marriage for his children. Elizabeth herself did not wish to burden the poet with an invalid wife. But gradually her health improved. On September 12, 1846, Elizabeth stole out of her home and was secretly married to Robert Browning. For a week after the marriage she remained at Wimpole Street and kept her secret. Then she left her father's home forever. The Brownings crossed to the Continent, and the following spring they settled in Italy, where they lived in happiness for more than fifteen years. She died in Florence in 1861. The Brownings had one son, named after his father.

Elizabeth Barrett Browning's finest poems, SONNETS FROM THE PORTUGUESE, were written before her marriage, under the inspiration of her love for Robert Browning. They are among the tenderest love poems in all literature. She intended AURORA LEIGH, a long poetic novel, in blank verse, to be her masterpiece. It was popular in her day, but is seldom read now. To us Elizabeth Browning's claim to remembrance rests on her sonnets alone.

Mrs. Browning was a woman gentle and sentimental in spirit, but strong in thought

Gramstorff Bros., Inc.

Hermann Kaulbach's illustration for Robert Browning's beloved poem, THE PIED PIPER OF HAMELIN.

where sentiment did not rule her. She is not consistently artistic enough to be called a great poet. She had little constructive or dramatic power. Yet when we remember how secluded was her life till middle age, the amount and general quality of her verse is remarkable. For a combination of sweetness of spirit with power of thought she is the most remarkable feminine figure in English poetry. She had a fine modern sense of justice; she hated the harsh conditions under which the poor tried to earn a livelihood. She hated most bitterly the labor of children.

The death of his wife left Browning desolate. Yet between this fateful year and his own death, twenty-seven years later, he composed some of his finest poems. In his dramatic monologues Browning created suffering, miserable creatures and laid bare their feelings and thoughts. He shows that the noble, yet apparently unsuccessful elements of mankind are eternally valuable, in such poems as THE GRAMMARIAN'S FUNERAL and RABBI BEN EZRA. His was a new kind of optimism. He believed in the wisdom of a just God and urged his fellow-men to accept both the good and the bad of life as worth while. Browning's genius at getting inside his characters, especially in his shorter works (notably, THE LABORATORY, EVELYN HOPE, PORPHYRIA'S LOVER and MY LAST DUCHESS) approaches the magical.

To appreciate Browning's skill, we must understand that very rarely is he writing about his own experiences, or out of his own character. He selects a personality, or a dramatic situation, and paints it with the inventiveness and power of his imagination. The number of characters and situations pictured in this way in Browning's works is amazing. They must not be regarded as referring to Browning himself, except in three of four clearly personal references to himself and his wife.

The poet stands apart and sketches and analyzes the people in his pictures, generally by making them speak their own thoughts. Take HOW THEY BROUGHT THE GOOD NEWS FROM GHENT TO AIX. There was no ride from Ghent to Aix, but the poet describes an imaginary gallop with as much gusto as if he had carried the good news himself.

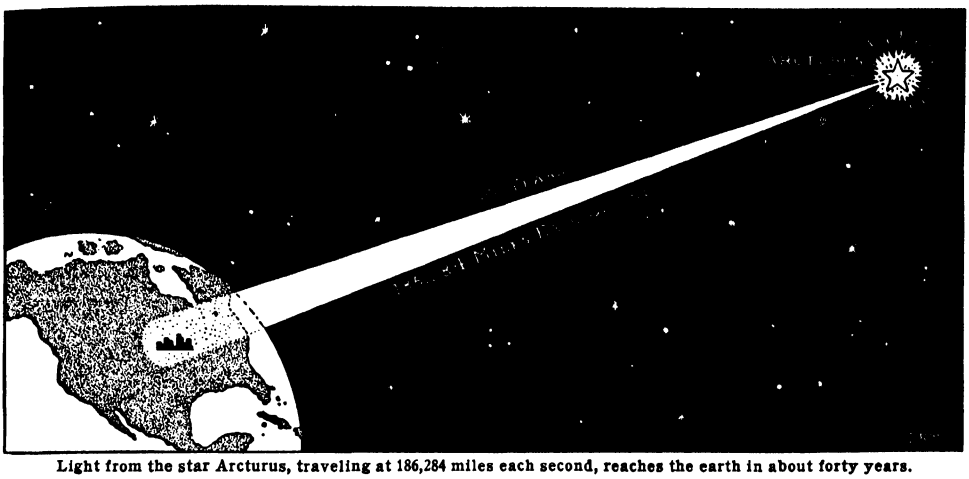
His poem on popularity, describing the fleeting nature of public favor, does not refer to any one rejected idol of the people. His THE LOST LEADER is not one particular deserter.

THE MAGIC OF BROWNING'S WRITING MAKES STORY-BOOK PEOPLE COME ALIVE

The most striking of all the poet's works is his masterpiece, THE RING AND THE BOOK, and it best shows his method of bringing his imagination to bear on a subject. He found an old Italian book with an account of a trial for an atrocious murder. To illustrate variety in human character he described what took place as it was seen by twelve different people. So much in human life depends on the angle from which we look at it, and Browning had the power of placing himself at any point of view. In that respect he probably stands next to Shakespeare in English literature. His insight is startling, and if he had had greater freedom and clearness in expression, he would have been one of the greatest poets.

Browning was a strong man, in faith and thought and word. "A battle's to fight ere the guerdon be gained," was the summing-up of his creed. That great faith nerved him throughout a strenuous life of thought and kept him young to the day of his death. He died in Venice on December 12, 1889, and he rests in Westminster Abbey among the poets.

THE NEXT STORY OF LITERATURE IS ON PAGE 3889.



Light from the star Arcturus, traveling at 186,284 miles each second, reaches the earth in about forty years.

HOW DO WE KNOW THE SPEED OF LIGHT?

WE know the rate at which light travels because it has been measured in various ways, and all the measurements agree. It was Galileo who made the first attempt to measure it. He had two observers some miles apart on a clear night, and gave each a lantern which could be covered by a screen. One observer was to uncover his lantern, and the other, as soon as he saw the first observer's light, was to uncover his. The period between the uncovering of a light and the time it was seen was to be measured. Galileo found, however, that light traveled so rapidly that the distance between the two observers was too small for its speed to be noted.

The Danish astronomer Ole Roemer, working in Paris, made the first real estimate of the speed of light in 1676, and came to the conclusion that it was 192,000 miles a second, a figure later proved to be, remarkably enough, approximately correct. He noticed, in observing the eclipses of the moons of Jupiter, that the intervals between the eclipses of one moon were not always the same, being 16 minutes, 26 seconds greater at one time of the year than at another. He decided that this difference could not be due to any real difference in the period of the eclipses, but must be caused by the greater or less distance over which the light had to travel from Jupiter to the earth when the earth was at different parts of its orbit, and therefore nearer to or farther from Jupiter. In this he was quite right.

Various methods of measuring the speed of light have been adopted since, and they all give practically the same figure. Two great French scientists, Fizeau and Foucault, about the middle of the last century did the pioneer work. They flashed beams of light back and forth between systems of mirrors and lenses. Fizeau interrupted the beam by the teeth of a revolving cog-wheel; Foucault made one of the mirrors revolve. In each case the speed of light was calculated from the speed of the cog-wheel or of the mirror, but the actual method is too complicated to be described.

The greatest modern measurer of the speed of light was Albert Abraham Michelson, about whom we tell you more elsewhere. Nearly all his life Michelson worked on this great problem. While still a young officer serving as instructor of physics at the Annapolis Naval Academy, he greatly improved Foucault's method and obtained much more accurate results. This was in 1878.

In 1924 Michelson resumed his work on the speed of light. He flashed light back and forth between various California mountain peaks, over a distance of as much as 88 miles. In 1926 he announced the speed of light

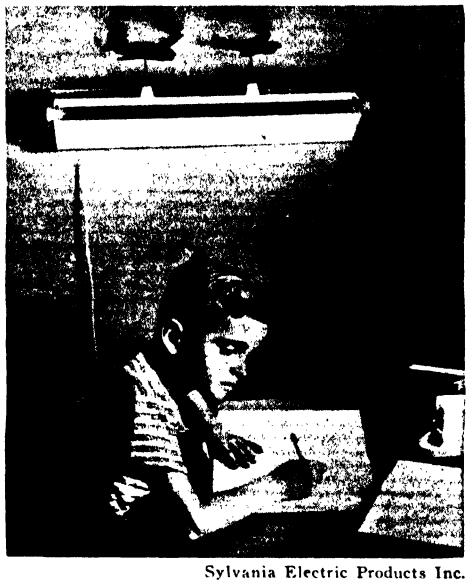
as 186,285 miles a second. Later, Michelson built an enormous vacuum tunnel, a mile long, for his experiments. Now that he was independent of atmospheric conditions, he hoped to find the speed of light more accurately. Later experiments have seemed to indicate that the speed of light is 186,270 miles a second. This figure may be changed as time goes on, for with better instruments and methods, scientists will undoubtedly get more accurate results.

WHAT IS COLD LIGHT?

We often think of the source of all light as being hot, like the sun. If you place your hand near an electric light bulb, or a candle, you can feel heat. There are many kinds of light, however, that give out almost no heat. We find this cold light in both living and non-living substances.

If you have ever picked up a firefly, you may know that the greenish yellow light emitted by this tiny insect does not warm your hand. Many deep-sea fishes glow with spots or streaks of light which flash on and off almost like electric lights. Decaying tree trunks and logs sometimes shine at night with a luminous glow.

Light of this kind is cold light, caused by a chemical change for which oxygen must be present. If the supply of oxygen were cut off, the firefly could not light up, the decayed tree trunk would not shine and the deep-sea fishes would be always without light.



Sylvania Electric Products Inc.

Home work is easier with a good light. This one is a fluorescent lamp, which never gets hot and yet sheds a strong light, without either glare or shadows.

You are no doubt familiar with quite another type of cold light, also. If you put your hand near a neon light, of which so many signs are made, you will feel no heat. Glass tubes, from which most of the air has been taken, are filled with one of the rare, thin gases such as neon. An electric current is passed through the gas, which then glows with its own peculiar color. Various gases, especially those called inert gases, are used for this purpose.

Scientists use several long words to describe various kinds of light. Light that is produced when a substance is heated to a high temperature is known as incandescence —our electric light bulbs are known as incandescent lamps. Light that is produced without heat—cold light—is said to be produced by luminescence. A firefly, for instance, shines by luminescence.

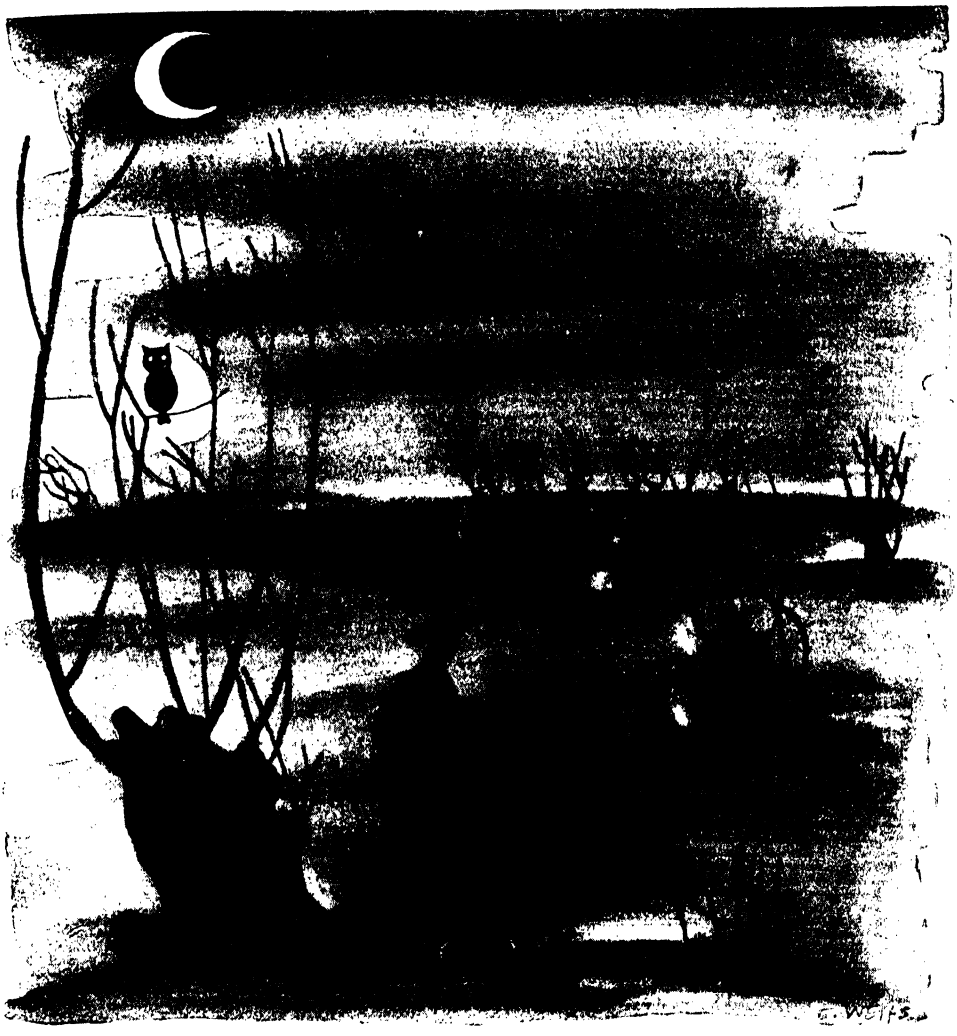
Some minerals shine with beautiful and brilliant colors when they are illuminated by certain kinds of invisible light, such as ultraviolet rays. When this kind of luminescence lasts after the invisible light has been withdrawn, the shining is called phosphorescence. If the shining lasts merely while the minerals are being illuminated (by ultraviolet light, for instance), the lighting up of the minerals is known as fluorescence.

Another example of fluorescence is the fluorescent lamps that are now so widely used in public buildings, offices and even in homes. These lamps are lined with a material that will fluoresce, or shine under ultraviolet light. The tubes contain a small amount of mercury gas, which produces ultraviolet light when an electric current passes through it. Then the fluorescent substance lining the lamp begins to give off light that we can see. Fluorescent lamps shine with different colors according to the materials with which the tubes are coated.

WHY DO WE SEE REFLECTIONS IN TRANSPARENT GLASS?

When we stand in a lighted room at night and look toward a window, we may see reflected in the glass the images of the brightly lighted objects in the room. Often we see several overlapping images of the same object. How does this happen, since glass is transparent?

A beam of light passes from a lamp, through the air in the room, and then strikes



the glass of the windowpane. Some of the light is reflected back into the room by the inside surface of the glass. This reflected light forms images of the illuminated objects in the room, as reflected light from a mirror shows us images. The reflections from the mirror are much clearer and brighter than from the windowpane, however.

Most of the light passes through the windowpane. At the outside surface of the glass, the light-rays pass into air again, out-of-doors. From this outer surface of the glass, however, more light is reflected back to our eyes, and more images are formed. Some of these may overlap the ones formed when the light first struck the glass.

WHAT IS A WILL-O'-THE-WISP?

Travelers crossing lonely stretches of country are sometimes alarmed by strange colored lights over marshes and damp lowlands. Pale lights of various sizes and shapes —blue, red, green or yellow—seem to hover above the ground. These lights look much like pale flames. They flit about at times—now you see them, and now you don't.

People have always been superstitious about these strange lights. They were often thought to be evil or mischievous creatures or spirits that were trying to draw travelers away from their path. The lights are known by several very curious names, among them

will-o'-the-wisp, jack-o-lantern and spunkie.

It is believed that decaying animal or plant matter may give off gases that become luminescent with a mysterious glowing light. Lights of this kind are in general known as *ignis fatuus*, the Latin words meaning "foolish fire."

WHY DO WE WEAR LIGHT THINGS IN SUMMER AND DARK IN WINTER?

We wear light-colored clothes in the summer because we are cooler in them. In the winter, we wear dark-colored clothes. In order to understand why we do this, we should know something of the nature of light and heat.

Most of the heat that we receive from the sun or from heated air from a furnace or fireplace is known as radiant heat. It is, in other words, not carried to us by conduction, as heat is carried along the handle of a silver spoon. It is not, in any very important way, brought to us by convection, either, which means by currents in the air. It is brought to us mainly by radiation—by invisible rays called heat-waves—which are of much the same nature as light-waves.

You probably know that surfaces that reflect white light we call white. The color of any object—a dress, an apple, a book—depends on the ability of its pigment or coloring matter either to reflect or absorb light of different wave-lengths. Objects that we see as red absorb all the wave-lengths that make up white light except the red. The red they reflect, and therefore we see the object as red.

A white surface always reflects white light—and most of the heat waves. A black surface, on the other hand, absorbs the light and a great deal of the heat that falls upon it.

Because dark clothing absorbs heat and then gives it out again to our bodies, we wear dark clothes in winter. Because white clothes merely reflect the light and heat back into space, and do not absorb them, we are cooler when we wear light-colored clothing.

IS IT DARKEST JUST BEFORE DAWN?

No. There is no reason to believe that the night is darker just before the sun's colored banners appear in the eastern sky. Long before any lightening of the sky can be observed by the average person, the darkness has actually begun to fade somewhat, while the sun it still very far below the horizon.

Probably the common saying that it is darkest just before the dawn was not meant in a scientific sense. If a person is ill and wakeful during the night, or in great sorrow or danger, the long dark hours of the night are hard to bear. One can only wait for the coming of day. Toward the end of the night, the time seems longer and the whole outlook on life seems darker. One's thought is—Will the day never come? Because of this, we are apt to think of the night as being darker just before day comes, but this is not actually true. It is merely one of those instances where strong feeling may color the evidence of our senses.

DOES LIGHT DIE AWAY?

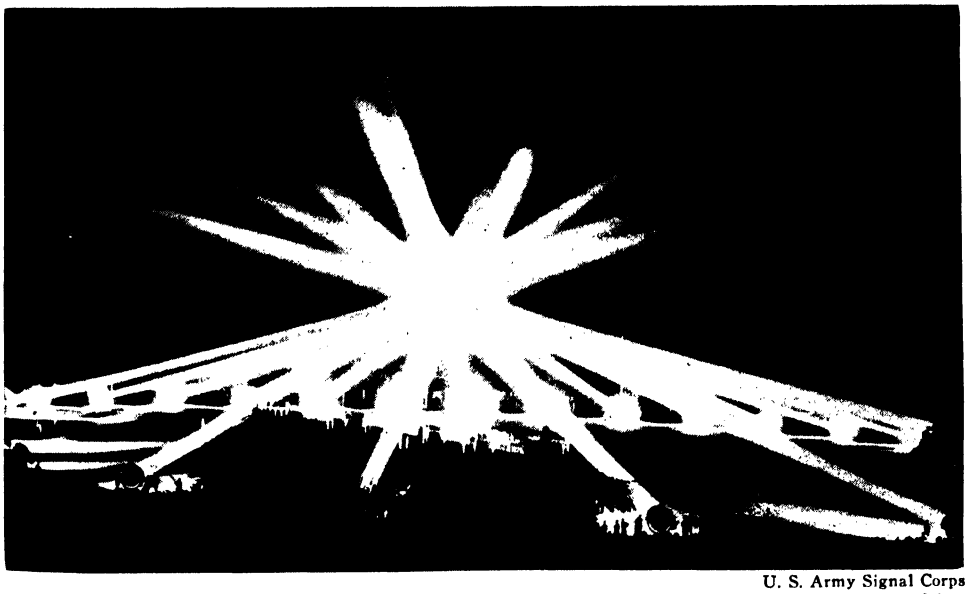
Light is always the result of the spending of some kind of power. The light shining from an electric light bulb is dependent upon the force of water or upon coal that contains the stored-up energy of the sun. The water or coal is transformed into electrical energy that runs along the wires until it reaches the bulb. So long as that energy flows into the wires of the bulb, light is produced. If the electric current is shut off, there is no light.

Light from a star is produced by changes going on in the atoms and particles of gas of which the star is composed. These particles are constantly being transformed into other kinds of particles and this change produces energy. Light is one form of energy produced by the changes within the star. When the stuff of which the star is made is all used up, there is nothing left to make light, and the star fades out. Light always dies away, as in the case of the electric light and the star, when the source of the light ceases to create energy, for light is a form of energy.

Now, we might look at this question from another point of view. Does the light from a candle, or from a star, travel on forever, so long as nothing gets in its way? We know that light from the nearest of the stars (with the exception of the sun) travels more than 25,000,000,000,000 miles before it reaches our eyes. Does the light of that star, out in space, go on forever, or does it die away? We do not yet know enough to answer this question definitely. We do know that possibly there are stars so far away that we could not see them even with the largest telescopes we can imagine. But because we might not be able to see them does not mean that the waves of light they send out into space might not travel on forever. If we had extremely delicate instruments for detecting light-waves, we might discover those waves, even though we could not see the light itself.

Light becomes fainter as it travels farther and farther. This is partly because the waves of light, with distance, spread out like the ripples made by a stone thrown in a pond. The waves of light, when they leave the star, begin to spread, just as the ripples in the pond become larger and larger circles as they move farther from the place where the stone struck the water. The same amount of light-energy goes into the spreading waves, but each succeeding circular wave of light is bigger than the one before it—the same amount of energy is spread out over a larger area. This causes the light to become fainter with distance.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3533.



U. S. Army Signal Corps

Though this concentration of searchlight beams makes a powerful light, the rays traveling outward grow faint.

Songs and Speeches from Shakespeare's Plays

Illustrated by Henry Pitz

Wise Sayings from Shakespeare

How far that little candle throws its beams!
So shines a good deed in a naughty world.
Merchant of Venice

O! It is excellent
To have a giant's strength; but it is tyrannous
To use it like a giant.
Measure for Measure

Cowards die many times before their deaths;
The valiant never taste of death but once.
Of all the wonders that I yet have heard,
It seems to me most strange, that man should fear;
Seeing that death, a necessary end,
Will come when it will come.
Julius Caesar

To gild refined gold, to paint the lily,
To throw a perfume on the violet,
To smooth the ice, or add another hue
Unto the rainbow, or with taper-light
To seek the beauteous eye of heaven to garnish,
Is wasteful, and ridiculous excess.
King John

I dare do all that may become a man;
Who dares do more, is none.
Macbeth

This above all—to thine own self be true,
And it must follow, as the night the day,
Thou canst not then be false to any man.
Hamlet

The cloud-capped towers, the gorgeous palaces,
The solemn temples, the great globe itself,
Yea, all which it inherit, shall dissolve;
And, like this insubstantial pageant faded,
Leave not a rack behind. We are such stuff
As dreams are made on, and our little life
Is rounded with a sleep.
The Tempest

For there was never yet a philosopher
That could endure the toothache patiently.
Much Ado About Nothing

And this our life, exempt from public haunt,
Finds tongues in trees, books in the running brooks,
Sermons in stones, and good in everything.
As You Like It

Farewell to Greatness

From KING HENRY VIII

Cardinal Wolsey was the King's chief adviser and a powerful man, but the King became angry with him, dismissed him from office and took all of his wealth away. In the last part of this speech Wolsey is talking to Thomas Cromwell, his secretary.

FAREWELL, a long farewell, to all my greatness!
This is the state of man: today he puts forth
The tender leaves of hope; tomorrow blossoms,
And bears his blushing honors thick upon him;
The third day comes a frost, a killing frost;
And—when he thinks, good, easy man, full surely
His greatness is a-ripening—nips his root.
And then he falls, as I do. I have ventured,
Like little wanton boys that swim on bladders,
This many summers in a sea of glory,
But far beyond my depth: my high-blown pride
At length broke under me and now has left me,
Weary and old with service, to the mercy
Of a rude stream, that must for ever hide me.

Vain pomp and glory of this world, I hate ye;
I feel my heart new opened: O, how wretched
Is that poor man that hangs on princes' favors!
There is, betwixt that smile we would aspire to,
That sweet aspect of princes, and their ruin,
More pangs and fears than wars or women have:
And when he falls, he falls like Lucifer,
Never to hope again.

. . . . . .

Cromwell, I charge thee, fling away ambition:
By that sin fell the angels; how can man, then,
The image of his Maker, hope to win by 't?
Love thyself last: cherish those hearts that hate thee;
Corruption wins not more than honesty.
Still in thy right hand carry gentle peace,
To silence envious tongues. Be just and fear not:
Let all the ends thou aim'st at be thy country's,
Thy God's and truth's; then if thou fall'st, O Cromwell,
Thou fall'st a blessed martyr. . . . .
O Cromwell, Cromwell,
Had I but served my God with half the zeal
I served my king, He would not in mine age
Have left me naked to mine enemies.

The Seven Ages of Mankind

From As You Like It

All the world's a stage
And all the men and women merely players:
They have their exits and their entrances;
And one man in his time plays many parts,
His acts being seven ages. At first the infant,
Mewling and puking in the nurse's arms.
Then the whining school-boy, with his satchel
And shining morning face, creeping like snail
Unwillingly to school. And then the lover,
Sighing like furnace, with a woeful ballad
Made to his mistress' eyebrow. Then a soldier,
Full of strange oaths, and bearded like the pard,
Jealous in honor, sudden and quick in quarrel,
Seeking the bubble reputation
Even in the cannon's mouth. And then the justice,
In fair round belly with good capon lined,
With eyes severe and beard of formal cut,
Full of wise saws and modern instances;
And so he plays his part. The sixth age shifts
Into the lean and slippered pantaloon,
With spectacles on nose and pouch on side,
His youthful hose, well-saved, a world too wide
For his shrunk shank: and his big manly voice,
Turning again toward childish treble, pipes
And whistles in his sound. Last scene of all,
That ends this strange eventful history,
Is second childishness and mere oblivion,
Sans teeth, sans eyes, sans taste, sans everything.

Mark Antony's Speech over the Body of Julius Caesar

From JULIUS CAESAR

FRIENDS, Romans, countrymen, lend me your ears;
I come to bury Caesar, not to praise him.
The evil that men do lives after them;
The good is oft interrèd with their bones;
So let it be with Caesar. The noble Brutus
Hath told you Caesar was ambitious:
If it were so, it was a grievous fault,
And grievously hath Caesar answered it.
Here, under leave of Brutus and the rest—
For Brutus is an honorable man;
So are they all, all honorable men—
Come I to speak in Caesar's funeral.
He was my friend, faithful and just to me:
But Brutus says he was ambitious;
And Brutus is an honorable man.
He hath brought many captives home to Rome,
Whose ransoms did the general coffers fill:
Did this in Caesar seem ambitious?
When that the poor have cried, Caesar hath wept:
Ambition should be made of sterner stuff:
Yet Brutus says he was ambitious;
And Brutus is an honorable man.
You all did see that on the Lupercal
I thrice presented him a kingly crown,
Which he did thrice refuse: was this ambition?

Yet Brutus says he was ambitious;
And, sure, he is an honorable man.
I speak not to disprove what Brutus spoke,
But here I am to speak what I do know.
You all did love him once, not without cause:
What cause withholds you then to mourn for him?
O judgment! thou art fled to brutish beasts,
And men have lost their reason. Bear with me;
My heart is in the coffin there with Caesar,
And I must pause till it come back to me.

. . . . . .

If you have tears, prepare to shed them now.
You all do know this mantle: I remember
The first time ever Caesar put it on;
'Twas on a summer's evening, in his tent,
That day he overcame the Nervii:
Look, in this place ran Cassius' dagger through:
See what a rent the envious Casca made:
Through this the well-beloved Brutus stabbed;
And as he plucked his cursèd steel away,
Mark how the blood of Caesar followed it,
As rushing out of doors, to be resolved
If Brutus so unkindly knocked or no:
For Brutus, as you know, was Caesar's angel:
Judge, O you gods, how dearly Caesar loved him!
This was the most unkindest cut of all;
For when the noble Caesar saw him stab,
Ingratitude, more strong than traitor's arms,
Quite vanquished him: then burst his mighty heart;
And, in his mantle muffling up his face,
Even at the base of Pompey's statue,
Which all the while ran blood, Great Caesar fell.
O, what a fall was there, my countrymen!
Then I, and you, and all of us fell down,
Whilst bloody treason flourished over us.

The Noblest Roman

From JULIUS CAESAR

Brutus, one of the men who killed Caesar, was later defeated in battle and died. Mark Antony, who had been a friend of Caesar's, says this of Brutus:

THIS was the noblest Roman of them all:
All the conspirators, save only he,
Did that they did in envy of great Caesar;
He, only, in a general honest thought,
And common good to all, made one of them.
His life was gentle, and the elements
So mixed in him, that Nature might stand up,
And say to all the world, 'This was a man!'

This England

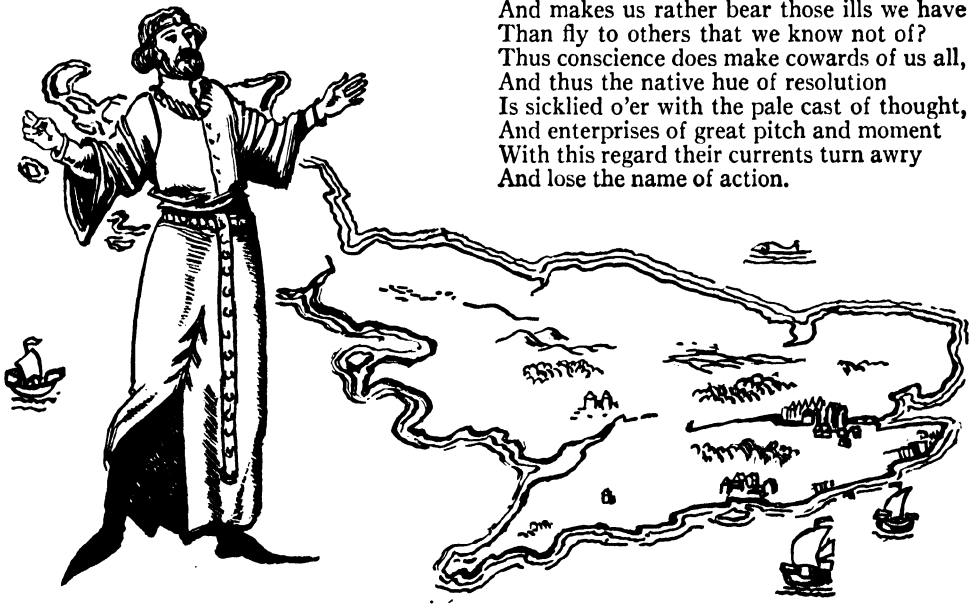
From RICHARD II

THIS royal throne of kings, this sceptred isle,
This earth of majesty, this seat of Mars,
This other Eden, demi-paradise,
This fortress, built by Nature for herself
Against infection and the hand of war,
This happy breed of men, this little world,
This precious stone set in the silver sea,
Which serves it in the office of a wall,
Or as a moat defensive to a house,
Against the envy of less happier lands,
This blessed plot, this earth, this realm, this England.

Hamlet's Soliloquy

From HAMLET

TO be, or not to be: that is the question:
Whether 'tis nobler in the mind to suffer
The slings and arrows of outrage us fortune,
Or to take arms against a sea of troubles,
And by opposing end them. To die: to sleep:
No more: and by a sleep to say we end
The heart-ache, and the thousand natural shocks
That flesh is heir to. 'Tis a consummation
Devoutly to be wished. To die, to sleep;
To sleep? perchance to dream! Aye, there's the rub;
For in that sleep of death what dreams may come,
When we have shuffled off this mortal coil,
Must give us pause: there's the respect
That makes calamity of so long life;
For who would bear the whips and scorns of time,
The oppressor's wrong, the proud man's contumely,
The pangs of despised love, the law's delay,
The insolence of office, and the spurns
That patient merit of the unworthy takes,
When he himself might his quietus make
With a bare bodkin? Who would fardels bear,
To grunt and sweat under a weary life,
But that the dread of something after death,
The undiscovered country from whose bourn
No traveler returns, puzzles the will,
And makes us rather bear those ills we have
Than fly to others that we know not of?
Thus conscience does make cowards of us all,
And thus the native hue of resolution
Is sicklied o'er with the pale cast of thought,
And enterprises of great pitch and moment
With this regard their currents turn awry
And lose the name of action.



The Quality of Mercy

From THE MERCHANT OF VENICE

THE quality of mercy is not strained;
It droppeth, as the gentle rain from heaven
Upon the place beneath; it is twice bless'd—
It blesseth him that gives, and him that takes.
'Tis mightiest in the mightiest: it becomes
The thronèd monarch better than his crown;
His sceptre shows the force of temporal power,
The attribute to awe and majesty,
Wherein doth sit the dread and fear of kings;
But mercy is above this sceptred sway,
It is enthronèd in the hearts of kings,
It is an attribute to God Himself;
And earthly power doth then show likest God's.
When mercy seasons justice.

King Henry V Before the Battle of Agincourt

From KING HENRY V

In the English camp the leaders are talking about the coming battle, and the fact that the French have a larger army. The Earl of Westmoreland wishes that some of the thousands of men who are celebrating St. Crispian's Day in England could be added to the King's forces. King Henry answers:

WHAT'S he that wishes so?
My cousin Westmoreland?—No, my fair cousin:
If we are marked to die, we are enough
To do our country loss; and if to live,
The fewer men, the greater share of honor.
God's will! I pray thee, wish not one man more.
By Jove! I am not covetous for gold;
Nor care I who doth feed upon my cost;
It yearns me not, if men my garments wear;
Such outward things dwell not in my desires;
But, if it be a sin to covet honor,
I am the most offending soul alive.
No, 'faith, my coz, wish not a man from England:
God's peace! I would not lose so great an honor,
As one man more, methinks, would share from me,
For the best hope I have. O, do not wish one more!
Rather proclaim it, Westmoreland, through my host,
That he who hath no stomach to this fight,
Let him depart; his passport shall be made,
And crowns for convoy put into his purse.
We would not die in that man's company,
That fears his fellowship to die with us.
This day is called the feast of Crispian:
He that outlives this day, and comes safe home,
Will stand a-tiptoe when this day is named,
And rouse him at the name of Crispian.
He that shall live this day, and see old age,
Will yearly on the vigil feast his friends,
And say 'Tomorrow is Saint Crispian':
Then he will strip his sleeve, and show his scars,
And say, 'These wounds I had on Crispian's day.'
Old men forget; yet all shall be forgot,
But he'll remember, with advantage
What feats he did that day! Then shall our names,
Familiar in their mouths as household words—
Harry the King, Bedford and Exeter,
Warwick and Talbot, Salisbury and Gloster,
Be in their flowing cups freshly remembered.
This story shall the good man teach his son;
And Crispin Crispian shall ne'er go by,
From this day to the ending of the world,
But we in it shall be remembered;
We few, we happy few, we band of brothers;
For he, today, who sheds his blood with me
Shall be my brother; be he ne'er so vile,
This day shall gentle his condition:
And gentlemen in England, now a-bed,
Shall think themselves accursed, they were not here,
And hold their manhood cheap, while any speaks,
That fought with us upon Saint Crispian's day.

Tomorrow, and Tomorrow, and Tomorrow

From MACBETH

TOMORROW, and tomorrow, and tomorrow,
Creeps in this petty pace from day to day,
To the last syllable of recorded time;
And all our yesterdays have lighted fools
The way to dusty death. Out, out, brief candle!
Life's but a walking shadow, a poor player
That struts and frets his hour upon the stage
And then is heard no more: it is a tale
Told by an idiot, full of sound and fury,
Signifying nothing.

Ariel's Songs

From THE TEMPEST

I

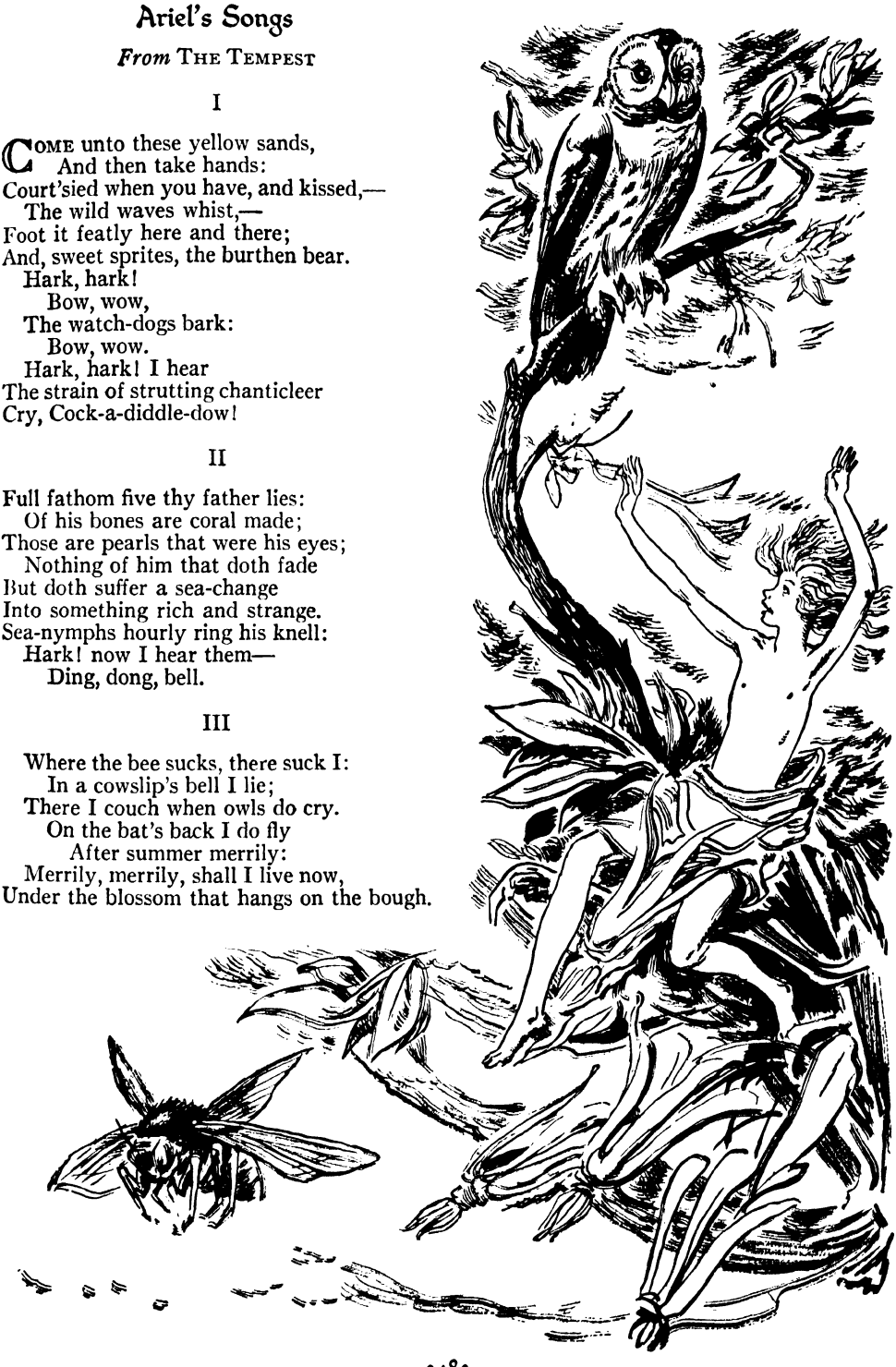
COME unto these yellow sands,
And then take hands:
Court'sied when you have, and kissed,—
The wild waves whist,—
Foot it featly here and there;
And, sweet sprites, the burthen bear.
Hark, hark!
Bow, wow,
The watch-dogs bark:
Bow, wow.
Hark, hark! I hear
The strain of strutting chanticleer
Cry, Cock-a-diddle-dow!

II

Full fathom five thy father lies:
Of his bones are coral made;
Those are pearls that were his eyes;
Nothing of him that doth fade
But doth suffer a sea-change
Into something rich and strange.
Sea-nymphs hourly ring his knell:
Hark! now I hear them—
Ding, dong, bell.

III

Where the bee sucks, there suck I:
In a cowslip's bell I lie;
There I couch when owls do cry.
On the bat's back I do fly
After summer merrily:
Merrily, merrily, shall I live now,
Under the blossom that hangs on the bough.

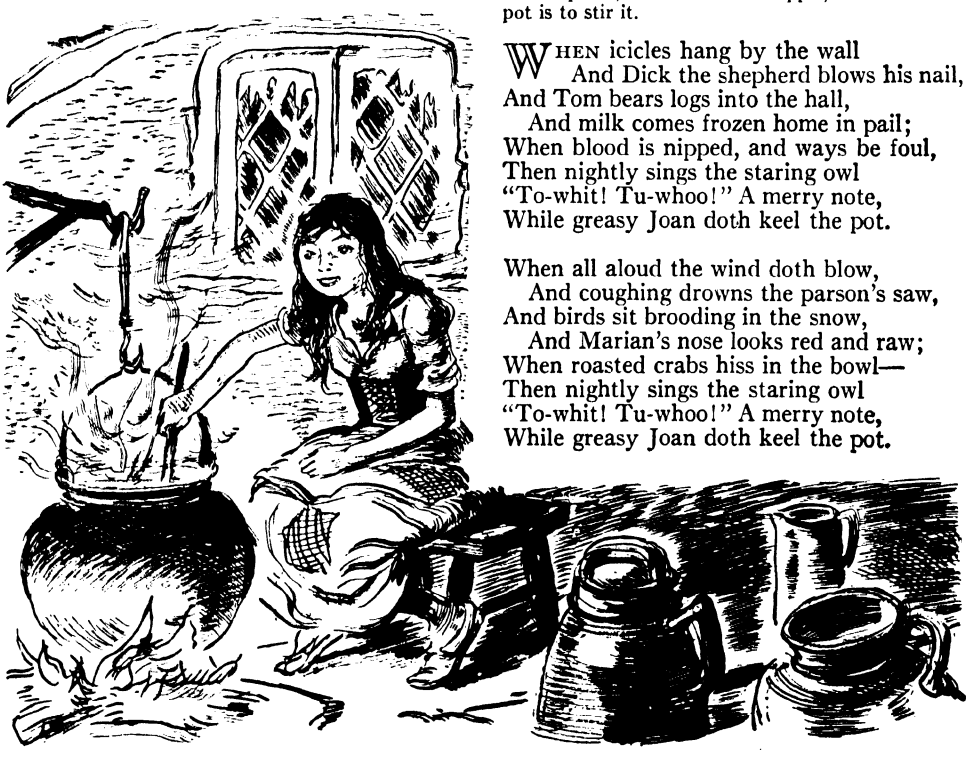


Blow, Blow, Thou Winter Wind

From As You Like It

Blow, blow, thou winter wind,
Thou are not so unkind
As man's ingratitude;
Thy tooth is not so keen,
Because thou art not seen,
Although thy breath be rude.
Heigh-ho! sing heigh-ho! unto the green holly;
Most friendship is feigning, most loving mere folly:
Then, heigh-ho, the holly!
This life is most jolly!

Freeze, freeze, thou bitter sky,
Thou dost not bite so nigh
As benefits forgot:
Though thou the waters warp,
Thy sting is not so sharp
As friend remembered not.
Heigh-ho! sing heigh-ho! unto the green holly;
Most friendship is feigning, most loving mere folly:
Then, heigh-ho, the holly!
This life is most jolly!



Fear No More

From Cymbeline

Fear no more the heat o' the sun
Nor the furious winter's rages;
Thou thy worldly tasks hast done,
Home art gone and ta'en thy wages:
Golden lads and girls all must,
As chimney-sweepers, come to dust.

Fear no more the frown o' the great,
Thou art past the tyrant's stroke;
Care no more to clothe and eat;
To thee the reed is as the oak:
The sceptre, learning physic, must
All follow this, and come to dust.

Fear no more the lightning-flash
Nor the all-dreaded thunder-stone;
Fear not slander, censure rash;
Thou hast finished joy and moan:
All lovers young, all lovers must
Consign to thee, and come to dust.

Winter

From Love's Labour's Lost

In this poem, Crab means crabapple, and to keel the pot is to stir it.

When icicles hang by the wall
And Dick the shepherd blows his nail,
And Tom bears logs into the hall,
And milk comes frozen home in pail;
When blood is nipped, and ways be foul,
Then nightly sings the staring owl
"To-whit! Tu-whoo!" A merry note,
While greasy Joan doth keel the pot.

When all aloud the wind doth blow,
And coughing drowns the parson's saw,
And birds sit brooding in the snow,
And Marian's nose looks red and raw;
When roasted crabs hiss in the bowl—
Then nightly sings the staring owl
"To-whit! Tu-whoo!" A merry note,
While greasy Joan doth keel the pot.

Hark! Hark! The Lark

From CYMBELINE

HARK! hark! the lark at heaven's gate sings,
And Phoebus 'gins arise,
His steeds to water at those springs
On chaliced flowers that lies;
And winking Mary-buds begin
To ope their golden eyes.
With every thing that pretty is,
My lady sweet, arise;
Arise, arise!

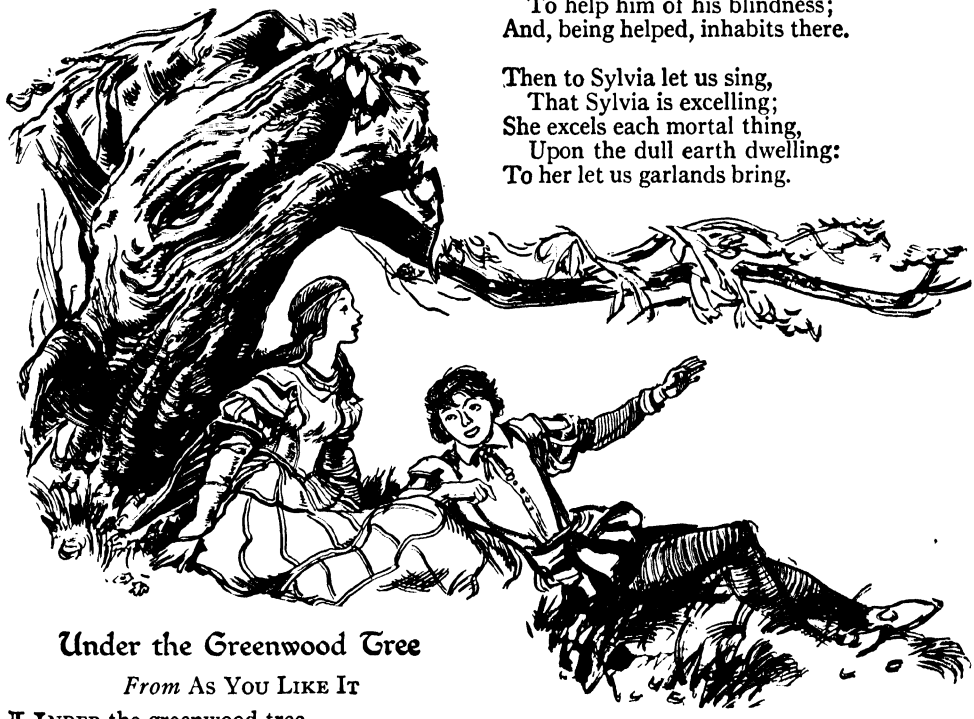
Who Is Sylvia?

From TWO GENTLEMEN OF VERONA

WHO is Sylvia? What is she,
That all our swains commend her?
Holy, fair, and wise is she;
The heaven such grace did lend her,
That she might admired be.

Is she kind as she is fair?
For beauty lives with kindness.
Love doth to her eyes repair,
To help him of his blindness;
And, being helped, inhabits there.

Then to Sylvia let us sing,
That Sylvia is excelling;
She excels each mortal thing,
Upon the dull earth dwelling:
To her let us garlands bring.



Under the Greenwood Tree

From AS YOU LIKE IT

UNDER the greenwood tree,
Who loves to lie with me,
And turn his merry note
Unto the sweet bird's throat,
Come hither, come hither, come hither:
Here shall he see
No enemy
But winter and rough weather.

Who doth ambition shun,
And loves to live i' the sun,
Seeking the food he eats,
And pleased with what he gets,
Come hither, come hither, come hither:
Here shall he see
No enemy
But winter and rough weather.

Where the Wild Thyme Blows

From A MIDSUMMER NIGHT'S DREAM

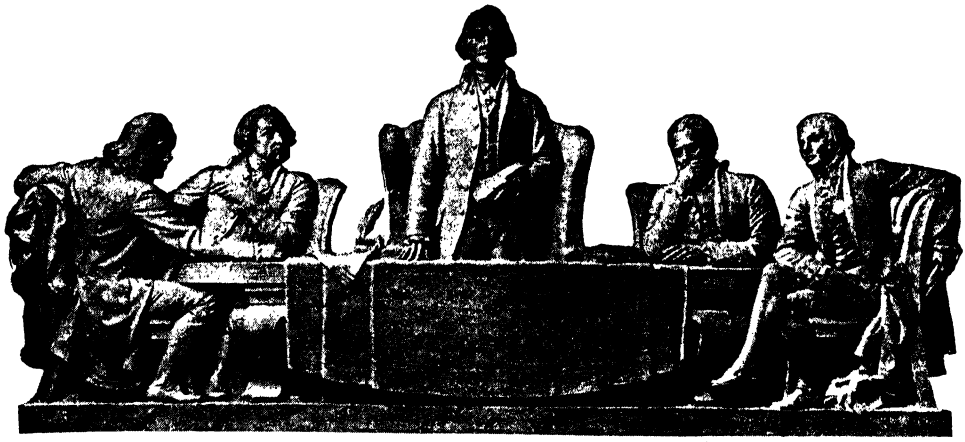
I KNOW a bank where the wild thyme blows,
Where oxlips and the nodding violet grows;
Quite over-canopied with luscious woodbine,
With sweet musk-roses, and with eglantine:
There sleeps Titania sometime of the night,
Lulled in these flowers with dances and delight;
And there the snake throws her enamelled skin,
Weed wide enough to wrap a fairy in.

THE NEXT POEMS ARE ON PAGE 3638.

BENJAMIN FRANKLIN HONORED AT THE COURT OF FRANCE

3486

When Benjamin Franklin was the minister of the thirteen states at the French court his simple manners, quaint speech and ready wit made him a favorite with the frivolous and the wise alike. Here he is being crowned with a laurel wreath. He did not object to anything by which he might with honor make a friend for America. He succeeded in getting arms, money and men, without which the Revolution could not have been won. After the war had been won, he helped to frame the treaty of peace with England. He continued to serve the new nation abroad until 1785 when he came home, a tired old man of 79. His country still had need of his services, however, and until 1790, the year of his death, he filled many important public offices.



Courtesy, Adolph A. Weinman

The signing of the Declaration of Independence, a sculptured group by Adolph A. Weinman. Thomas Jefferson is standing; seated, left to right, are Benjamin Franklin, John Adams, Roger Sherman and Robert Livingston. The picture is from a sculptured panel on the beautiful Jefferson Memorial in Washington, D. C.

SOME AMERICAN STATESMEN

IN other parts of our book we have told of many great Americans. Some were sailors or soldiers, and others showed their greatness in many different occupations or professions. In our stories of the history of the United States we told of some of the men who had a share in building the nation, and in this story we shall say something of some other very great statesmen.

We might call John Smith the first American statesman. He really understood something about the way that a state must be governed, and he was almost the only man in the Virginia colony that did understand; but he remained in America only a short time.

John Winthrop is remembered and highly honored in New England as the greatest man in the history of the Massachusetts Bay Colony. He was born in England in 1588, was educated at Cambridge University and became a lawyer. Though successful in his profession, he was not happy in England, for he was a strong Puritan, and did not like the management of religious or state affairs at that time. He determined to move to New England and was elected governor of the colony that landed in Massachusetts in 1630.

Until his death, in 1649, he was governor or deputy governor nearly all the time, and gave his strength of body and mind and will to keep the little colony on the right path. Some of the old Puritans were very stubborn, and it was sometimes difficult to prevent them from doing unwise things. Through his influence a sort of union of the New England colonies was formed for defense against the Indians or other foes.

Governor Winthrop was married four times and had many children. One of his sons, also called John, was almost as important in Connecticut as his father was in Massachusetts.

The next man of whom we speak belongs partly to colonial days and partly to the era of the United States. This is Benjamin Franklin, famous as author, scientist, inventor, business man and statesman. Here we shall tell of Franklin the man and the statesman. He was born in Boston in 1706, the fifteenth child and the tenth son of his father. His father was a poor candle-maker, but the boy became a printer under his brother. They could not agree, and when seventeen years old the boy ran away and found work in Philadelphia. He spent some time in London, but returned to Philadelphia, opened a shop of his own, bought a newspaper and became a prominent citizen. Through him the police and fire departments, a library and an academy were organized. He invented a stove which used less coal than others to heat a room. Of his experiments with electricity we have told about elsewhere (see Index).

Franklin was postmaster of Philadelphia for a time, and later Postmaster-General for all the colonies. He formed a plan of union for the colonies, which was not adopted, however; went to England to represent Pennsylvania, and remained there as the representative of all the colonies. He helped to draw

up the Declaration of Independence, was sent to France to persuade the French to help the colonies to gain their liberty and succeeded in getting money, arms and men. His simple manners and his wit made him a favorite in Paris. He was at the head of the government of Pennsylvania for three years, and helped to make the Constitution of the United States. He died in 1790, after a busy and useful life. His autobiography is often read in schools as a specimen of good English, and his Poor Richard's Almanac, full of wise sayings, was very popular when published, and is still read.

THE EARLY YEARS OF THOMAS JEFFERSON, THE THIRD PRESIDENT

Thomas Jefferson, third president of the United States, was born in 1743, near Charlottesville, Virginia. He received very little schooling as a boy, and became, like Washington, a surveyor, enduring the hardships of pioneer life. He was so fond of books and learning that he prepared himself for college. Bashful, yet warmhearted and eager for information, it was not surprising that Jefferson made many friends for himself in the College of William and Mary, at Williamsburg, Virginia. This college, as you may know, is next to Harvard in age.

He studied law and began to practice, but his chief interest was in farming. From his father he had a large tract of land and he bought more. In 1772 he married Martha Skelton, a charming young widow, who also had a great deal of land. All his life he was trying experiments in farming. He introduced better machinery, invented a plow, and brought many kinds of trees and plants from different countries to find if they would grow in the United States.

He was not to be allowed to remain on his plantations. Virginia and the nation had need of him. He served in the Virginia legislature, in the Continental Congress, where he wrote the Declaration of Independence, and as governor of Virginia. After the Revolution he served in Congress, and from 1784 to 1789 represented the country in France. After his return he was appointed Secretary of State by President Washington, but resigned in 1793. One of the reasons was private business, and another the fact that he and Alexander Hamilton, also a member of Washington's cabinet, could not agree.

He was a candidate for president when Washington refused to accept a third term, but John Adams, of Massachusetts, was elected It was the law then that the man who received next to the highest vote should become vice-president, and so Jefferson held that office for four years. In 1801 he became president, and served two terms. He might have been elected again, but, like Washington, refused the honor.

THE "REPUBLICAN SIMPLICITY" OF THOMAS JEFFERSON

He was much opposed to show of any kind, and went to the Capitol very quietly when the time for the inauguration came. There is a story that he rode alone on horseback, hitched his horse to the fence, and entered the building. The truth seems to be that some friends came to the house where he was stopping, and that together they walked to the Capitol. With Jefferson's administration there began an era of "republican simplicity." He believed in plain clothes, in simple food and simple manners. As a leader he was most lenient and just.

For the seventeen years following his retirement from office Jefferson lived at his home, Monticello, which became a resort for the great and noble minds in the country. But keeping open house to all who came ruined Jefferson financially. To his great grief, he was forced to sell his library, which he had been collecting for over fifty years. The money thus obtained was but a temporary relief. Some friends heard of his difficulties and raised the sum of $18,000. Jefferson was greatly touched by this proof of the loyalty and affection of his countrymen, but he did not live long to enjoy the relief thus given him. He died July 4, 1826.

JEFFERSON WAS A MAN OF MANY AND VARIED INTERESTS

Few men of his time were interested in so many things. He loved mathematics, music and botany, knew several languages, and was a skillful architect. He was a fine shot and a good rider. More than all else, Thomas Jefferson believed that the people—all the people, not just a few at the top—should rule themselves.

Putting aside the winning personality and lovableness of the man, there are two things alone that would give Thomas Jefferson his niche in American history. He was the "Pen of the Revolution" and wrote for us the Declaration of Independence; and it was during his administration as president, largely owing to his influence, that the purchase of Louisiana was successfully accomplished.

Alexander Hamilton and Thomas Jefferson are often mentioned together in the history of the United States. This is not because

they were so much alike, but because they were so different in their ideas and their lives. Hamilton was born on the island of Nevis in the West Indies in 1757, but came to New York while still a boy, and soon entered King's College, now Columbia. He was very much interested in the disagreement between the colonies and great Britain, and won a great reputation by his writings and speeches while he was no more than a boy.

When only nineteen years old, Hamilton was appointed captain of a company of artillery. He soon attracted the attention of Washington, and became his secretary, but resigned near the end of the war because he felt that Washington had been unjust to him. He fought bravely at Yorktown.

ALEXANDER HAMILTON'S SERVICES IN DRAFTING THE CONSTITUTION

After the Revolution he was a member of Congress for a little while, but soon began to practice law and was very successful. His keen mind plainly saw the weaknesses of the government set up under the Articles of Confederation, and he urged a stronger government. He was a member of the convention which formed the Constitution of the United States, and his writings had much to do with making people agree to accept the new instrument of government.

When the new government began, it had no money and no way of getting it. The country owed a great deal at home and abroad, and no one could see how the debts were to be paid. President Washington appointed Hamilton to the new office of Secretary of the Treasury, and he at once set to work to find ways to secure money. He was wonderfully successful, and soon the new government had money enough, though some people grumbled at the taxes.

HAMILTON RETURNS TO PRIVATE LIFE IN NEW YORK IN 1795

The salaries paid by the new government were small, and Hamilton, who had married the daughter of General Philip Schuyler and had several children, felt that he must make more money for his family. He resigned his office in 1795 and returned to New York, but continued to take great interest in politics. During the administration of John Adams he had more influence in the nation than the President himself.

You remember that in the presidential election of 1800 Jefferson and Aaron Burr got the same number of votes, and so the House of Representatives had to make the choice. Hamilton did not like Jefferson, but he felt that he was a better man than Burr, and advised all his friends to vote for Jefferson. Jefferson was chosen president and Burr vice-president. Burr felt that he had lost the presidency because of Hamilton, and Hamilton four years later opposed his desire to be elected governor of New York. Burr challenged him to a duel in 1804, for in those days men often fought to settle their quarrels. Though his own son had been killed in a duel only a little while before, Hamilton accepted, and a meeting took place July 11, 1804, at Weehawken, New Jersey, just across the river from New York. Hamilton was mortally wounded and died the next day.

Few have done more for the United States than this very able man, though we do not to-day feel that he was right in all of his ideas. He believed that the people could not govern themselves, and thought that only men of property and education should vote. He thought that the president and the senators ought to hold office for life, and did not believe in allowing the states to keep much power. He deeply loved his country and served it with all his strength.

THE CAREER OF ALBERT GALLATIN, WHO WAS BORN IN SWITZERLAND

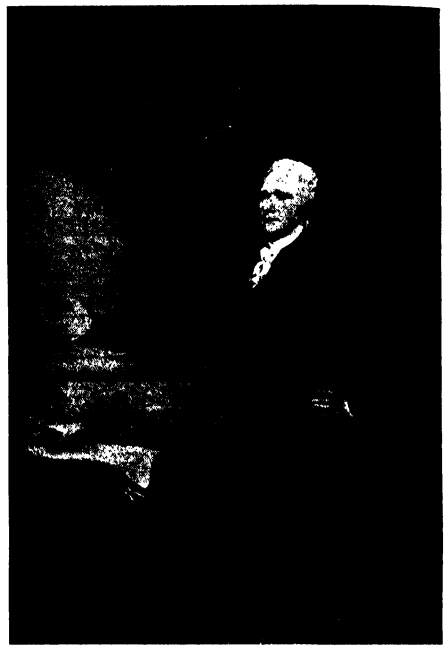
Another great statesman, who was born about the same time, was also a foreigner. This was Albert Gallatin, born in Switzerland in 1761 and educated there. He came to Boston as the Revolutionary War was nearly at an end, and went into business. Failing in this, he taught French in Harvard College for a little while. He did not feel happy in New England, however, and moved to western Pennsylvania, then almost a wilderness. The young Swiss was afraid of a strong government and tried to prevent his state from accepting the Constitution of the United States, but did not succeed.

Though he could not yet speak good English, he was sent to the Pennsylvania legislature, and in 1793 he was elected to the United States Senate. There was a dispute about the length of time he had been a citizen, and he was not allowed to remain in the Senate. His state then sent him to the House of Representatives, and there he became the leader of the new Democratic party which Jefferson was founding. When Jefferson became president, he made Gallatin Secretary of the Treasury.

Gallatin believed that the business of a state should be conducted like that of a family. He thought that a state should pay back all borrowed money as soon as possible.

STATESMEN OF THE EARLY DAYS

Benjamin Franklin was statesman, diplomat, author, inventor, and with it all a shrewd and able business man. He signed both the Declaration of Independence and the Constitution of the United States.



Alexander Hamilton was born in the West Indies, but came to the colony of New York when only a boy. He won great fame as Secretary of the Treasury. He was killed in a duel with Aaron Burr.

Albert Gallatin was a Swiss by birth, but soon became a good American. He was Secretary of the Treasury under President Jefferson and made a great record. Later in life he was a banker.

John Quincy Adams is the only president of the United States whose father had held the office before him. He held other high places in the government, and died while a member of Congress.

Therefore he set himself to pay off the debt of the United States, and for twelve years worked to do it. All his plans were broken up by the War of 1812, and he went to Europe in 1813 to try to bring about peace. He did not succeed at first, but he was one of the men who made the Treaty of Ghent which ended the war.

President Madison gave him the choice of becoming minister to France or of taking his old place as head of the Treasury. He chose the former, and remained in France seven years. He was talked of for vice-president in 1824, but was not a candidate, and in 1826 was sent to England as minister. He did not stay long, but came back to New York, and became president of a bank. In his spare time he was deeply interested in the study of the Indian tribes.

JOHN QUINCY ADAMS, PRESIDENT AND SON OF A PRESIDENT

The next American of whom we shall speak was born in 1767 in Massachusetts, where his ancestors had lived from the first years of that colony. His father was John Adams, the second president, and his mother was Abigail Smith, of whom we tell in Some Famous Ladies of the White house. The boy was called John Quincy in honor of his mother's grandfather, and soon showed that he had a remarkable mind. His father was sent to England by Congress in 1778, and the boy went along, but kept up his studies in Paris and Leyden. In 1781, when only fourteen years old, he was appointed private secretary to the minister to Russia, but soon returned to Paris and acted as one of the secretaries of the men who were making a treaty of peace between the United States and Great Britain. When that task was completed, he returned home and entered Harvard College.

After his graduation from Harvard, in 1787, at the age of twenty, John Quincy Adams studied law, but Washington sent him as minister to the Netherlands in 1794, and later he was transferred to Prussia. On his return to the United States he became United States Senator from Massachusetts, in 1803. The next office was that of minister to Russia, and then he was one of the men who made the treaty of peace with Great Britain after the War of 1812.

It seemed that the country could not get along without him. He was sent to London as United States Minister, but was recalled to become Secretary of State under President Monroe. Adams had had all these honors before he was fifty years old. In the State Department he served eight years and won great fame.

He managed the purchase of Florida from Spain, the discussion of the fisheries disputes with England, and the argument about the Oregon question. He wrote a few important paragraphs in the Monroe Doctrine. On page 1914 you have an explanation of the doctrine.

LIKE HIS FATHER, JOHN QUINCY ADAMS SERVED ONLY ONE TERM AS PRESIDENT

In 1824 John Quincy Adams was elected President of the United States, but many things prevented him from being a success. In the election no candidate got a majority of the votes, and General Andrew Jackson received more than Adams. The House of Representatives chose Adams, and all of Jackson's friends were angry. Then, too, President Adams liked to have his own way and did not get along with Congress, which refused to do things he advised. He was again a candidate in 1828, but was badly beaten, and went out of office in 1829.

Adams was now sixty-two years of age; he had lived a very busy life, and had held the highest offices his country could give. Many men would have been glad to retire and live a life of ease. Adams did not think of such a thing. Though he had been United States Senator, Secretary of State and President, he took a seat in the House of Representatives in 1831, and was re-elected term after term until his death.

He spoke on every question that interested him, and spoke so well that he was called the "Old Man Eloquent." His chief work was directed against slavery, and he always said what he really thought. In 1848 he had a paralytic stroke on the floor of the House and died two days later, at the age of eighty-one.

ANDREW JACKSON, WHO WAS THE SON OF IRISH PARENTS

Andrew Jackson was the son of Irish parents who had emigrated to America. He was born on March 15, 1767, shortly after the death of his father. His birth took place in Union County, North Carolina, though Jackson himself always thought he had been born in South Carolina.

When he was only thirteen young Andrew and his older brother Robert joined a group of patriots determined to drive the British soldiers from the Carolinas. Both boys were taken prisoner, and contracted smallpox in the British camp. Robert died.

When Andrew was sixteen his mother died. The youth worked for a while as a saddler, then taught school (though he was a very poor scholar himself) and then studied law.

When he was twenty-nine years old he became a Representative in Congress from Tennessee. In 1797 he was chosen Senator but resigned a year later.

Then he was elected to the Supreme Court of Tennessee, and held that office for six years. Later he was major general of the militia, but continued to practice law.

He was an honest man, and lovable, but his fiery temper led him into many rash acts that injured his career. He fought duels, and was known to many as a harsh and profane man. Yet for children and for helpless animals he had a softer side that never failed.

Truly this man was a strange combination of harshness and tenderness. In his eyes his friends could do no wrong; but while an act of injustice made him angry, he himself was sometimes unjust and unkind toward those who had injured him or his friends.

HOW ANDREW JACKSON WON THE NAME OF "OLD HICKORY"

It was during the Creek Indian War that Jackson won for himself the term of "Old Hickory," which grew to be a name of endearment among his soldiers, for they would proudly tell each other that the general was "tough as hickory." Later Jackson served in the War of 1812, gaining for himself much renown and an undying name for fairness to foes and bravery in battle. His chief fame as a soldier was gained by the surprising victory at New Orleans.

In 1824 Andrew Jackson was among the candidates for the presidency, but, owing to the enemies made by his hasty temper, he was defeated in favor of John Quincy Adams. On December 23, Rachel, his beloved wife, died, leaving her husband utterly stunned and brokenhearted over his loss. For years he was inconsolable, and until the end of his life he wore her picture upon a chain about his neck.

Jackson was elected president in 1828 and served two terms. Upon his retirement from office he returned to his home in Tennessee, The Hermitage, to spend the remainder of his days among his own people. There he died on June 8, 1845.

Now we come to three men who are often spoken of together, because they were in public life at the same time and had great influence in the nation. All of them served in both houses of Congress, all held Cabinet offices, two were candidates for president, and one was twice elected vice-president. These men were Henry Clay of Kentucky, John C. Calhoun of South Carolina and Daniel Webster of Massachusetts.

HENRY CLAY, A GREAT STATESMAN OF THE NINETEENTH CENTURY

Henry Clay was the oldest and came first into notice. He was born in Virginia in 1777, during the Revolution, and went to work as a clerk in Richmond at the age of fourteen. As he was very intelligent and wrote a good hand, a distinguished judge employed him as a sort of secretary. After studying law a little while he was given permission to practice when only twenty years of age. About this time he moved to the new state of Kentucky. His power of making friends was very great, and he was soon successful both in law and in politics.

Before he was really old enough Clay was appointed to fill a vacancy in the United States Senate. This time he served only a few months, but was again appointed for a short time in 1809. He now determined to go into politics in earnest. In 1811 he became a member of the House of Representatives and was at once elected Speaker. Trouble with England was brewing, and the War of 1812 was soon under way. Clay, Calhoun and other young men favored the war so strongly that they were called the "War Hawks." After the war Clay was a member of the commission that arranged a treaty of peace.

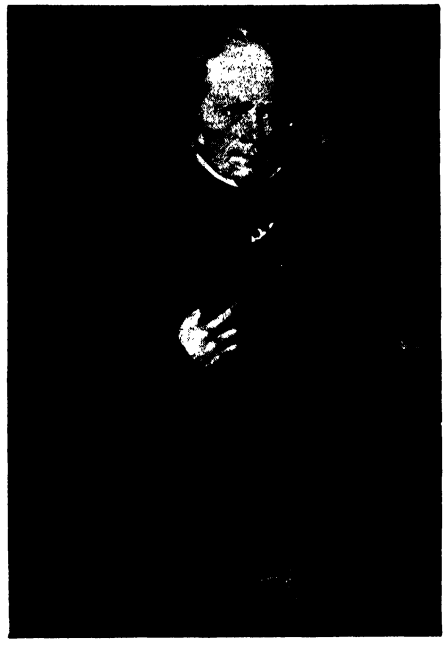
CLAY WINS HIS GREATEST FAME AS A MEMBER OF THE SENATE

While a member of the House he arranged the Missouri Compromise, about which you can read in the History of the United States, and in 1824 was a candidate for president, but was defeated. During John Quincy Adams' administration he served as Secretary of State. In 1831 he once more became a member of the United States Senate, where he gained his greatest fame. He was again a candidate for president in 1832, but was defeated by Andrew Jackson. He resigned from the Senate in 1842, but was the Whig candidate for president in 1844, against James K. Polk. He was again elected to the Senate in 1848, and served until his death, in 1852.

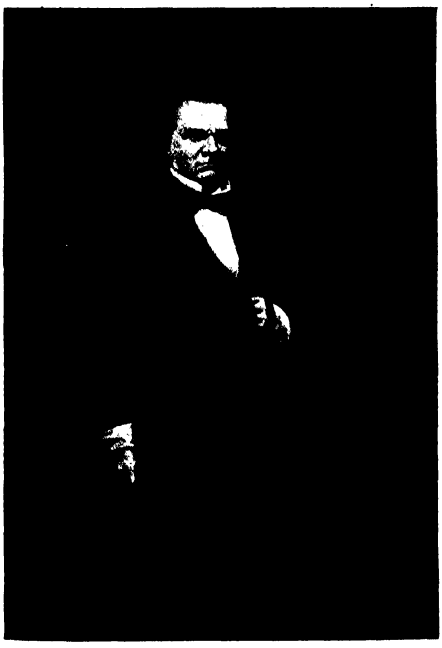
During his long service Clay was noted for two things. He was a strong advocate of a tariff to keep out foreign goods, so that all the articles we needed might be manufactured in the United States. This policy he called the "American System." He is

STATESMEN OF THE MIDDLE PERIOD

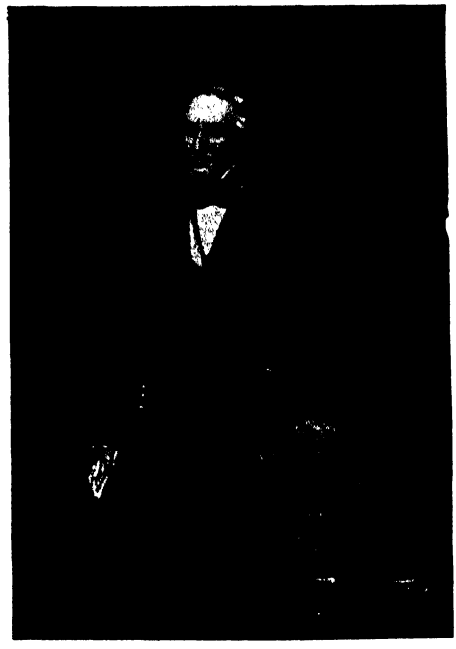
Daniel Webster, the greatest orator of his time, though born in New Hampshire, moved to Massachusetts and represented that state in the Senate for many years. He was twice Secretary of State.



Henry Clay was one of the best loved and most influential men ever in public life in the United States, but he failed to realize his ambition to be president. He was peacemaker while in Congress.



Stephen A. Douglas was called the "Little Giant." He introduced the Kansas-Nebraska Bill, and was defeated for the presidency by Abraham Lincoln. He was only five feet tall, but seemed much taller.



Thomas H. Benton sat in the Senate with Clay and Webster, but opposed them in politics. He was a member of the Senate for thirty years, and wrote a large book telling what he had seen there.

even more noted for his efforts to settle differences of opinion which threatened to break up the Union.

In 1821, in 1833 and again in 1850 he came forward with plans which both sides accepted, and gained the title of the "Great Pacificator."

Few men in our history have been so much loved as Clay, but he failed to gain the presidency, which he desired above all things. Though he was a candidate three times, there was always some special reason for his defeat. Once, when told that some act of his would lose the presidency, he said, "I would rather be right than president."

JOHN C. CALHOUN, WHO BELIEVED IN THE DOCTRINE OF STATES' RIGHTS

Though John C. Calhoun had a greater mind than Clay, he did not have such power to gain the affections of men. He was born in South Carolina in 1782, and when twenty years of age entered the junior class of Yale College, and was graduated with high honors two years later. After studying law in Connecticut and in South Carolina, he began to practice, but was soon sent to the legislature of South Carolina, and then to the United States House of Representatives, where he favored a declaration of war against Great Britain. In 1817 he became Secretary of War under President Monroe, and made a fine record. He became vice-president in 1825, under John Quincy Adams, and was re-elected vice-president under Jackson. He quarreled with President Jackson, however, and resigned in 1832, before the end of his term.

THE DOCTRINE OF "NULLIFICATION," PROPOSED BY CALHOUN

We have already told on page 1916 of the objection of South Carolina to the high-tariff laws of 1828 and 1832. Though Calhoun had favored a protective tariff in 1816, he had come to believe that such laws were unconstitutional and that they would ruin the South. He declared that a state had the right to decide whether a law was wrong and could refuse to obey it. This is called "Nullification." As soon as he resigned the vice-presidency he was sent to the United States Senate, and there spoke for what he thought were the interests of the South. Later, for nearly a year, in 1844 and 1845, he was Secretary of State under President Tyler, and helped to bring Texas into the Union. After filling this office he was again sent to the United States Senate, and remained there until his death, though his health and strength were failing fast. He died in 1850, while the question of admitting California to the Union was before the Senate.

This statesman saw earlier than most of the men of his day that the Union could not continue part slave and part free unless the states had more power than the national government. If Congress tried to make laws upon the question of slavery, there was sure to be trouble. Calhoun loved the South, and in 1849 spoke of "dissolving the partnership," that is, breaking up the Union, if the rights of the South were trampled upon. He loved the Union, but he loved the South more.

We have said that Clay was a great orator and Calhoun a great thinker. Now we come to a man who was great as both orator and thinker. Daniel Webster was born on a small farm in New Hampshire in 1782, the same year that his great opponent John C. Calhoun was born in South Carolina. He was a delicate child, and so eager to learn that his father, a soldier of the Revolution, determined to send him to college. In 1797 he entered Dartmouth College, then a small, struggling institution, and was graduated four years later.

THE REMARKABLE POLITICAL CAREER OF DANIEL WEBSTER

Like so many young men of the time, Webster taught school, but he also studied law, and in 1805 began to practice in a little village near his home. Soon he removed to Portsmouth, then a flourishing town, and in 1812 was elected to the United States House of Representatives, and was re-elected. During his second term he decided to move to Boston, where there were greater opportunities for a lawyer. While in Congress he opposed the War of 1812, as the people of New England felt that it was harmful to that section. Soon after he removed to Boston the people began to speak of sending him to Congress from Massachusetts; in 1822 he was again elected to the House of Representatives, and remained until he was elected to the Senate, in 1827. From that time until his death he was a member of the Senate or else Secretary of State nearly all the time.

While telling you of Calhoun we spoke of the dissatisfaction of South Carolina over the tariff laws. One of the Senators for South Carolina, Robert Y. Hayne, made a speech in which he said that New England had always been unfair to the South and the West, and that the Union might be broken up if

those sections were not better treated. He said also that the Union was simply an agreement between the states and that any state had a right to leave the Union or to refuse to obey unjust laws.

Senator Webster replied in a speech four hours long, in which he defended New England and declared that the Union could not be dissolved. His speech closed with the words: "Liberty and Union, now and forever, one and inseparable." This famous speech, "The Reply to Hayne," every schoolboy knows.

WEBSTER AS SECRETARY OF STATE UNDER HARRISON AND TYLER

In 1841 Webster became Secretary of State under President Harrison and continued in office for a time under President Tyler. The most important thing he did was to make a treaty with Great Britain which settled the boundary between Maine and Canada. After the treaty had been signed, Webster resigned and went back to the law. He had bought a farm in Marshfield, near Boston, and loved to spend much time there. But the people of Massachusetts again sent him to the Senate in 1845. He accepted, as he hoped to be elected president of the United States, but in this he was disappointed, as Clay had been.

His last great speech was made in 1850, when he favored the Compromise of 1850. Some of the New England people were opposed to making any compromise with slavery, and Mr. Webster was much abused for his "Seventh of March Speech." While he was not a friend to slavery, he loved the Union and wished to preserve it at any cost. Before the Compromise had passed, President Fillmore offered him the position of Secretary of State, and for a second time he took that great office.

WEBSTER FAILS TO WIN THE NOMINATION FOR THE PRESIDENCY

In 1852 the Whig party nominated General Winfield Scott for president. A party always wishes to win, and always nominates the man who the leaders think can get the most votes. Daniel Webster had made enemies during his long service, and the leaders thought that a military hero might get more votes. This is one of the reasons why many of our greatest men have never been chosen to head the nation.

Webster was much disappointed, and only a few days before the election he died at his beloved Marshfield. He had had a remarkable life. From a poor New Hampshire farm he had gone on to high position in the nation. He was looked upon as the greatest lawyer and orator of his time. He had gained everything except that which he most desired.

Another statesman who was in the Senate with Webster, Clay and Calhoun, and had great influence there, was Thomas Hart Benton. He was born in North Caro'na in 1782, and attended the state university for a little while. His father died young, and his mother moved to Tennessee, where the young man studied law and was soon elected to the legislature. He volunteered during the War of 1812, but saw no fighting.

Missouri was then growing rapidly, and the ambitious young lawyer moved to St. Louis in 1815. He edited a paper, had many quarrels and fought several duels, but made many friends. When Missouri was admitted as a state according to the Missouri Compromise, he was chosen one of the first Senators and served five terms—thirty years. Few men have served so long as this.

THOMAS HART BENTON AS A MEMBER OF THE UNITED STATES SENATE

In the Senate he took a prominent place though the measures he favored did not always become laws. For example, he wished to have the president of the United States elected directly by the people, and he was much opposed to paper money. He believed that only metal should be used as money and was often called "Old Bullion" for this reason. He favored building a railway to the Pacific, and he also favored giving farms to the people instead of selling public lands. Both of these things were done after he had left the Senate. When many men thought that the United States should not gain any more territory, Senator Benton believed in pushing on to the Pacific.

Though he had quarreled with Andrew Jackson before he left Tennessee, they became friends again. While Jackson was president Senator Benton was one of his strongest supporters. In some things they were much alike. Both were western men, and though both held slaves, they hated men who were willing to break up the Union on account of slavery. Because Benton grew to believe that slavery should not be extended into some of the new western lands he was finally defeated, and retired from the Senate in 1851.

He had held office so long that he could not be happy as a private citizen. He was elected to the House of Representatives in 1852, but because of his views on slavery served only one term. Then he was a candi-

Photo by Brown Brothers

Andrew Jackson ("Old Hickory"), seventh president of the United States, in his general's uniform.

date for governor of Missouri in 1856, but he had lost his popularity. His defeat broke his heart.

Another western man was younger than any of these, but was almost as important. This was Stephen Arnold Douglas, who was born in Vermont in 1813. His father died soon after the birth of the boy, who at the age of fourteen was apprenticed to a cabinet-maker. But he was determined to do something else, and soon began the study of law. The West seemed to offer a better chance, and he moved to Illinois in 1833 and began to practice law. He made many friends and held several small offices. When only twenty-eight years old Douglas became judge of the supreme court of the state.

He found his place when he became a member of the United States House of Representatives in 1843. In spite of his youth he at once became prominent. He, like Benton, believed that the United States should extend its territory, but, unlike him, was willing to go to war with Great Britain over the Oregon country. He also favored a railroad to the Pacific.

From 1847 until his death he was a member of the Senate, where he was known as the "Little Giant," for he was only five feet tall. In the Senate he spoke on many questions, but the measure for which he is chiefly remembered is the Kansas-Nebraska Bill, about which you may read on page 2429. He believed that the people of a territory ought to decide for themselves important questions like slavery.

Though Senator Douglas owned no slaves himself, his wife, a North Carolina woman, owned some, and the new Republican party, which was growing in Illinois, wished to defeat him for the Senate. Abraham Lincoln was put up as the candidate against him, as you may read in our story of Lincoln, but Douglas was re-elected.

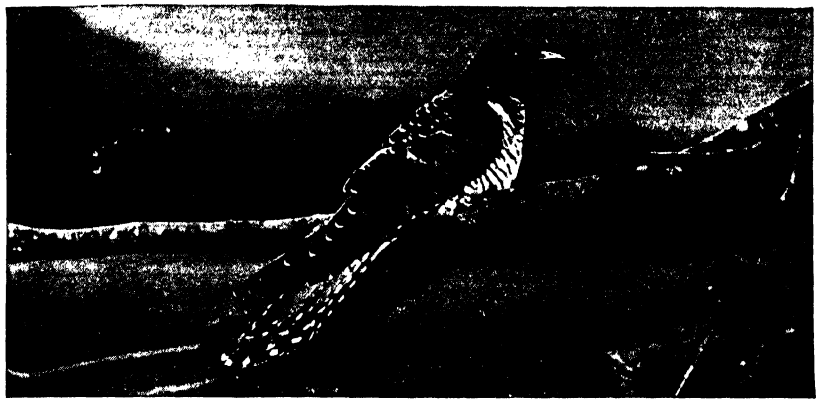
In 1860 he was nominated for the presidency by the Northern Democrats, but the Southern Democrats nominated another man. Thus the Democratic votes were split and the Republican, Lincoln, won the election. Douglas loved the Union and opposed the efforts of the Southerners to break it up. He did everything he could to help President Lincoln, but died in 1861, before war really began.

When Abraham Lincoln was president he knew how to make skillful use of many able helpers. One of these was William H. Seward, who was born in Orange County, New York, in 1801. He was graduated from Union College, Schenectady, in 1820, studied law, and began to practice in 1823. Soon he was elected to the legislature, and became governor of New York at the early age of thirty-seven. He was elected to the United States Senate as a Whig in 1849, and re-elected in 1855, but his dislike of slavery finally led him to help to organize the new Republican party.

A GREAT SECRETARY OF STATE UNDER TWO PRESIDENTS

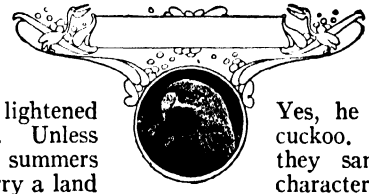
Most people expected him to be the Republican candidate for president in 1860, but Abraham Lincoln was chosen instead. President Lincoln at once made Seward Secretary of State, and in this office he served until 1869. He was always loyal to his chiefs, and managed the foreign affairs of the country with much skill. Besides much difficult business with Great Britain, he got the French out of Mexico and purchased Alaska from Russia. When Lincoln was assassinated, an attempt was made to kill Seward, who was ill in bed. After leaving office he made a trip to Alaska and then went around the world. He died in 1872.

THE NEXT STORY OF MEN AND WOMEN IS ON PAGE 3600.



The European Cuckoo, the messenger of Spring.

THE CUCKOOS



IN Europe when the first note of the Cuckoo swells through the countryside hearts are lightened and faces gladdened. Unless seasons change and summers fail, winter cannot harry a land where the cuckoo chants. The cuckoo is Spring's own trumpeter. How much its coming meant to our forefathers! Winter was a season of sore discontent to them, shut up in dismal, unsanitary dwellings, in which plague and pestilence lurked, where food was sour and scanty, and the long months of darkness were dreary and unhealthful. When the cuckoo made his joyous proclamation men rushed out to hear him sing. They knew that they could breathe again sweet airs and comfort and gain new life from fresh food in the fields.

The first lyric in the English language was inspired by the bird's arrival. Some unknown poet, emancipated from winter's miseries, burst forth into a song as dear as anything of Shakespeare's. In modern English it runs like this:

> Summer is a-coming in,
> Loud sing Cuckoo!
> Groweth seed and bloweth mead,
> And springeth the wood now—
> Sing Cuckoo!

And so forth—three stanzas of sheer musical delight, lilting from a poet heart seven hundred years ago.

Yes, he is a poet's bird, the cuckoo. Did they know, when they sang of him, his true character, the dark secret of his life? Possibly they did not, for poets in general, unlike Shakespeare and Tennyson, are little skilled in natural history. We know the worst about the European cuckoo to-day. For every cuckoo an entire nest of other little birds has been slain. That is one way of putting a strange fact, the general one, and an excessively wrathful one.

To many people the cuckoo has a horrible fascination, as if his habits were unique in nature. The cuckoo is the herald of Summer. He is handsome and gay; he lives entirely on insect enemies, the "woolly bears." All of these things are to his undying credit; but, on the other side, he is entirely the product of a system of "crime" commonly deemed without parallel. The items to the credit of his account are true, and equally true are the charges against him; but no less certainly is it untrue nonsense to mark the cuckoo down as an exceptional criminal.

What is it that happens? The hen cuckoo lays an egg which is very small

in comparison with the size of the bird. As she never builds a nest, she has no place in which to put it. So she takes it to the nest of another bird, whose eggs her own resembles. The introduction of the eggs may be effected in two ways. If the nest is large and accessible the cuckoo may sit on it for a moment and lay her egg. She may also push out one or more of the eggs she finds there.

THE AMAZING STORY OF THE CUCKOO AND THE EGG IT LEAVES BEHIND

When the nest is very small, or where it is placed in such a position that the cuckoo, which is quite a large bird—nearly fourteen inches long—cannot enter, she lays her egg on the ground, takes it up in her beak, flies to the nest and drops it in, withdrawing at once with another egg not her own. She may break and eat the egg which she has stolen; she may even break and eat other eggs from the nest, but that rarely happens.

Such a practice might lead the builders of the nest to desert it, and the chick which should come from the cuckoo's egg would not be hatched. As a rule, then, one egg is stolen from a nest, as if the cuckoo, with an instinct like that of a practiced boy birdnester, realized that if you put in an egg you must take one away, to lull the suspicions of the brooding bird.

So far the part of the mother. Now for the young one. When this hatches it has a curiously hollowed back. During its second day of life the little cuckoo grows restless, and, working its way beneath any object in the nest, be it egg or young bird, it heaves and struggles with instinctive accuracy until the object is worked to the top of the inner edge of the nest, then tilted over to fall with a crash to the ground below.

THE LOVE OF THE BIRDS FOR THE LITTLE STRANGER IN THEIR NEST

The interloper is thus left in sole possession of the home, and to its care the deluded foster parents devote all their attention, brooding and feeding it with the care due to a creature of their own flesh and blood. We need not believe that they are so misled as to regard this growing monster as their own chick. At the nesting period and after, birds are filled with a yearning love for young bird life, and they will unhesitatingly feed nestlings not of their own kind.

When the rightful owners of the nest return and find their chick dying on the ground they stare at it in pathetic amazement. They know it is their own, and that it has met with disaster; but they do not attempt to help it back to the nest; they do not seek to feed it. They seem to accept it as an unavoidable stroke of destiny.

Then they flutter to the nest and feed the criminal. They feed it constantly while it is in the nest; they feed it when it has outgrown the nest; they feed it when it has become so huge, in comparison with their own size, that they have to perch on its shoulders to put the food into its gaping, clamorous mouth. But they are not friendly to adult cuckoos. Little birds, on which cuckoos prey, combine to mob their enemies. Whether they do so out of inbred hatred of the interlopers, or whether they are misled by its hawk-like outline into mistaking it for a bird of prey, we shall never know. The second suggestion needs consideration.

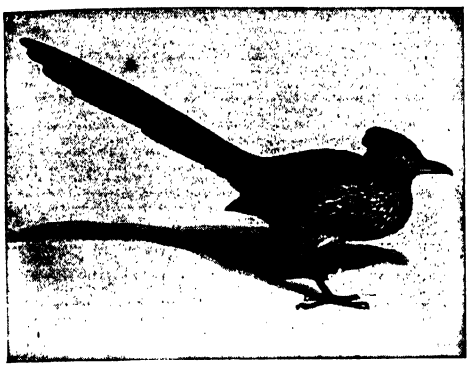
WHY THE CUCKOO DOES NOT BUILD ITS OWN NEST

It is within the bounds of possibility that, because it is attacked in this manner from age to age, the cuckoo has found it unsafe, or at least inconvenient, to make a nest for itself among so many little enemies. Therefore, it has been driven by this unending persecution to utilize the nurseries of its enemies in the place of those which, if not attacked, it would have been content to furnish for itself. Even supposing there is some truth in this explanation, there is another influence against building a nest.

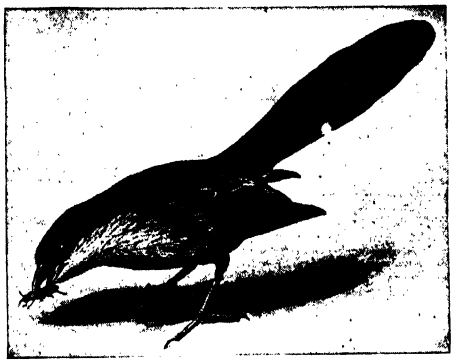
We have many examples of birds which mate for life and we have instances where one male has many hens; but the position is reversed in the case of the cuckoo. Here it is the hen which has many gallants and squires, and she does not strike up a partnership with any one male. The males by far outnumber the females, and at her call from a bough half a dozen candidates for her society fly to her side.

So there can be no hard-and-fast associations between the sexes as there is with the majority of species, and therefore no settled purpose directed to nest-building and care of the family. It is not certain how many eggs the hen lays in the course of a summer, perhaps as many as fifteen or twenty.

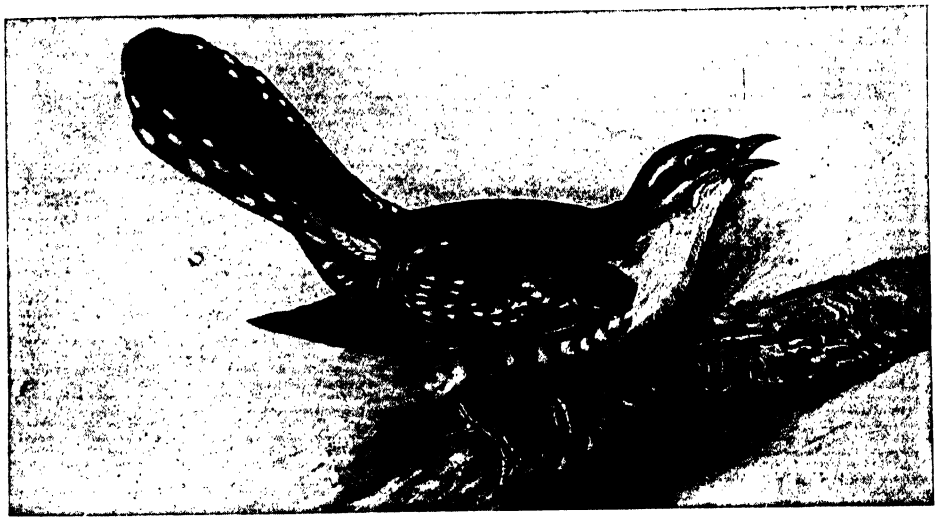
MEMBERS OF THE CUCKOO FAMILY



The road-runner.



The Egyptian coucal.



The golden cuckoo.

The great spotted cuckoo.

The giant plantain-eater.

But in whatsoever stolen nest we look, we nearly always find the intruding egg matching the rest of the eggs in the clutch in a general way. Robin, wagtail, pipit, warbler, hedgesparrow, and the rest, they are all often mimicked as to the size and color of their eggs.

A NEW AND STRANGE DISCOVERY ABOUT THE CRADLE OF THE CUCKOO

This fact led to great confusion until not long ago. The matching of the eggs was supposed to mean that the cuckoo could change the shape, size and hue of its eggs to suit any nest in which it had to be placed. But the fact seems to be that the adult generally returns to the type of bird by which it was reared. Accident, the need of a nest for an egg which is laid when there is no convenient receptacle of the right species available, occasionally leads the anxious cuckoo to place her egg in the first nest she can find. But it is not the rule.

The pugnacious red-backed shrike is imposed on, and rears a cuckoo which, if it is a female, will return to lay its eggs in the nests of other butcher birds. The same policy is followed by the cuckoo cradled in a thrush's nest, in a redstart's nest, and so on. Over eighty species of birds are victimized in this way. Each is believed to give rise to a fixed variety of cuckoo, in the sense that the nestling will grow up to lay in a copy of the nest from which it flew.

THE FOLLY OF THE COWBIRD AND THE WISDOM OF THE CUCKOO

So it is wrong to imagine that the cuckoo alters the outline of its eggs to meet the needs of the hour. It always lays the same kind of egg, but that egg is like the eggs of the bird whose little ones the cuckoo, when little more than one day old, toppled from its nursery to death.

All European cuckoos have this habit, but there are species of cuckoos which are respectable citizens of the bird world, and build nests and hatch their own eggs with propriety and punctuality. The New World cuckoos hatch their own eggs and care for their young. Nor is the hateful habit found only among cuckoos.

As we have already seen, the honey-guide is as confirmed a little poacher as the cuckoo. And the American cowbirds are for the most part just as unscrupulous. They belong to the Blackbird Family, but they not only lay their eggs in the nests of their relatives but in the nests of birds quite unrelated, even going so far in their folly as to drop their eggs into nests which have been deserted. They commit other absurdities with their eggs, too, suggesting that here, at any rate, the decay of the natural instinct for the preservation of the species is accompanied by a failing of acuteness.

Stupid in that way the common cuckoo never is. This bird is as watchful as an eagle. It will prowl in the neighborhood of birds while they build, carefully marking down the best-hidden nursery, and wait for them to lay. Then, at the right time, it will slip its own egg into the nest, and continue the chapter of instinctive misdoing at the expense of another pair of reluctant foster parents.

HOW THE OWNERS ARE LURED FROM THEIR NEST

Even the courage of the little birds in attempting to drive off adult cuckoos is turned to the cuckoo's profit. The male seems deliberately to challenge attention, and draws attack on itself. It flies away, pursued by the owners of the nest. While the male is thus drawing the guardians of the nest from their post, the hen cuckoo darts to the undefended nest and lays her egg. If only the mother cuckoo tarried to tend her infant at its hatching, we might forgive her. But no, parasitism and parental care never go together.

One good thing may be said for the European cuckoos. They eat hundreds of the hairy caterpillars which are such a pest. They are the only birds known to eat these enemies of human comfort.

The cuckoos are a large family of nearly two hundred species, nearly all tropical. Northern Europe sees only the common cuckoo regularly, and the Great Spotted Cuckoo as a rarity. This bird, common in Southern Europe and the warm lands of the East, ignores small birds and victimizes the fighters of the crow tribe. Sometimes a spotted cuckoo will lay three or four eggs in a crow's nest, and that may account for the fact that the interlopers and the rightful heirs to the nest live together in amity till the time to fly arrives.

THE INDIAN CUCKOO, WHICH USES THE NEST OF THE BABBLERS

The Indian Pied Cuckoo effects a lodgment for its egg in the nests of the babblers, and there out go the baby babblers

at the instance of the hatched invaders. Other Indian cuckoos which haunt the same type of nest are called Hawk Cuckoos, from their exact resemblance to birds of prey. It would be interesting to work out the theory of the cuckoo's advantages and disadvantages resulting from this mimicry.

Africa has a Golden Cuckoo into whose plumage Nature has worked the loveliest metallic lustre, parasitic on sparrows and their like, and dining, it seems, on the egg which they remove in order to make way for their own. A dress of handsome bronze clothes allied cuckoos in Australia and India.

American cuckoos are sober in garb. Two species are common, the Black-billed and the Yellow-billed, and are much alike. They are grayish brown above, and grayish white underneath. Their song is harsh, but they feed on hairy caterpillars, and the caterpillar of the gipsy moth. They build apologies for nests, and hatch out their own young. Apparently the parent birds begin to sit as soon as the first egg is laid. The young hatch at different times, and so there may be young of several sizes in the nest. They are fond of the eggs of other birds and often rob their nests. Both species are called "rain crows" in some sections, as their harsh calls are supposed to prophesy coming rain. Some careful observers of birds believe that the birds really have this power. There is also another species, the Mangrove Cuckoo, which belongs to the West Indies but occasionally ventures into Florida and Louisiana.

THE BIRDS THAT FLY LOW ON THE ROADS OF SOUTH AMERICA

Then there are the Coucals, ground-keeping cuckoos which make quite ambitious domed nests; bush-dwelling cuckoos in India and adjoining regions which are called Malkoahs; ground cuckoos of Sumatra and Borneo which run like pheasants; road-runners of South America which fly so low along tracks and highways that they seem to course along the earth; Savanna and Guira cuckoos which not only nest in company, but pile the eggs of several birds in one nest.

The home of a Guira cuckoo having been made, a layer of eggs is laid and covered with leaves. Then another layer is added by another bird, and that in turn is overlaid with a similar covering. There may be two or three such strata, but other eggs are scattered in the foliage amid which the nest is placed, and there must be great loss of eggs and probably of life among the young when the hatching is at an end.

Even now we have not named all the cuckoos. The golden cuckoo has its nearest kin in the lovely Emerald Cuckoo. The California Road-runner, sometimes called the Chaparral-cock, is a ground-living cuckoo, and the Ani also. This is a bronze-black bird which only occasionally comes into the United States. The natives call it the "black witch" and attribute all sorts of crimes to it.

Both Australia and Asia have so-called Pheasant Cuckoos, though the species are far sundered in general characteristics. Perhaps as strange a species as any is the Drongo Cuckoo, a bird endowed with this title from the fact that it is the living copy of the drongo, and profits by the circumstance to penetrate the drongo's nest undetected and there work its act of betrayal.

THE LINKS THAT ARE MISSING FROM A GREAT GROUP OF BIRDS

Was this policy of parasitism at one time more common to birds? No one knows, but the cuckoos are like some of our other birds, so that it is natural to ask whether, seeing that so many kinds were once based on a general physical plan, they shared the cuckoo's peculiarity of nesting and neglect of its young.

On the one side we can now trace an affinity between cuckoos and bee-eaters; then, marching on, we find the plantain-eaters next in the scale of living relatives. Their popular name has been bestowed in relation to their habit of eating plantains, or bananas. That, however, is but part of their diet. They eat many kinds of wild African fruits, and some species take insects, small reptiles, and even young birds.

THE TURACO, WHICH LIVES ONLY IN AFRICA

The scientific name of the plantain-eaters is Turaco, or Turakoo. They number over a score of species, all restricted to the Dark Continent. They vary in size from fifteen inches to two and a half feet long, and within those limits many remarkable and fine specimens of birds are included.

Rich and varied hues adorn the soft plumage of the body; the tails are long

and effective in appearance, and the head is crowned with a fine crest. Green, blue and red are the predominant tones, and naturalists group the whole into two brigades, one embracing all the birds which have red feathers in the wings, the second group those which lack red feathers.

It is well to have this grouping in mind, for it helps us to remember that in the turacos we are brought face to face with a very extraordinary fact. The red matter which colors the feathers dissolves in water like an inferior dye.

There is copper in this red pigment, and no man knows where the birds get it. It has been suggested that the birds may pick up grains of the mineral when feeding. We can change the color of a bullfinch's feathers to sable by feeding him on hempseed. We can convert a pale yellow canary to deep orange by adding cayenne pepper—which he enjoys—to his food when he is on the eve of molting. But is there any evidence that we can alter the hue of a bird's clothes by giving him a mineral to eat?

THE BAFFLING MYSTERY OF THE RED FEATHERS OF THE TURACO

Supposing that here and there a turaco does swallow some grains of copper or malachite, or whatever the substance may be. Only the few birds which found such substances would be affected. But the red coloring matter of all red-feathered turacos contains copper. The pigment is a substance well established in the records of science, and it is called turacin.

Obviously, then, the curious composition of the pigment cannot result from the haphazard collection of foodstuffs taken into the birds' crops. The birds which sport these mysterious feathers are among the species which seem never to feed on the ground, where mineral matter would enter into their diet; on the contrary, they keep to high trees—shy birds, unwilling to expose themselves away from the boughs.

No, it cannot be that. To clinch the matter, we have the fact that turacos kept in captivity have evolved the copper-containing red pigment, year after year, in aviaries where not a grain of mineral matter capable of conversion to such end is obtainable.

The red feathers of the turaco, then, are a complete puzzle to us. We have not the faintest notion how a bird eating fruit and animal food can evolve a metal from its inner substance—a unique feat. Workers among the white ants, or termites, might see a parallel in the fact that where these creatures have labored unmistakable iron is to be found in the substance of their fortresses. That, however, must result from the material in which the termites work, not from conversion of animal matter into mineral.

THE COLOR THE RAIN TAKES AWAY AND THE SUN BRINGS BACK

We cannot explain it; we can only ponder the problem and leave it, in the certain hope that some day the solution will be worked out by some bright mind to which leisure and opportunity and unlimited supplies of turacos come happily all together.

But we must not forget that this confusing red pigment, so doubtful of origin, fades away in water, as we have said. What purpose can this serve in the life and labors of the bird? The turacos live mostly in heavy forests, where in the rainy season moisture descends with an intensity suggesting waterspouts. One good drenching and the red feathers of the turaco blanch, the gorgeous pigment flows away.

If he is well and truly rained on, if he takes a wholesome bath, the deep blush from the turaco's feathers fades out completely and a bird of pinkish white hue is there. Nature must at once set to work to restore the lost pigment, and she does. The red returns, coppery turacin again flushes the pinions of the plantain-eater, and he is a gorgeous red with his green and blue once more.

THE CHANGING PLUMAGE THAT MARKS THE PROGRESS OF THE SEASON

There is deeper design in this than is apparent. Many wonderful plumage changes mark the progress of the season. Feathers bleach and fray, like the weathered leaves of autumn trees, and fall easily, like those leaves. Some grow light and pale under the influence of the sun; some grow dark under the influence of moisture; but in the turaco, as we see, wet makes fine feathers pallid, dry weather permits the baffling pigment to return and the feathers to be bright again. This is one of those things we cannot understand. There are hundreds of them in nature, and the more we study, the more mysteries we find to puzzle us.

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 3613.

PHOTOGRAPHIC SILHOUETTES

Courtesy, Eastman Kodak Company
A fine silhouette study of a boy and his pet.

SILHOUETTE making is based upon the practice of causing the white background, against which the subject appears, to be much more strongly lighted than the side of the subject that faces the camera. Photographic silhouettes can be made indoors, with daylight, ordinary household electric light, photoflood lamps or photoflash lamps.

It is relatively simple to make photographic silhouettes by daylight. You should place your subject in front of a window that gives a large amount of light. Then you should cut off all of the light in the room except that which comes from the window in front of which you are going to pose the subject. The window-shade should be drawn down until it is only a few inches from the top of the subject's head. This is done so that there will be no detail in the hair on the side of the head facing the camera. Detail of this kind would ruin the silhouette effect.

If a tree or wall or some other dark object can be seen in the viewfinder of the camera, the window will not make a completely white background and your silhouette will not be very satisfactory. You may sometimes avoid this darkened background by taking the snapshot from a point near the floor of the room, or by having the subject stand. If you are making a picture of a child, it may be well to have him sit on the end of a table so that you will be able to get more than a mere head and shoulders effect.

As the brightness of daylight varies from hour to hour and also changes rapidly when clouds obscure the sun, the other ways mentioned below of obtaining silhouette negatives are surer.

When photographic silhouettes are made with incandescent lamps, photoflood lamps and photoflash lamps, two rooms, with an open doorway between, are needed. The doorway must be wholly covered with a sheet of white cloth, such as a bed sheet; this sheet must be stretched smooth so that no wrinkles will be seen. Any wrinkles in the sheet will be reproduced in the finished print and the resulting lines will quite spoil the silhouette effect.

The subject is photographed in one of the rooms while the light is in the other. If the photographic silhouette is made in the daytime the room in which the subject and the camera are placed must be made very dark. If there is any light in this room which is strong enough to affect the film during the time that the shutter is open, it will be impossible to get a sharp image.

The subject is placed in position in front of the white sheet between the two rooms; he should face at right angles to the camera. The face should be in full profile, so that not even the lashes of the eye can be seen when viewed from the lens of the camera.

The lamp should be so placed, back of the sheet, that a line drawn from the center of the lens to the position of the light would pass through the center of the sheet that covers the doorway. This line should also pass through the center of the subject to be photographed (see diagram). When the subject consists of two figures, they should be placed so that the line in question will pass between them, if one lamp is used. When

two lamps are used, it is a good idea to have one in back of each figure that is posed.

Good results may be obtained with unshaded incandescent lamps. The stronger the lights, the less exposure will be required. With three 60-watt, inside frosted Mazda lamps, an exposure of about 5 seconds will be effective. Remember that the lamps

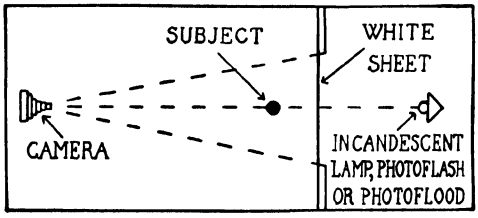


Diagram of a silhouetting process.

should be placed in back of the figure that is being silhouetted; otherwise a spot of light is apt to show through the sheet.

If you place something in back of the lamps to act as a reflector, your exposure time may be reduced. You may use for this purpose a sheet or cloth, pieces of white cardboard or even a bright dishpan.

You should guard against light being reflected on the subject from white walls, highly varnished doors or mirrors in the room where the camera and the subject are. A very important thing to remember is that white or light colored costumes are less suitable for photographic silhouettes than those of darker colors.

You may include in your picture such "props" as a table, a chess set, a bird cage and so on. You will find that by experimenting with these "props" you will be able to produce striking effects. Of course you should use only such articles as will be easily recognizable when seen in outline.

Particularly fine silhouettes may be made by using flashlight (with photoflash lamp). Flashlight gives an instantaneous but very brilliant illumination.

Unless full-length figures are to be shown, the lower part of a silhouette negative is usually masked in printing. The mask may be made of any kind of opaque paper, cut to the shape desired. The mask may be placed between the printing paper and the negative, or placed over the back of the negative.

If anything that was outside of the area covered by the sheet shows in the negative, you may get rid of this by applying opaque with a spotting brush to the back of the negative. You may also modify the outlines of the costumes and the accessories by this method. Silhouettes should be printed on a paper intended to bring out contrasts.

HOW TO FEEL THE PRESSURE OF THE AIR

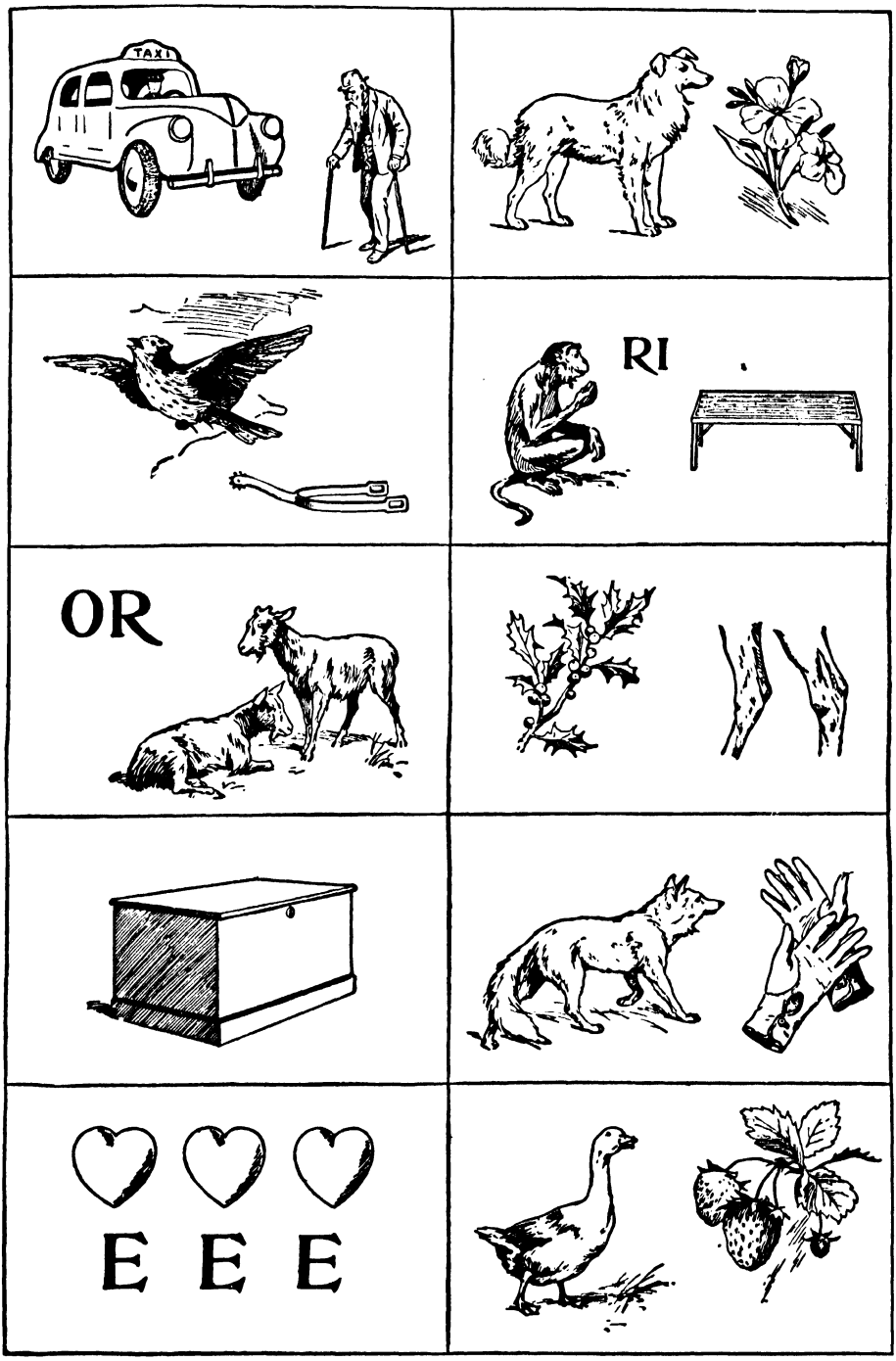
THIS experiment shows us the working of a well-known principle of physics. We take a narrow board about 2 feet long and set it upon a table, with 6 inches of board extending beyond the table. We now put a newspaper page on top of the board in such a way that one side of the newspaper will extend up to the very edge of the table. The rest of the paper will not only cover the board but will extend considerably beyond the edges of the board that are in contact with the table. We now smooth the paper down so that it will lie as flat as possible.

Clenching the hand, we bring it down sharply upon the projecting part of the board. No matter how hard we may strike, the board will not be knocked off the table. And yet, if we press gently upon the projecting end of the board, down it will go!

The experiment illustrates the fact that the air presses upon everything on the surface of the earth with a force equal to 15 pounds per square inch. When we put the paper over the board and make it lie flat on the table, there is very little air *under* the newspaper. The result is that the pressure of 15 pounds to the square inch is exerted almost wholly downward upon the upper surface of the newspaper and, of course, upon the part of the board that lies under the newspaper. The pressure upon the whole surface of the paper acts as a great weight holding the board down.

When we strike the projecting part of the board a sharp blow, the part under the newspaper is kept in place by this weight. Suppose now that, instead of hitting the projecting part of the board a hard blow, we press down slowly upon it. In so doing, we lift up the edges of the newspaper, the air rushes in under it, and soon the pressure of the air will be as great under the newspaper as upon it. Neither the newspaper nor the board will be held in place.

WHAT ARE THESE PLANTS?



Study these ten sets of pictures carefully. By putting together the names of the objects that you see in each set, you will have the names of ten American plants. You will find the correct solutions to these puzzle pictures on page 3506; the solutions are given in reversed (upside down) type.

A WORDY GAME

FOR this word contest you will have to insert an appropriate word in each group of sentences given below to replace *word,* written in italics. The same word is to be inserted throughout in each numbered group. For example, suppose that we had a group of sentences reading thus:

> We all like the *word* of this school. A *word* of corn is nourishing. If you give a horse his *word,* he may run away. Never strike anyone with the *word* of a hammer.

In this case the word to be inserted is *head.* See if you can find the correct words for the sentences that follow. The answers are given below in reversed type.

1) You can throw a *word* and shoot a *word.* Each foot has a *word.* You can go to a *word* game or to a *word.* Perhaps you would prefer to recite a *word*-ad.

2) Many a man *word*-s before he fights. A *word* on a dress is elegant. A *word* will take you places. Never interrupt a *word* of thought.

3) A mother told her little boy to keep to the *word* and he would always be *word.* When his bicycle fell over, he *word*-ed it, which was the *word* thing to do.

4) I used a *word* to *word* a poem. Then I went to see some *word*-guins in their *word.*

5) *Word*-y a sea-*word* has dared to *word* a boat. Wasn't that a *word*-ly thing to do?

6) When the sun is *word* over the *word*-lands, the cattle sometimes start to *word.* The *word*-ly farm hand then seeks his rest.

7) Dogs often *word,* but a *word* horse never *word*-s. Many a fine old house has a *word* window. Have you ever seen ships in the *word?*

8) It is all very well to *word* your grievances, but you should never put on *word*-s. The *word* is necessary for all, but *word*-waves bring only wretchedness for some people.

9) *Word*-es are useful to builders; but fallen *word*-es are to be avoided. Many a fair lass has her way because she smiles *word*-ly. *Word*-ives are places of refuge for many a wise man. But fat people should avoid st-*word*-es by all means.

10) You can *word* a person dead, but you won't hurt him. If you *word* him, however, he is likely to howl for mercy. A *word* of meat is a godsend to the hungry. If you take a *word* at a ball, you're likely to hit something.

11) A *word* often makes a man wealthy. We are apt to be sluggish after eating a good *word.* Many a game could not be played without a *word.* If you *word* in silks and satins, many a fine lady will visit you.

12) Many a bird shuns a *word.* When a man *word*-s something, good housewives gather near. Many, many years ago, *word*-ing was a favorite sport of the wealthy.

SOLUTIONS OF PUZZLE PICTURES ON PAGE 3505

On the preceding page we gave ten sets of puzzle pictures, each representing the name of a well-known plant. By putting together the names of the objects that are shown in the pictures, we get the following answers:

(1) cabbage; (2) cauliflower (collie plus flower); (3) larkspur; (4) apricot (ape plus *ri* plus cot); (5) orchids (*or* plus kids); (6) hollyhocks; (7) box; (8) foxgloves; (9) heartsease; (10) gooseberries.

ANSWERS TO PUZZLES ON THIS PAGE

Here are the answers to the wordy game puzzle that is given on this page. Insert each of these words in the appropriate sentence group: (1) ball; (2) train; (3) right; (4) pen; (5) man; (6) bow; (7) bay; (8) air; (9) arch; (10) cut; (11) deal; (12) hawk.

THE SELF-SUSPENDING WAND

THE magician's wand is one of his most valuable possessions. For one thing, as he moves it imposingly this way and that, he diverts the attention of the audience from maneuvers that might betray the secrets of his astonishing performances. But the wand can perform not a few miracles of its own, as we shall now see.

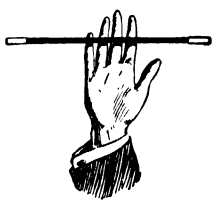
The magician begins his performance with the statement that he has the power of magnetizing anything with which he comes into contact. To give an illustration of his powers, he lays his wand upon the table and magnetizes it by drawing the finger-tips of the right hand lightly backward and forward along it. After doing this for a few moments he raises his hand. The wand comes with it, as shown in figure 1, as though it were indeed held up by some magnetic force. The magician waves the wand about, but to the astonishment of the onlookers the wand does not fall.

Tilting it to an upright position, as shown in figure 2, the magician removes the second and third fingers from the wand, leaving it in contact with the fore and little fingers only. He now transfers the wand to the left hand and shows that it will cling to the backs of his fingers, as in figure 3. After a minute or two he pretends to feel that the magnetic influence is getting weaker; soon the wand falls to the ground. The magician picks it up and offers it for examination, but the closest inspection fails to reveal anything that could account for the strange behavior of the wand.

To perform this trick the performer needs nothing more than a bit of black silk thread about 7 inches long. A loop is to be made at each of the ends; this loop must be of such a size as to slip easily over the wand. The length of the silk thread between the two loops should be about 4 inches; the exact length will depend upon the size of the performer's hand and can be determined only by experimenting with the wand.

To prepare the wand for use the loops are passed over it and drawn apart in such a way that the two loops will be equally distant from the centre of the wand. Under cover of the pretended magnetizing, the magician brings the two loops a little nearer together. This makes a space between the wand and the thread. The performer now works the fingers of the right hand under the thread, as shown in picture 4. Once he has done this, all the rest is easy. At the end of the performance the magician has only to draw the wand through the two loops; after that he allows the thread to drop on the floor.

At a distance of three or four feet the thread is quite invisible by artificial light, against the dark background of the wand. Of course the portion of the thread that encircles the performer's hand must always be kept turned away from the spectators. If they see the thread, the trick is revealed.



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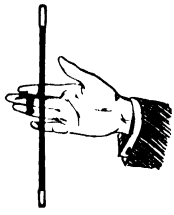

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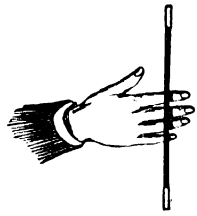

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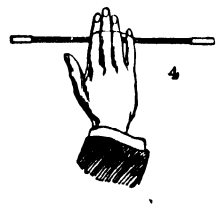


4.

WHAT CAN IT BE?

HERE is an entertaining sort of question bee that will enliven any party. You will note that only one of the four statements in each of the following sentences is correct. Can you choose the correct letter in each case? We give the answers in reversed type on the next page.

1) A *Nebula* is *a*) a bulbous plant; *b*) a vague statement; *c*) an arithmetical term; *d*) a collection of stars.

2) A *Mandrill* is *a*) a baboon; *b*) a carpenter's tool; c) a shaft or spindle; *d*) the upper or lower part of a bird's beak.

3) A *Cantilever* is *a*) a fruit; *b*) a sort of bridge; *c*) a tool; *d*) a vegetable.

4) The word *Pancreas* refers to *a*) a series of athletic contests; *b*) a gland; *c*) a movement to unite a certain group of nations; *d*) a rare disease.

5) *Veneer* is *a*) a legal term; *b*) an adjective meaning "pertaining to the veins"; *c*) a kind of paint; *d*) a thin layer, as of choice wood, upon a less costly surface.

6) An *Amphora* is *a*) an important part of a radio tube; *b*) a two-handled earthenware jar; *c*) a theater devoted to combats of gladiators and wild beasts; *d*) an animal living both on the earth and in the water.

7) A *Mastodon* is *a*) an extinct elephant; *b*) a disease of the ear; *c*) a large watch-dog; *d*) a large, stately tomb.

8) A *Cashew* is *a*) a close-fitting garment; *b*) a kind of nut; *c*) a woolen dress-fabric; *d*) an ostrich-like bird of Australia.

9) *Erosion* is *a*) rubbing out pencil or chalk marks; *b*) a bursting out; *c*) the wearing away of rocks; *d*) a disease.

10) A *Frieze* is *a*) a playful skipping about; *b*) a decorative feature; *c*) a violent fit of temper; *d*) a fresh-water stream.

11) A *Flying Fox* is *a*) a fruit bat; *b*) a fox trained for racing; *c*) a social error; *d*) the name applied to a swift racing vessel.

12) *Victoria Nyanza* is *a*) a famous woman scientist; *b*) an African colony; *c*) a soprano; *d*) a source of the Nile River.

13) *Inoculation* is *a*) the process of introducing disease germs in the body; *b*) the measurement of the eyes for glasses; *c*) the act of kissing; *d*) the act of listening to sounds produced in the chest.

14) A *Carnivore* is *a*) a period of gaiety; *b*) a merry-go-round; *c*) a flesh-eating animal; *d*) a horse-driven vehicle.

15) A *Mongoose* is *a*) an Indian animal; *b*) a male goose; *c*) a poisonous plant; *d*) an animal of mixed breed.

16) *Kapok* is the name of *a*) an Eskimo boat; *b*) a fiber; *c*) a fierce African tribe; *d*) a Mohammedan sect.

17) The word *Pleistocene* refers to *a*) a geological epoch; *b*) a plastic material; *c*) an expression of the popular will by the vote of the people; *d*) a group of stars.

18) *Bessemer* is *a*) a famous French musician; *b*) a district in northern Rumania; *c*) a process for making steel; *d*) a fortified city in Eastern France.

19) A *Toucan* is *a*) a bird; *b*) a Chinese magistrate; *c*) a small wig; *d*) a large nut.

20) A *Bovine* is *a*) a plant which climbs by means of tendrils; *b*) a rude man; *c*) an animal; *d*) a faultlessly dressed man.

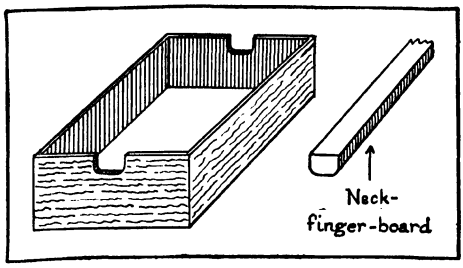
ANSWERS TO "WHAT CAN IT BE?" QUESTIONS

Here are the correct letters: 1) d; 2) a; 3) b; 4) b; 5) d; 6) b; 7) a; 8) b; 9) c; 10) b; 11) a; 12) d; 13) a; 14) c; 15) a; 16) c; 17) a; 18) c; 19) a; 20) c.

A VIOLIN FROM A CIGAR BOX

THE one-stringed instrument that we are going to describe in this article is very easy to play. If we have what is called a good ear for music; if we can hum, sing or whistle an air correctly after having heard it several times, we shall soon be able to play a one-stringed violin.

We shall make our violin out of a cigar box—the kind that holds fifty cigars and that has a paper hinge to hold the lid in position. First we must take off the paper stuck around the edges of the box. The best way to do this is to scrub it off with a hard nail brush that has been dipped in boiling water. We must not make the wood too wet or it may warp. The lid will now



1.

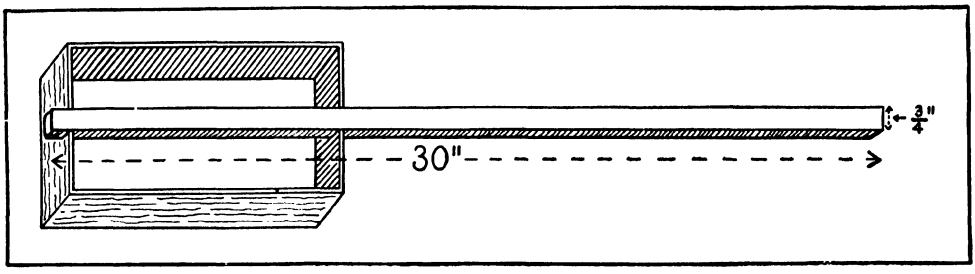
come off; it was only the paper that formed the hinge. On this lid we must draw with a pencil the two little figures, something like an *S* in shape, that are shown in figure 4. We can cut these shapes out with a fret-saw or with a chisel and hammer.

Now we must get a piece of hardwood, 30 inches long, ¾ of an inch wide and ½ of an inch thick. Either walnut or mahogany will do. A carpenter will be glad to cut a piece of wood to the above dimensions for a very small sum. We should ask him to plane away the sharp edges on one side and to leave the other edges square. We must round off the planed edges with sandpaper. Then, when we look at the end of the walnut or mahogany stick, we shall see that it is shaped like a *D*—round on one side and flat on the other, as shown in figure 1. This long piece of wood is called the neck of the violin. On a real violin a long piece of ebony, called the finger-board, is glued to the upper part of the neck, and the fingers slide up and down this finger-board. In our violin, however, the neck will also serve the purpose of a finger-board. To make this perfectly clear, we shall call it hereafter the neck-finger-board.

Next, with a sharp pen-knife, we must cut two notches at each end of the cigar box (see figure 1). The neck-finger-board is to fit in these notches, with the straight surface uppermost. The two notches, therefore, should have the same *D*-like shape as the cross-section of the neck-finger-board. Now we glue the wood into the notches, leaving about an inch projecting at one end (figure 2). Then we put a little glue all around the edges of the box and on the top of the neck-finger-board and we set the lid in place again. Finally we put in a few tiny brass screws around the edge of the lid.

We are now to make the bridge and the stop, which are shown in figure 3. The stop is to be glued close to the peg (at B in figure 4). We shall see later just how the bridge is to be adjusted. About an inch from the end of the neck-finger-board (A in figure 4) we make a hole about ⅓ inch in diameter and we fit into it a wooden violin peg. You can buy this peg at any musical supply store.

At the musical supply store we must also ask for a double-length violin A String, costing about a quarter. Be sure to get a double-length string, as a single-length string will be too short for our purpose. Finally we must provide ourselves with a violin bow. Bows range in price from a dollar or less to several hundred dollars. Naturally we shall want the lowest-priced bow that is available. You may be able to pick up a fairly good bow for very little money at a pawn shop or second-hand store.



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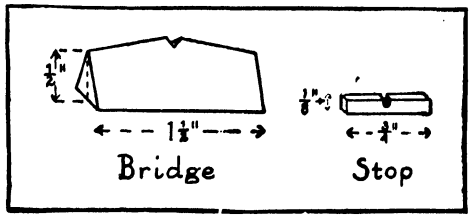
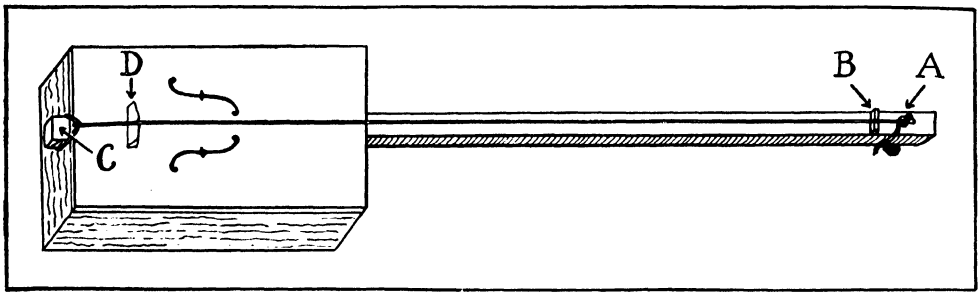
Our next task is to fit the violin string on our violin. Before doing this, we should round off the edges of the little piece of wood



3.

that projects from the bottom of the violin (C in figure 4). Use a sharp whittling knife for this purpose and finish the job with fine sandpaper. Apply sandpaper also to the surfaces of the box until they are quite smooth. Finally give all these surfaces a coat of varnish.

When the varnish is quite hard, we take the string and make a loop at one end large enough to slip over the projecting part of the neck-finger-board at the bottom of the violin (C in figure 4). Next, we set up the bridge in position (at D in figure 4) and we pass the string over it. Then, as shown in figure 4, we stretch the string to the other end of the neck. We now pass the string through the hole in the peg and we make the string tight by turning the peg. If the peg does not hold, rub a bit of violin rosin on the surfaces of the peg that come in contact with the neck-finger-board. The pressure of the string will hold the bridge in position; do not paste it down.



4.

To play on the one-stringed violin the performer must be seated; the violin is held in a vertical position with the box firmly gripped between the knees. The bow is drawn across the string over the *S*-shaped holes and at right angles to the string. The left hand clasps the neck of the violin, in such a manner that the four fingers are held in position over the string. The picture of the cello player that is shown on page 1289 will give you some idea of the manner in which the bow should be held; it also shows you the correct position of the left hand.

To produce different notes we press the string as firmly as we can with the second finger of the left hand at different places along the finger-board part of the neck-finger-board. The further away from the peg the string is pressed, the higher the resulting note will be. In a very short time you will learn to slide your finger up and down the string so as to get the exact notes required for the piece that you are playing.

HOW TO MAKE COCONUT CANDY

HERE is an easy recipe for making delicious coconut candy. We shall need the following ingredients: ½ cup shredded coconut, ½ cup milk, 1½ cups sugar, 2 teaspoons butter, ½ teaspoon vanilla.

First melt the butter in a saucepan, placed over a low flame. Then add the sugar and milk, stirring the mixture until the sugar is quite dissolved. Turn up the flame a trifle and boil the mixture, stirring constantly, until a small quantity of the syrup forms a soft ball when dropped in a glass of cold water. You will find that it will take about ten minutes or so of stirring for the syrup to acquire the proper thickness.

Now remove the saucepan from the fire and stir in the shredded coconut. When the mixture has become lukewarm, add the vanilla and beat until the mixture creams. A shallow tin, not more than eight inches square, is lined with wax paper, and the contents of the saucepan are poured into it. When the mixture is cold, take a sharp, broad-bladed knife and cut into squares.

Instead of using vanilla, you may flavor the candy with ½ teaspoonful of lemon or orange extract or with melted baking chocolate. The baking chocolate (a square will do) is added at the same time as the sugar.

THE NEXT THINGS TO MAKE AND TO DO ARE ON PAGE 3625.

Courtesy Metropolitan Museum of Art.
Unicorns, by Arthur B. Davies.

PAINTING IN THE UNITED STATES

ARTISTS OF THE LATER YEARS II

THE to-day of art is always slipping into the yesterday, or, to put it differently, "The modern of one day has become the back number of a later day." How then can the term "modern" as applied to art be defined? The Pre-Raphaelites were revolutionary moderns in the middle of the nineteenth century; Impressionism was a radical modern movement, twenty-five years later. Some of Turner's "incoherent fantasies of light" amazed his generation. Now it is the turn of our "modernists," of the early twentieth century, to challenge accepted standards and thrust aside traditional ideas.

At the opening of the century no influence later than Impressionism had affected the older ideals of American painting. In museums, private collections, and exhibition galleries are many delightful landscapes akin in tone and feeling to those of Inness, Wyant, Homer Martin, and others in the group of which Inness was the leading inspiration and in which there lives something of the spirit and technique of the French painters of Barbizon. Henry W. Ranger (1858–1916) painted scenes of wooded land, decorative in pattern and the treatment of light, and touched with quiet emotionalism. Some others of the many through whom the American scene has come to life in a personal and romantic way are Howard Russell Butler, Edward Gay, Charles Melville Dewey, Henry Golden Dearth, Charles G. Curran, and Paul Louis Dessar. The vision of the romanticist is marked in the landscapes and symbolical and religious compositions of Elliott Daingerfield (1859–1932), who was also a fine draftsman; and in a quite different and distinctive way in the canvases of Ballard Williams, where ladies in rich costumes reminding us of Watteau are grouped in highly decorative scenes, with jewel-like effects of light and color.

Closer acquaintance with Impressionism brought into American painting a tendency toward a new technique. Idealism and the charm of romance strongly characterize the work of the landscapists of the transition stage. Among them are several widely known for their representations of New England: Ben Foster (1852–1926), who chiefly pictured nature in a tranquil mood; Charles H. Davis (1856–1933), noted above all for the enchantment of the skies and cloud-masses that he depicted; Bruce Crane, whose autumn and winter landscapes have a decora-

tive quality and suggest the rhythms and harmonies of music; and Chauncey F. Ryder, who presents with vigor in an altogether individual way open stretches of country. Another painter of the New England scene was Charlotte Coman (1833–1927), whose work shows fine atmospheric effects.

THE BEGINNING OF IMPRESSIONISM IN THE UNITED STATES

Impressionism proper in the United States owns as its pioneer Theodore Robinson (1852–1895), who had worked with Monet in France. He, as well as most of the other American Impressionists, while following the principles of the movement, made modifications of the methods and manner of the French. The new handling of light and vibrant color was most successfully adopted by Twachtman, Weir, Metcalf, and others, of whom we have spoken.

The individual applications of Impressionism results in varying styles. Maurice Prendergast (1862–1924) created his own holiday world of gay life and movement, revealed in clear and glowing color in a pattern of human figures used as a part of a decorative design, often including, besides, horses and carriages, dogs, umbrellas, sailboats, etc. Details have no value except as essential items of the complete whole. These lively scenes sometimes give the effect of stained glass, sometimes of tapestry. Daniel Garber is another who works color into patterns for decoration.

SOME OF THE ADOPTERS OF THE NEW MANNER

Ernest Lawson in his scenes along the Hudson and the Harlem Rivers, or in his more intimate and informal views of swimming hole or chicken yard, conveys the impression of a happy, human world to which trees, houses and water contribute their part. His Vanishing Mist is counted among great American landscapes. William J. Glackens, a painter given to experiment and adventure in his art, emerged from an early "dark" period into a later manner, where the luminous color of Renoir fitted his need. He takes pleasure in the unending movement of nature.

Jonas Lie, born in Norway, has worked out his own effective way of painting reflected light and the rippling, shimmering, restless appearance of water in motion. Sails of boats often form part of the design. On a more heroic theme than his other work is a series of paintings (now in the Military Academy at West Point), in which he has recorded every phase in the construction of the Panama Canal. Another painter whose adaptation of Impressionistic method is entirely personal is John E. Costigan. His figures in landscape are often touched with sunlight splashing down through the foliage of trees.

PAINTERS OF LANDSCAPES IN THE WINTER SEASON

Landscape in winter is a theme that offers new possibilities since the introduction of Impressionism. The later method works out more satisfactorily than the older practices. A number of painters in America have won distinction in this field. Leading the way is Birge Harrison (1854–1929). He studied in Paris, spent a time in Brittany painting, then sought subjects in various parts of the world—California, the South Seas, New York streets in winter, the St. Lawrence. Later he became noted for his teaching at Woodstock, New York, and for the snow scenes he painted there, especially in moonlight.

One of the most original and individual American painters, Edward W. Redfield, reveals the very quality of the snow and thereby indicates truthfully the state of atmosphere and temperature in his realistic presentation of the country along the Delaware River. In his work, beauty of design has an important place, as it does in an eminent degree in the winter scenes and other landscapes of George Gardner Symons. Elmer Schofield often chooses the last traces of departing winter to set the mood and furnish the pattern of his pictures. There is poetic feeling in the highly-keyed landscapes of Leonard Ochtmann, and subtle play of color in the glimpses of New England caught in the canvases of Walter L. Palmer (1854–1932). John F. Carlson pictures the beauty of forest trees in the season of snow and ice.

THE MANY PAINTERS OF THE SEA

In the painting of the open sea America has attained unique distinction. Winslow Homer holds first place among our marine painters; but several others have gained great skill in reproducing the form and movement of waves, the dash and spray upon rocks. As colorists some of them surpass Homer. Frederick Judd

A GROUP OF FIGURE PAINTERS

The Spielers, by George Luks.

Polly, by Eugene Speicher.

Interior — Evening — by John Johansen.

Interior, and Polly, courtesy Metropolitan Museum of Art.
The Spielers, reprinted by permission of the Addison Gallery of American Art, Phillips Academy, Andover, Mass.

Waugh presents many aspects and moods of ocean, conveying the feeling of remoteness and power. Charles Herbert Woodbury, also, excels in painting the open sea; and he is noted for his pictures of the Maine coast. Paul Dougherty, another distinguished marine painter, is well known for his landscapes, besides. There is extraordinary delicacy of coloring in the poetic marine canvases of Emil Carlsen (1853–1931), who was born in Copenhagen. He also holds high rank as a painter of still life. In the latter field his son, Dines Carlsen, follows him.

The coast scenes and landscapes of Hobart Nichols are poetic in quality. John Noble's sea-coast paintings are impressive in their simplicity and dramatic feeling. Haley Lever, Australian by birth, paints in an original Impressionistic style the shore of Gloucester, Massachusetts. Other notable compositions of his present the Cornish coast of England.

TAOS AND THE DISCOVERY OF THE INDIAN

New York, Philadelphia, Boston—the larger cities—are no longer the only important centres of art production and influence. From the shores of Maine to the California coast active groups are making enviable records. Conspicuous among these centres is Taos, New Mexico. The basic theme is the life of the American Indian. E. Irving Couse, whose Indian studies we noted earlier, opened up the possibilities of Taos. His decorative works present the Indian in a poetic aspect. Among the foremost of those linked with the place and its accomplishment is Ernest L. Blumenschein. In his portrayal of the Indian there are dignity and stateliness, a suggestion of the myth and tradition of the race. His canvases have richness of color and value as decoration.

Walter Ufer (1876-1936) found at Taos a world suited to his genius; and his paintings are distinctly representative. He worked out his varying patterns, brilliant in coloring and often daring in the use of contrast. The Taos group includes some of the younger painters who are becoming favorably known. There is a striking contrast between these studio paintings of Indians, and the dashing pictures of their life on the open plains, drawn and painted by Frederick Remington (1861–1909) forty years ago.

The American deserts, with lofty skies and brilliant atmospheric effects, have been painted by Albert L. Groll, who has devoted his skill to this field.

In portraiture and figure painting many since the time of Whistler and Sargent have achieved excellence and charm. A number of artists have painted ably in both these allied fields. Some have been already reviewed. To those must be added the names at least of the following, pre-eminently portrait-painters: Wayman Adams, Douglas Volk, Irving R. Wiles, Charles Hopkinson, Ernest Ipsen, Louis Betts, John C. Johansen, Ellen Emmett Rand, Ivan Olinski, and Leopold Seyffert; and among figure painters: Max Bohm (1868–1923), Robert Vonnoh, Sargent Kendall and Philip L. Hale (1865–1931).

SOME OF THE IMPORTANT INNOVATERS

Before the century began, there had already been a turn away from presenting the soft side of life and a tendency towards the portrayal of harsher, hardier, more commonplace aspects, led by Henri, Bellows and their associates. Of these George Luks (1867–1933), strongly individual, drew and painted with quick, bold strokes, records of momentary experiences—bits of human drama, humorous or touching, that had caught his interest. Children dancing in the streets, old women, ruddy-faced old cabmen lived on as he had seen them. John Sloan, realist and to a certain extent satirist, gives a pictorial treatment to his comment on the life about him in the city. The tone of the comment is less kindly when the subjects are of the fashionable world than when they are humbler fellowmen and women. Sloan's draftsmanship is fine, and he is an etcher of eminent ability. In his later paintings he has experimented in a new style. Another distinguished draftsman, well known as etcher, lithographer and illustrator, and noted for the finish and versatility of his technique, is Albert Sterner. He has made a reputation for the painting of portraits, still life, and figures, as well as landscapes.

ARTHUR B. DAVIES, THE PROPHET OF MODERNISM

While Arthur B. Davies was a dreamer of dreams, revealing in his painted scenes glimpses of other worlds, he was also sympathetically in touch with his own world; and, with Henri and other progressive leaders, encouraged the new spirit of interest and investigation. He made some experiments in the new media and

TWO PAINTERS WHO SEEK TRUTH

Tables for Ladies, by Edward Hopper.

Still Life, by Henry Lee McFee.

Both pictures, courtesy Metropolitan Museum of Art.

is looked upon as the first who made a direct advance toward modernism in America.

The influence of Cézanne and the later Europeans has had its effect on all American painting of recent years. But while Americans watch the experiments and borrow when they see fit, they continue to find out things for themselves. This is true of Eugene Speicher, who paints figures and portraits giving the impression of thought and moral quality. His subjects are frequently young girls, but landscapes and flower arrangements are included in his range. Rockwell Kent, independent by nature, marks out new paths and explores new methods, even adventures to far lands and paints solitary scenes of quiet grandeur, striking in design and with fine balance of spaces.

Edward Hopper deals with the subjects he chooses, whether lighthouses, engines, or human episodes, with the sternest simplicity, finding no place for anything that serves merely for adornment. There is severe truthfulness in all his work. Leon Kroll shows an original treatment of compositions with figures, usually in homelike settings. Another individualist whose realism is direct, sincere and vital is Henry E. Schnakenberg. He paints landscapes, figures, still life and portraits.

Cities and their life are variously seen by different artists. Glenn O. Coleman (1887–1932), through his steady observation, added generously to the pictorial history of New York. Gifford Beal, a painter of sparkling landscapes in watercolor, also gives vigorous, original impressions of the life of the city, full of movement and color. Reginald Marsh, influenced by Sloan, presents crowded corners of the city and its recreation resorts with devotion to the truth and detail. Charles Burchfield finds food for satire in the life of smaller towns. There is a strong personal note in the terse realism of Guy Pène Du Bois in his painting of the everyday scenes he chooses. The scenes may be cheerful or have a suggestion of ugliness. George Overbury ("Pop") Hart (1868–1933) ranged far and wide, recording, with a realistic and often gaily grotesque accent, the habits of humanity.

THE FAMOUS ARMORY SHOW OF 1913

A group called the "Eight," Henri, Davies, Prendergast, Glackens, Lawson, Sloan, and Everett Shinn, worked together from 1908 to show their conviction that painting was closely related to life. It was Davies who directed the Armory Show of 1913, now counted as a milestone in American art history. This was the first comprehensive International Exhibition of Modern Art to be held in the country. In the collection there were examples of the latest tendencies in art in America and Europe. It included Cubism, Futurism, and other attempts at finding self-expression in almost any way except the representation of recognizable forms (Post-Impressionism is Roger Fry's term to cover them all.) To many minds the Nude Descending a Staircase by Marcel Du Champ, a bit of French Cubism given wide publicity, became representative of all that was "modern" in art.

Rebelling young artists of America had already been busy with the problems of this "new gospel." Their chief instigator and champion was Alfred Stieglitz, who preached the value of art as a human activity rather than a luxury. He opened the first gallery in New York for exhibiting the latest phases of art expression, and he was really responsible for the Armory Show.

WHAT ARE THE MODERNS STRIVING FOR?

Personal expression of the inner emotions and being is the avowed object of the young modern. The quest for self-expression naturally finds widely varying answers. Some seek it in abstractions. Other answers are formal arrangements of planes or lines. Machinery, railways, chimneys, all the objects that are a part of life to-day take their place as material. Still life is a field where experiment finds large scope.

The group of young artists working in America, after study in France, who were represented at the Armory included Bernard Karfiol, Samuel Halpert, John Marin, Thomas Benton, Max Weber, and William Zorach. Karfiol, who is able to give a feeling of the monumental even in a canvas not large in size, is at his best in figure compositions, but has also made good arrangements of the Maine coast. Halpert uses formal arrangement authoritatively. Marin has a technical mastery of water color. His coloring is rich and beautiful and is used with poetic insight. Benton, with subjects drawn from contemporary life, has created a style in mural painting characteristically Ameri-

LANDSCAPES IN THE MODERN MANNER

Hills, by Bernard Karfiol.

His Wealth, by Walter Ufer.

Both pictures, courtesy Metropolitan Museum of Art.

can, giving interwoven scenes of action. He is an able draftsman. Max Weber, Russian by birth, employs color with subtlety and daring. He has painted still life, landscapes and religious compositions. Zorach, a sculptor, also paints, using water color in an individual manner.

AN INTERESTING GROUP OF LIVING ARTISTS

Maurice Sterne, also born in Russia, is etcher and sculptor as well as painter. Learned in the history of art, he takes the old masters as a basis for artistic thought. Walt Kuhn, painting principally a world of clowns and show-girls,

Courtesy, Museum of Modern Art.
Cow's Skull and Roses, by Georgia O'Keeffe.

which give proof of the keenness of his observation, works in a highly simplified manner, but his pictures have great emphasis and convey personality. In the style of Alexander Brook, personality is included to a great degree, and delight in his work is evident. Ernest Fiene is concerned with the romance of the actual. Henry Lee McFee is first of all intellectual, though the emotional element is not suppressed. His power of perception gives his work great faithfulness to the facts of vision.

Painters who put such emphasis upon structure that they achieve a realism of great austerity in their interpretation of the American scene are Charles Demuth and Charles Sheeler. Demuth as a student in Paris was captivated by the sweeping rhythms, the shapes of cubes and cones and cylinders in the style of painting then current in France. But he learned to use them as aids to expression instead of as ends in themselves. His handling of form and color is sure and sensitive. By means of them he creates formal patterns of great elegance. In water color he is a master worker. Sheeler, representative of the age of machinery, keeps for his interpretations only such elements as are needed for design, making a precise arrangement of spaces. Preston Dickinson (1891–1930) shows the influence of Cézanne and of Japanese art in the organization of his still life and landscape. In exact sense of color, in the comprehension of form and in the use of spacing he has few equals.

SPACE FORBIDS THE MENTION OF MANY

Georgia O'Keeffe has developed an art of her very own which sets her apart almost as a discoverer. When working at Taos, from her view of sand dunes and forest trees she was able to pass on the impression of vast height and pervasive luminosity. In her flower paintings she has produced what may be called the "immortalization of flowers by their expansion into a formal blooming of pure design." Peter Blume has remarkable skill in the handling of surfaces and unusual inventive originality.

With sincere regret we acknowledge the omission of many a painter who is making a constructive contribution to art in the United States, an art going forward into an era when new possibilities may always be found in the large and varied store of material to be explored.

We may, and we should, among the treasures of art, choose the things that are most to our taste. But let us take pains to keep our taste fine, and let us make a sincere and intelligent attempt to find in each work the artist's own purpose and feeling.

"An artist's style may be intimate or commanding, he may deal in broad brushstrokes or effects of miniature; the first and last requisite is that he do a beautiful thing and reveal himself in doing it."

THE NEXT STORY OF THE FINE ARTS IS ON PAGE 3699.

Canadian Pacific Railway

Bringing in the harvest of hay.

THE GREAT GRASS FAMILY

THE grasses are the most important of all the plants that grow. It is doubtful if civilization could exist, or if the great variety of higher animal life found in the world to-day could have been produced without them.

Directly or indirectly, grasses form the chief food of mankind, and of the cattle, sheep and horses on which we depend for so many of the necessaries and comforts of life. A large part of the animal world to-day is made up of grass-eaters, and the carnivorous creatures live on the grass-eaters. The statement of the prophet Isaiah, "All flesh is grass," is almost literally true.

We have already seen that the great cereals—wheat, oats, barley, rye, maize, rice, millet and sorghum—are cultivated grasses. We have also seen that various other grasses are grown as forage plants. We know also that the sugar-cane, one of the most important plants outside the cereals, is a grass. It is a good thing for the world that grasses grow so freely, and that they respond to the efforts of man to improve them.

Many people who know nothing of botany seem to think that the grasses form a separate class of plants like the mosses or the ferns, but this is not so; they are simply one of the numerous families of flowering plants that produce stems, leaves, flowers and seeds like the Buttercup Family or the Rose Family. The grasses form a big family, for there are between three and four thousand different species. Eight hundred or more are found in North America. Many European grasses have been introduced by accident, or intentionally.

The idea that all grasses are more or less alike is a mistaken one, for these plants are as varied in size and form and habit as the members of any other family of flowering plants.

They are wonderfully adapted to the different soils, climates and conditions in which they grow. To the casual observer our grasses look more or less alike, but when we go abroad we find some very remarkable members of the family. In India and China, for example, the great bamboos, which are grasses, reach a height of a hundred feet, and some have a stem like the trunk of a small tree, over four feet around. On some the outside covering is so hard that when the stem is struck with an ax sparks of fire are seen to fly from it as though it were a piece of flint.

Some of the many uses to which the bamboo is put in the East are mentioned elsewhere, and there are numerous others. From the pith of some bamboos a

sugary substance is extracted which is used for sweetening, and the seeds of other species are used in the same way as rice. From them, also, is prepared a fermented beverage, and the young shoots are eaten.

Bamboos, though generally very tall and big plants, are of exceedingly rapid growth, which adds to their value. They flourish on the mountains to a height of two miles or more above sea-level, and their graceful, drooping, feathery tops give them a very beautiful appearance.

THE CLIMBING GRASS THAT BLOCKS THE TRAVELER'S WAY IN CHILE

How different from the bamboo is another grass found growing in Chile. This is a climbing species, and winds round and round the tall trees, hanging down from the branches in graceful festoons. It is so tangled that the traveler can hew his way through it at only a very slow rate. To travel a mile where this climbing grass abounds would take two days. Even bamboos are sometimes almost impassable, and travelers who have climbed Mount Ruwenzori, in Uganda, tell us that it takes nearly a day to pass through a comparatively narrow zone of bamboos.

Still another kind of grass, very different from the restful and useful pasture grasses, is found in various parts of the world. There are several species, and they have long, spiny points on their fruits, with a number of short, stiff hairs which enable them to make their way into the ground and keep a place there ready for germinating. As the wind blows the seed and twists it round and round, the hairs entangle themselves among the other plants, and enable the seed to get a hold from which it cannot be dislodged; the twisting works the point into the soil in the same way as twisting will work a gimlet into wood.

GRASSES AS AGENTS OF CIVILIZATION AND FRIENDS OF MAN

When these seeds fall on the back of a sheep they become entangled in the wool, so that the sheep cannot rid itself of them. Sometimes the seed is gradually driven through the animal's skin, making a nasty wound that often causes death. There are a number of grasses growing in Russia, Australia and North America that cause the death of sheep in this way. The grasses that give life to sheep in some parts of the world have, therefore, very dangerous relatives that destroy them in other parts.

As a rule, however, the grasses are the true friends of man; and they have been great agents in the spread of civilization. They have enabled man to grow large quantities of food for the support of great populations such as are found in big cities and towns, and they provide pastures for his flocks and herds.

Grasses, like other plants, have a constant fight for existence, and structure and habits have no doubt been modified through the ages as they adapted themselves to circumstances. Perhaps the outstanding feature of a grass plant is the extreme narrowness of the stem and leaves compared with the height to which it grows.

Generally a factory chimney sixty feet high has a base some six feet in diameter, but the stem of a grass—the rye for example—though 1,500 millimetres high, is only three millimetres in diameter at the base. In other words, man in building a chimney can make the height only about ten times the base's diameter. We fall far short of the rye plant which can set up a structure five hundred times the height of its diameter. This is really a very marvelous achievement, and means that if man could rival nature, a chimney with a base five feet in diameter could be built to a height of half a mile.

WHY THE GRASS IS ABLE TO STAND UP STIFF AND STRAIGHT

A stem of grass is a wonderful structure. It is hollow in most species, though Indian corn and sugar-cane are exceptions in having solid stems. A considerable amount of silica gives the stem a stiff and wiry character which enables it to stand upright. The rain may beat it down temporarily, but as soon as the sun shines and the weather becomes dry once more, the stem often jumps up as erect as ever. Grass leaves are usually long and narrow with no stalk, but with a long sheath which is rolled round the stem. One edge overlaps the other, and is split down on the side opposite to that on which the blade is found.

The flowers occur in spikelets, or ears, and are arranged sometimes in the form of spikes, sometimes as racemes, or clusters, with the flowers attached by short equal stalks at equal distances along the central stem, and sometimes in panicles—that is, with a loose, irregular arrange-

THE GLORY OF THE GRASS

Here our artist shows us a spike of meadow fox-tail grass as we see it with the naked eye and the flower as it looks through a magnifying lens. A glume, or husk, is shown on the point of opening, and we see the feathery stigmas (female parts), and the anthers (the parts of the male organ called the stamens, which bear the pollen).

ORCHARD GRASS

RYE GRASS

OAT GRASS

UPRIGHT BROME GRASS

WALL BARLEY

QUAKING GRASS

The Grass Family exceeds all other plant families in the number of its individual plants, and in its wide distribution over the earth. Grasses range from the Equator to Spitzbergen in the North and to the extreme tip of South America in the South. Nine out of every ten plants in the world are grasses.

TIMOTHY GRASS

MANNA GRASS

BEARDED DARNEL

TUFTED AIRA

CANARY GRASS

REED GRASS

Grasses are mostly fertilized by the wind, and in order that their pollen may be easily shaken off to be carried from plant to plant, the anthers which bear it are suspended on the most delicate filaments. The slightest breeze sets them in motion and a field of grass, or a prairie, is like the sea: it is never still.

THE COMMON REED AND PART OF ITS MANY-FLOWERED HEAD, GREATLY MAGNIFIED

A SPIKE OF COUCH WHEAT GRASS ON THE RIGHT AND THE FLOWERS MAGNIFIED ON THE LEFT

As all these pictures show, the flowers of the grasses are alike in two things, their pollen-bearing anthers are suspended on very fine supports which can be moved by the slightest wind, and their stigmas have a feather-like form, so that they may easily catch the pollen as it falls upon them.

ment like that of oats. The fruits, or grain, are filled with the seed, their coats adhering to one another; and the embryo, from which the new plant grows, lies to one side at the base of a mass of starchy endosperm, on which the young plant can feed as it develops. The character of a grass seed can be studied in a grain of wheat, and the flowers of grass are well illustrated.

The flowers of grasses are rather difficult to examine, but by means of a powerful lens they may be seen in all their detail, and are very beautiful. When walking through a meadow we scarcely notice the colors of the grass flowers, but if we examine them closely we find they consist of a mass of delicate shades of greenish blue, purple, brown and pink. Most grasses are wind-pollinated, but some, like sweet vernal grass, have been seen to be visited by flies. Grasses have three ways of multiplying—by seeds, by underground stems, or rootstocks, and by stolons, or stems, which grow along the surface.

Where land is left untended grass almost always appears. This is largely due to the fact that the young plants are so well protected. After the plant has germinated, the leaf tip projects above the earth and the plant remains in that position for a long time. The stem and ear stay underground, inclosed in a series of cylindrical sheaths which are peculiarly adapted for their duties. They are very hard and tough, and protect the young plant not only from insects and drought, but, being bad conductors of heat, they protect the plant from sudden changes in temperature. When the grass begins to grow it springs up very much as if a telescope were being opened out. Meanwhile the root is fixing itself with root-hairs in the soil, gathering nourishment, and storing this up in the bud. New buds appear within the leaf-sheaths, and in a suitable soil many stems spring from one seed, and a tussock of grass results.

Wood Melic. | Annual Meadowgrass. | Meadow Barley. | Brown Bent Grass. | Smooth Meadowgrass. | Sheep's Fescue Grass.

The leaves of grasses are wonderfully adapted to the conditions of the place where they grow. In Siberia and Argentina, for instance, they contain alternate strips, or ridges, of hard cells and of delicate cells in grooves. In dry, hot weather the delicate cells collapse and the leaf is wrapped round into a kind of cylinder, hard and uninviting to the animal that might otherwise devour it. This rolling-up of grass leaves is a very familiar feature of the plants, even in our fields, and the action is due to the presence of special cells, called motor-cells, on the upper side of the leaf.

When the air is dry and the cells are losing water rapidly they contract and draw together the adjacent parts of the leaf. Sometimes, as in meadow grass, there are two rows of motor-cells, one on each side of the midrib, and the leaf simply folds over by their contraction; but, in most cases, the leaf does not merely fold over once, but rolls up into a tube.

The average grass plant gives out its own weight of water in twenty-four hours in hot, dry weather; and it has been found that a square foot of turf will yield more than one and a fifth pints of water in that time. Long pasture grass, however, gives off much more—over four pints to the square foot, or about 106 tons to the acre.

How grass produces millions of seeds and fights for its life

The seeds of grasses vary very much in size. In wood meadow grass, for example, there are 2,330,000 seeds to the pound, in sheep's fescue 1,560,000, and in golden oat grass 1,400,000. On the other hand, tall oat grass has only 140,000 seeds to the pound, perennial rye grass 220,000, and meadow fescue 240,000. The amount of hay that different grasses produce also varies considerably. Cocksfoot grass has yielded 28,000 pounds per acre on a rich sandy loam, which when dried became 12,000 pounds. Timothy grass has given 40,000 pounds, decreasing to 17,000 when dried. On the other hand, perennial rye grass gave only 7,800 pounds an acre, or, when dry, 3,400 pounds.

In the fight for life grasses rapidly overcome other plants, as we can see on neglected garden paths and disused roadways. Various plants, like dandelions and buttercups, appear first, but in course of time grass will cover the whole area. The shafts of grass, by reason of their pointed and narrow shape and their hard texture, are able to fight their way up through any soil. Nature dislikes bare ground and wherever possible covers it with grass.

Why we should appreciate the grass that gives us cheap food

We ought to understand the part of grasses in providing us with food. Were it not for the grass pastures we should certainly have to pay very much more for our meat, milk and wool. They can be produced from pasturage more cheaply than from any other form of food. Grass dried in the sun and wind is hay, and this provides a nourishing winter food for animals; but if the grass, after being cut, lies too long exposed to sun and wind, the food value, fragrance and color are all diminished. The fragrance is important, as it makes the fodder palatable to the animals for whom it is intended. Grass to be used as hay should be cut in full vigor and bloom before any woody fibre or seed has developed. Rain falling on the cut grass does harm, as it washes out some of the soluble parts such as sugar, gum and albumin; if it lies wet for long, fermentation sets up and the sugary matter is turned into alcohol.

From the earliest times grass has been the basis of live-stock production, but it has been more than a useful friend to man: it has clothed the earth with beauty, it has softened the ravages of tempest, and earthquake, and war, and has been a symbol of peace and quiet restfulness. A famous writer has well said: "Grass is the forgiveness of Nature—her constant benediction. Fields trampled with battle, saturated with blood, torn with the ruts of cannon, grow green again with grass, and carnage is forgotten. Streets abandoned by traffic become grass-grown like rural lanes, and are obliterated. Forests decay, harvests perish, flowers vanish, but grass is immortal."

The sedge that was used as paper in ancient Egypt

In the order to which the grasses belong there are two families. One of them is the grasses themselves and the other the sedges. Sedges are very much like grasses in appearance, but the two families may be distinguished by their stems. The grasses have stems that are round or flattened in section, while the stems of the sedges are three-cornered, or triangular. Further, the stems of sedges are usually neither swollen at the nodes where the leaves grow out, nor hollow like the grass stems. The sheaths of the grasses, too, are open, and, while gripping the stem, can be unfolded without fracture, while in sedges the edges are fastened so that the whole forms a complete tube.

Two or three thousand species of sedges are known. The papyrus of Egypt, which used to be prepared for manuscripts, is a sedge. Sedges are of little use, as only a few provide poor pasture.

THE NEXT STORY OF PLANT LIFE IS ON PAGE 3647.

The Canadian-built air base at Goose Bay in Labrador served as a mighty link in the wartime bomber route to England. Below, a Canadian soldier guards American Fly ıg Fortresses on their way to the skıes over Europe.

National Film Board of Canada

CANADA'S AVIATION

THE first aircraft to fly in Canada was a flimsy crate of bamboo and silk that skimmed half a mile above the ice at a speed of forty miles an hour, at Baddeck, Nova Scotia, on February 23, 1909. The craft was piloted by John A. D. McCurdy; and with that flight Canadian aviation was born. Progress, however, was slow for some years.

Interest in flying developed tremendously in the first World War. Almost 20,000 Canadians enlisted in the Royal Flying Corps, the Royal Naval Air Service and their successor, the Royal Air Force. More than 800 of these men were decorated or mentioned in dispatches. Majors W. G. Barker and W. A. Bishop, and Second Lieutenant A. A. McLeod won the Victoria Cross. Toward the end of the war two Canadian squadrons were being organized in the Royal Air Force, and a Royal Canadian Naval Air Service was created to combat German submarines in the western Atlantic. However, the armistice of November, 1918, was signed before the pilots had finished training for these Canadian military aviation services.

In 1920 a Canadian Air Force was formed as a part-time militia. It became the Royal Canadian Air Force in 1923 and was made a permanent force in 1924. Its work in the years of peace was to make photographic and map surveys in the far north, to provide forest-fire patrols, to protect fisheries and prevent smuggling, and so on.

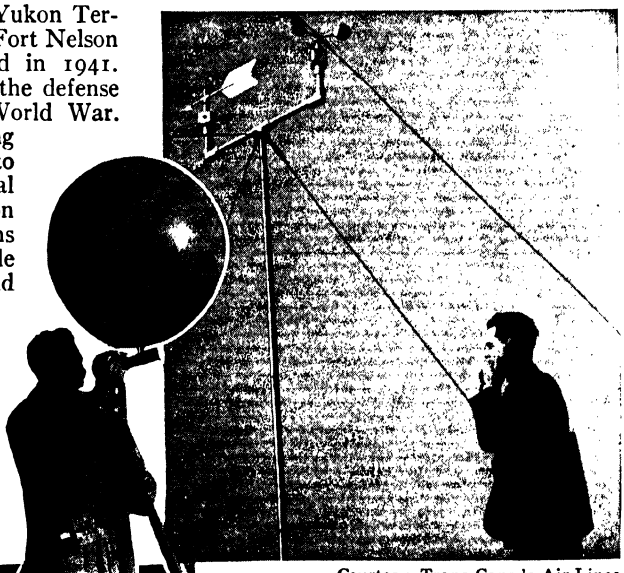
Many pilots of the first World War became pilots of commercial planes. These men ("bush pilots") helped to develop new mining areas in the north, carrying, in a few hours, machinery, cattle, food and supplies that by canoe and dog-trains would have taken weeks or months to reach their destination. Millions of tons of freight were carried in this way every year, and Canada held first place for freight transport by air. Together the Royal Canadian Air Force and the "bush pilots" did more in a few years to open up the north than had been accomplished in the three hundred years that had gone before.

In 1928 the Dominion Government authorized a survey for a transcontinental air-

way. All the principal cities already had, or were constructing, their own airports; but to connect these cities a chain of intermediate landing fields was required. Lighting for night flying, beacons, radio and weather services were also needed. As a result of the survey new airfields were carved out, longer and better runways were constructed and a radio-range system was set up. A weather service was created, not merely to forecast the weather but also to keep pilots abreast of conditions as they flew along the air routes. In 1937 an act of Parliament created the Trans-Canada Air Lines which, early in the following year, began regular services with fast Lockheeds on the route west of Montreal. By 1941 regular routes were extended to Halifax and, in 1942, to St. John's, Newfoundland. Passengers and freight were also carried to Edmonton and later to New York. A route from Edmonton to Whitehorse, Yukon Territory, by way of Fort St. John, Fort Nelson and Lower Post, was completed in 1941. This proved to be important in the defense of Alaska during the second World War.

In 1939 the emphasis in flying shifted from the arts of peace to the hazards of war. The Royal Canadian Air Force was placed on active service. Fighter squadrons were assigned to ward off possible air attack from the east; and bomber-reconnaissance aircraft escorted Atlantic convoys in and out of Canadian ports. In the west, after Pearl Harbor, Canadian units worked with the Americans to hold off the Japanese threat to Alaska and to drive out the Japanese who had landed in the Aleutian Islands. The Royal Canadian Air Force was greatly expanded.

In addition, the Canadian Government undertook with Great Britain and the governments of Australia and New Zealand to train in Canada thousands of pilots, navigators, bomb-aimers, wireless operators, flight engineers and air gunners. This was called the British Commonwealth Air Training Plan. It was a tremendous undertaking. New airports had to be constructed and equipped, radio-range stations had to be set up, highway connections had to be made and telephones and teletype installed. By the end of March, 1945, there were 131,533 graduates of the British Commonwealth Air Training Plan.



Courtesy, Trans-Canada Air Lines

Above—This combined anemometer and wind vane gives a direct reading of wind speed and wind direction to a radio operator indoors. He can then send the information to planes. Here an operator speaks to an unseen plane by remote control.

Right—A weather balloon is about to be released. The information it will help the weatherman to gather is valuable to all pilots.

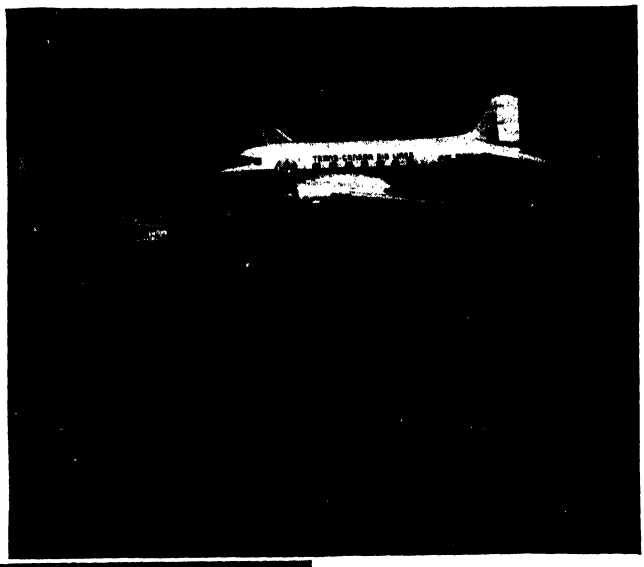
Courtesy, Trans-Canada Air Lines

Left—The weather balloon's progress will tell an important story of the winds in the upper air. Here, an observer watches a balloon rise. He is looking through an instrument called a theodolite, something like a surveyor's transit, or a telescope.

An Air Cadet Corps made up of some 380 squadrons was organized in 1941, and in the same year a Women's Division was formed, which grew to 17,000 members, many of whom served overseas. The Air Cadet Corps gave useful training to cadets who might later enlist in the Royal Canadian Air Force.

Deeds of valor were not unknown in the Western Hemisphere. Leading Air Craftsman K. M. Gravell suffered serious injuries and burns from which he later died when he and his pilot crashed. He made a desperate effort to rescue his companion and for his heroism was awarded the George Cross. Another student, Leading Air Craftsman K. G. Spooner, sacrificed his life to permit other members of the crew to bail out when their aircraft was out of control. He, too, was awarded the George Cross. There were many others whose names are recorded, and there were many whose names are unknown.

In Europe the first member of the Royal Canadian Air Force to make an operational sortie against the Germans was Squadron Leader W. I. Clements. At the time this officer, attached to the Royal Air Force, was serving as a flight commander in an RAF squadron, which he accompanied to France with the Advanced Air Striking Force. In this capacity he made a long-distance reconnaissance over Hamm and Hanover in Germany in a Blenheim on September 29, 1939.



A Douglas DC-3 air liner cruises above the city of Montreal.

Photographs courtesy, Trans-Canada Air Lines

The vast prairies of the West are crossed by Canada's air lines.

Many other Canadians had joined the Royal Air Force in the years just before the war. Some of these were posted to an RAF fighter squadron commanded by Squadron Leader F. M. Gobeil who later was awarded the Air Force Cross for serving as co-pilot of the first glider to cross the Atlantic. A Canadian officer was navigator for the bomber formation that carried out the first raid of the war on Wilhelmshaven in September, 1939, and there was a Canadian airman serving as gunner on one of the five planes which made the vital suicide attack on the Maastricht bridges in May, 1940.

In 1940 two Army Co-operation squadrons, the City of Toronto and the City of Winnipeg, and one Fighter squadron, the Ram, were sent to England. The Ram, led by Squadron Leader E. A. McNab, was the first RCAF squadron to see action against the enemy. In the Battle of Britain, in the late summer of 1940, the Ram shot down thirty-one German raiders and probably destroyed and damaged many more, they themselves losing three pilots. They remained in Europe until the war ended.

A stewardess delivers a complete, hot dinner to a Trans-Canada Air Lines' passenger. Meals are served while the airplane is in flight.

During the years 1941 to 1945 many new RCAF squadrons were organized in Britain and posted to Army Co-operation, Fighter, Bomber and Coastal commands, to the Northwest African Air Force, India Command, Air Command South-East Asia, Transport Command, the Air Defence of Great Britain and the Second Tactical Air Force. Bomber Command had its own RCAF group and there were RCAF wings as well in Fighter Command, Northwest African Air Force and Second Tactical Air Force. Over and above this, officers and men of the Royal Canadian Air Force served with RAF units wherever the Royal Air Force found it necessary to go.

When the Allies passed to the offensive in the air in the spring of 1941, Canadian fighter squadrons swept over the Channel to range the skies of France and Belgium in search of enemy craft, or to attack ground targets, or to escort bombers.

CANADIAN FIGHTER SQUADRONS HELP FORCE THE ENEMY BACK DEEP INTO GERMANY

On D-Day in June, 1944, Canadian Spitfires gave cover to the ships and the troops making the landings. Along with Canadian Typhoon squadrons they prepared the way for the ground forces to advance. As the armies moved across northern France, Belgium and Holland and invaded Germany, they constantly harried the enemy, making his positions untenable, or brought back information that enabled the army to make short work of any attempt by the German generals to restore their defenses.

After sunset Canadian night fighters guarded the skies over Britain or went on intruder sorties over enemy territory. Between September, 1941, and May, 1944, the Lynx Nighthawk and Cougar squadrons, with their Beaufighters and Mosquitoes, accounted for 53 enemy aircraft and destroyed or damaged 38. In June, July and August, 1944, they added another 64 to their total. Guided by instruments and instructions given by a ground-control officer, the night-fighter pilot followed the directions of his navigator until the enemy hove into sight; and then he blasted the enemy craft to pieces. Pilots had to be able to recognize an aircraft in a split second, a fleeting glimpse being all that was sometimes afforded.

The City of Edmonton (Intruder) Squadron flew to German-held airfields to catch enemy bombers as they returned from forays or to hold down the Luftwaffe's night fighters when Allied bombers were flying over the Ruhr. They also made a specialty of bombing and machine-gunning anything they saw moving on the ground, and for a time they took great pleasure in destroying doodle-bugs destined for London. By V-E Day they had chalked up 169 victories, to make themselves the highest scoring RCAF unit.

BOMBERS OF THE ROYAL CANADIAN AIR FORCE JOIN IN OPERATIONS OVER GERMANY

The City of Vancouver Squadron was the first RCAF bomber unit to take part in operations over Germany. By the end of 1941 the Goose Squadron had joined it; and in 1942, nine more Canadian units were to be found in Bomber Command. In January, 1943, the Royal Canadian Air Force Bomber Group was formed, and the number of squad-

Canadian National Railways

Above—Air-express cargo is loaded on a plane for swift delivery to a distant point.

Canadian Pacific Air Lines

Right—Canadian aviation is a world leader in cargo transportation. In the picture, a plane, fitted with skis instead of wheels, loads heavy equipment for a far-away outpost.

tional honor to the Royal Canadian Air Force when it was made a part of the Pathfinder Force, an organization whose function was to mark the route to the target and drop target indicators round the objectives to be attacked. For a time this squadron was commanded by Air Craftsman J. E. Fauquier who was one of the first master bombers and who acted in that capacity in the attack on Peenemunde in August, 1943. This attack delayed for some months the development of Germany's secret weapon, the V-bomb.

Coastal Command squadrons not only protected convoys and roamed the seven seas in search of submarines, but also struck at enemy shipping along the coasts of occupied Europe. The Buffalo Squadron concentrated on German convoys off the Norwegian coast and pioneered with rocket projectiles against shipping. The Demon Squadron set a record when it destroyed 83,000 tons of enemy shipping in one month, while the Swordfish Squadron played havoc with shipping off the Dutch coast and fought the German E-boats in their efforts to close the Strait of Dover to allied commerce. Sunderland flying-boats of two RCAF squadrons spent weary hours guarding the Western Approaches and patrolling the Bay of Biscay.

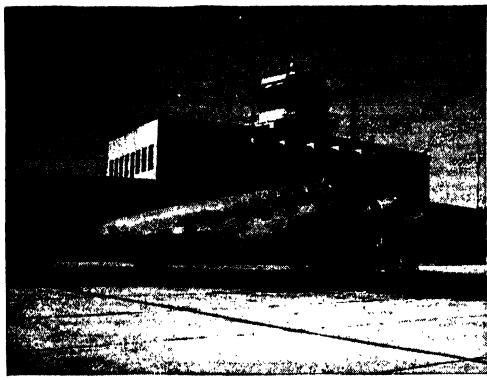
Far to the north No. 162 (Canso) Squadron flew over the North Atlantic from a base in Iceland. One of its pilots, Flight Lieutenant David E. Hornell, was awarded the Victoria Cross for his heroic efforts in sinking an enemy submarine, getting his blazing aircraft down safely, and encouraging his crew while they clung to their only serviceable dinghy, awaiting rescue. This was the

rons was increased in that year to fifteen.

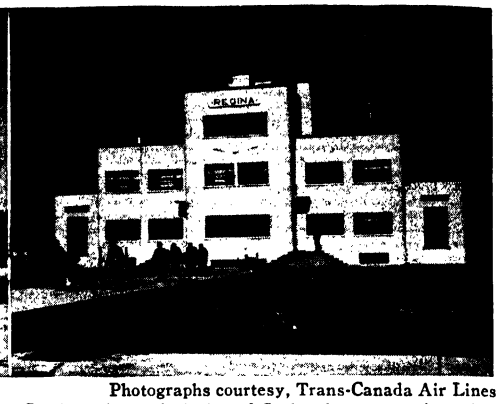
Whereas only three Canadian Wellingtons with 15 tons of bombs and 540 incendiaries took part in the first RCAF raid, nearly 300 Halifaxes and Lancasters were participating in a single operation by 1944, on some occasions dropping over 1,000 tons of bombs.

All told, the Canadian group dropped 125,575 tons over the continent of Europe and flew 48,927 sorties. It participated in nearly 100 raids on the cities of Germany; it laid mines in enemy waters; it bombed railways and coastal defenses in France and Belgium, and after D-Day it concentrated on communications behind the German lines, at one period bombing as much by day as it did by night.

The Vancouver Squadron brought addi-



The Montreal airport used by Trans-Canada Air Lines is located at near-by Dorval, Quebec. Westward, air routes run across the continent to the Pacific.



Photographs courtesy, Trans-Canada Air Lines

Regina, the capital city of Saskatchewan province, has a modern airport. From here important lines run northward into the Northwest Territories.

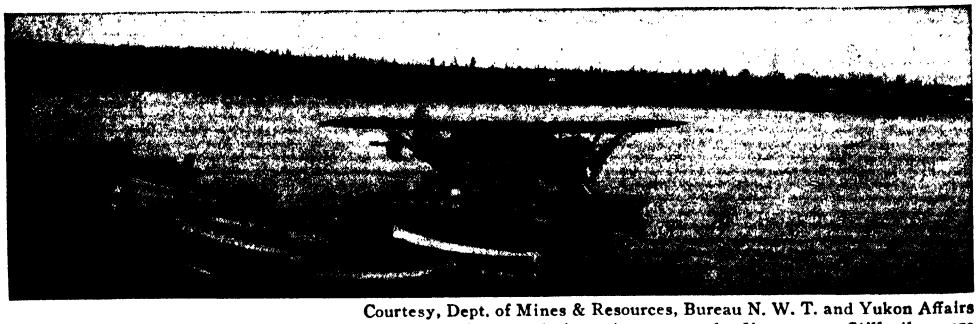
only award to a member of the Royal Canadian Air Force of the most coveted decoration the King can bestow.

The Tusker Squadron operated in a very different climate. Stationed in Ceylon, the Tuskers patrolled the warm waters of the Indian Ocean. It was there that Squadron Leader Len J. Birchall and his crew sighted a Japanese invasion force, and by their vigilance and prompt action warned the island of Ceylon, which might otherwise have fallen to the enemy. Birchall's Catalina had been shot down and he was taken prisoner.

In North Africa three bomber squadrons assisted in the conquest of Sicily and the invasion of southern Italy by bombing enemy strategic positions, airfields and communications. One fighter squadron, the City of Windsor, that had pursued Rommel across Africa, also shared in these operations and helped to chase the forces of Von Kesselring (the German general in charge) all the way to the plains of Lombardy. A number of RCAF transport squadrons carried troops and supplies to the Allied front in the Netherlands and Germany and on the far-flung battle fields of Burma.

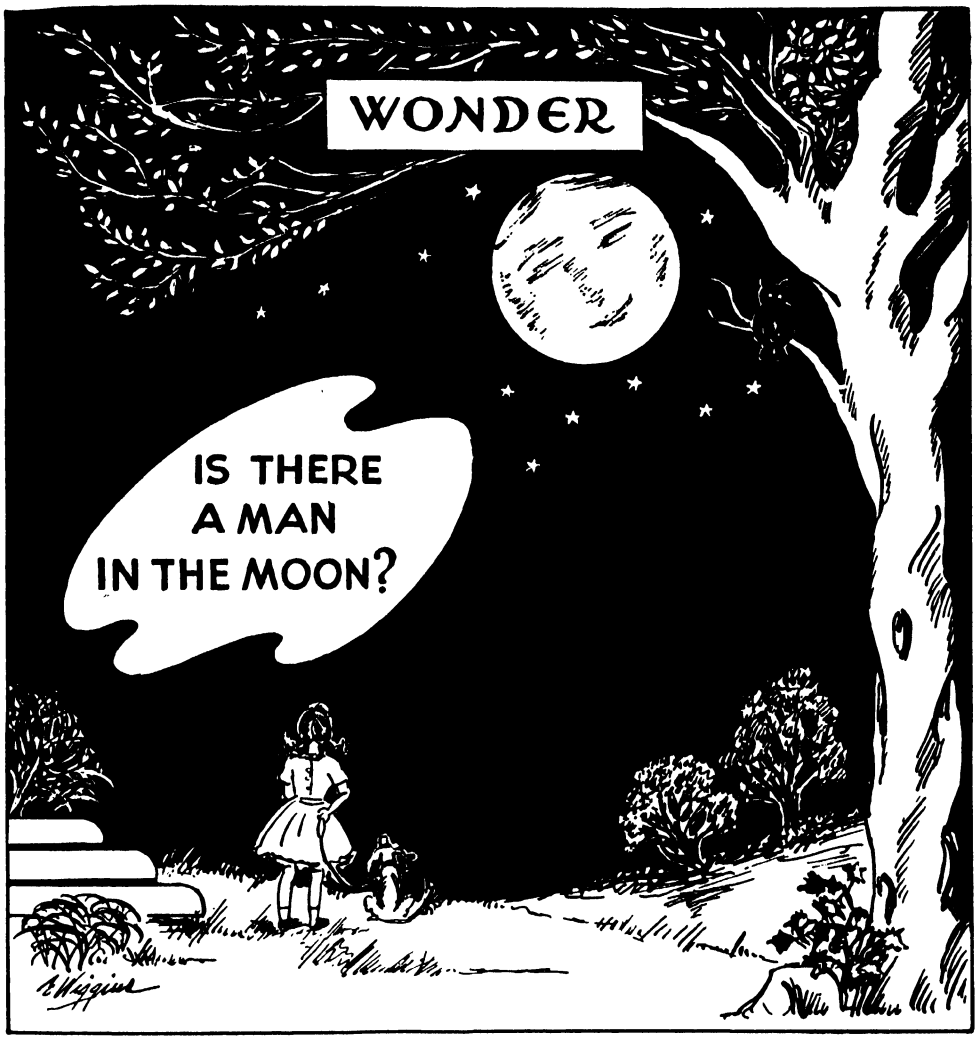
Even before the war ended Canada began to turn her attention to the peaceful development of airways—passenger, freight and mail-carrying services—the further development of the far north and the part that the country is to play in international commercial aviation. Canada sees herself as a link on the routes from Britain to the antipodes. Canada commands part of one of the best routes from New York to London, and must be crossed by aircraft making the shortest journey from Moscow to the cities of the United States. Routes are projected to the West Indies and Latin America, and agreements have been reached with the United States for one-stop services to Boston, New York, Cleveland, Detroit, Chicago, Duluth and Seattle; and Fairbanks, Alaska. A regular passenger-mail service between Canada and Great Britain is already being maintained. Canada is at the aerial crossroads of the world.

By H. H. COULSON.



Courtesy, Dept. of Mines & Resources, Bureau N. W. T. and Yukon Affairs

Many of the tiny communities served by air rely on lakes and rivers to serve as landing areas. Still others are reached only by ski planes. In the picture we see a floating dock for airplanes, at Aklavik, Northwest Territories.



PERHAPS someone has pointed out to you the face of the Man in the Moon. And you may have imagined that you were able to see, in the full moon, two dark spots that make the eyes, another spot for the nose, and still another for a wide mouth.

If we look at the moon through a telescope, we see that its markings consist of mountains, craters and the sunken beds of what were once thought to be seas and oceans, but which we now know to be merely great flat plains. Some of the moon's more than 30,000 craters are very large. The largest one, called Clavius, is 146 miles across and nearly 17,000 feet deep. No one knows whether these craters were caused by volcanoes on the moon or by the fall of great meteorites. There are also mountains on the moon, some as high as 25,000 feet.

Now, to come back to your question about a man in the moon. The moon is not inhabited—we are very sure of that. There is no air there and no water. No kind of life that we can imagine could exist without either of these.

If men ever succeed in traveling to the moon from the earth, they will find a dead world, not only without air and water, but also without sound of any kind. A day on the moon would last for fourteen of our days and nights, and the night there would be equally long. In the daytime the sun would

blaze with terrific heat and at night the cold would be so great that we can not even imagine it. These extremes of heat and cold occur because the moon has no atmosphere.

On the moon you would weigh much less than you do on earth—only one-sixth as much—because the moon's mass is much less than that of the earth. You could jump six times as high, or throw a baseball six times as far.

DOES THE MOON PULL THE SEA?

The moon does pull the sea, and it is the pulling of the sea by the moon that makes the tides. In any great dock or port or harbor we see how the water rises and falls twice a day.

The moon is made of matter, and so is the water of the sea. Every particle of matter in the universe exerts a pull upon every other particle of matter. And the larger the object, and the nearer it is, the greater the pull it exerts. We call this gravitation. The water on the earth, and the earth itself, are pulled by the moon, and the moon is pulled by the earth. Since the water of the oceans is less rigid than the land, the water is pulled more by the moon than is the land. The water below the moon is pulled up toward the moon. As the earth is spinning all the time, this means that a mighty wave, or tide, of water travels over all the oceans, day and night, in response to the pull of the moon. Why, though, are there tides on the side of the earth away from the moon? Perhaps the simplest explanation is that the high tide on the side of the earth away from the moon is caused by the moon's pulling the land away from the water on that side.

The sun also plays a part in causing tides in the oceans, but it is so much farther away from the earth than the moon is that its gravitational pull on the ocean is smaller. At new moon or full moon, however, the earth, the moon and the sun are nearly in a straight line. Then the pull of the sun and the moon upon the earth are combined, and we have exceptionally high and low tides—spring tides—with a great range between. At first and last-quarter moon, the sun and the moon are pulling upon the earth at right angles to each other, and then we have neap tides, in which the range from high tide to low tide is not half so great as in the spring tides. If the moon had oceans, there would be tides there, too, owing to the earth's pull.

You know that the moon is moving around the earth, while the earth turns on its axis. This makes the moon seem to rise and set each day about fifty minutes later, on an average, than the day before; and the tides in any spot on the earth are also about fifty minutes later each day than the day before.

WHY DOES THE MOON GROW BRIGHTER AS THE SUN SETS?

If we watch the moon as the sun begins to set, we shall see it grow brighter and brighter until, when the night has come, it is quite brilliant. Of course, it has really been shining in the same way all the time, but during even the last hours of daylight the sun sends so much light to our eyes that the light of the moon seems pale. If you turn on a very powerful electric bulb in a room where there is bright sunshine, you will observe the same effect.

WILL THE WORLD BECOME LIKE THE MOON?

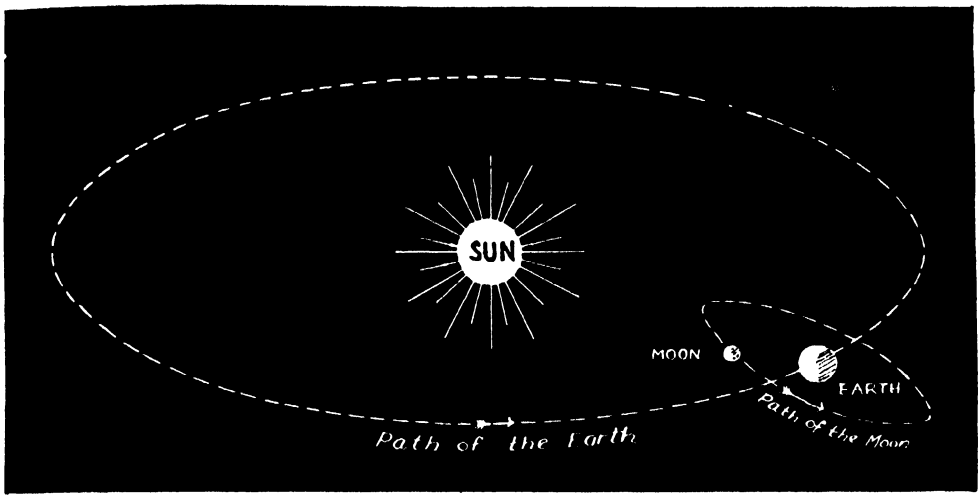
Our earth will probably, in time, become a dead world like the moon, for, as the millions of years pass, the earth will lose its atmosphere. Then it, too, will be without life, since life can not exist without air or water. You may be surprised to know that the earth is slowly losing its atmosphere now, but very gradually. To escape from the earth's gravitational pull a molecule of gas must be traveling at the rate of at least seven miles a second. Scientists have discovered this speed by extremely complicated calculations; and they call it "escape velocity" or "velocity of escape." A space-ship, to escape the earth's gravitational pull, would have to travel at this speed in order to reach the moon.

WOULD THE EARTH SEEM TO BE UP IN THE SKY IF WE WERE ON THE MOON?

Yes. The earth is a ball, and anyone looking out from the surface of that ball gets the notion, of course, that he is in the center of all things hung in the sky on all sides of him. We see things only *up* in the sky and not *down* in the sky, also because the earth interferes with our view down-sky. If the earth were transparent, we should see the sun and moon when they are *down* in the sky, underneath our feet, just as now we see them *up* in the sky.

This must be true not only of the earth, but of any other heavenly body. Up and down have no real meaning in themselves, or out in space, but merely refer to our own special point of view.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3558.



The moon revolves around the earth about once a month, and the earth makes a journey around the sun once a year.

The EARTH *and the* MOON

NEXT to the sun, though not to be compared with it in importance, the moon has had the greatest influence on the life and history of the earth. It is our nearest neighbor. Sometimes it is no more than 220,000 miles away. It was not so long ago that radar waves from the earth were sent to the moon, where they were reflected and bounced back to earth. Besides being near, the moon is not very different from the earth in substance. It measures about 2,200 miles in diameter, rather more than a quarter of the diameter of the earth. It is not quite so dense. If we could weigh a slice of the earth and a slice of the moon of equal size in the same scales, the slice of the moon would weigh about two-thirds the slice of the earth. About fifty moons could be packed like small shot in a ball the size of the earth.

In all the sun's family of planets there is no other satellite that is anything like the same size when compared with its parent. There is but one other planet that has only one moon, and, like the earth and moon together, forms a true couple in the solar system. That is Neptune.

The moon, we have said, is sometimes 220,000 miles distant; it is also sometimes as much as 253,000 miles away, for it travels round the earth in an ellipse. But, however near or far, it always turns the same face to the earth. It sometimes travels faster and sometimes slower. Because it is tilted a little, like a top that does not spin quite upright, we who are on the earth sometimes see a little strip more at one side or the other, or at the top or bottom, lighted by the glare of the sun. The tilt from the upright is very small—about 6½ degrees from a right angle.

We have spoken of the moon as spinning like a top, and so it does, but it spins very slowly. It turns round only once during the whole time it takes to travel round the earth.

If you should wonder how it can be spinning at all, as it always turns its face to the earth, imagine yourself to be the moon, and stand facing a bowl of flowers sitting in the middle of a round table. We take this bowl to be the earth, and the rim of the table marks the orbit of the moon in traveling round the earth. For better illustration you might put a lamp at your back to represent the sun, which shines both on you, the moon, and on the bowl of flowers, the earth. Now move round the table, always keeping your face to the bowl of flowers, and when you have moved halfway round the table the sun, or the lamp, which was at your back, will now be shining full in your face. So, evidently, you must have turned half round. Pursuing your journey in the same way, you come back to the point

you started from. You must have made one complete turn, though you have always kept your face to the flowers. That is what the moon does. Its path round the earth is traveled in 27 days 7 hours 43 minutes 11.5 seconds. In that time the moon turns on itself.

THE SHINING MOON THAT STIRS THE THOUGHTS OF MEN

This estimate, accurate to the fraction of a second, is only one of many which astronomers and mathematicians have made. For hundreds of years they have been calculating the motions of the moon, which not only influences the life and history of the earth, but also has stirred men's thoughts. Sir Isaac Newton obtained information from the moon relating to the law of gravity. Nearer our own day, two great mathematicians, Henri Poincaré and Sir George Darwin, spent half their lives in tracing the past and future of the tides which the moon, as well as the sun, raises on the earth. They followed back the joint career of the moon and the earth through ages. The work still goes on, and Professor E. W. Brown took some thirty years to calculate those tables which appear in the famous Nautical Almanac. By foretelling almost exactly the positions of the moon at any time in any year, at any hour, they enable us to ascertain the times of the tides.

THE WONDER OF THE TIDES THAT THE MOON SENDS ROUND THE EARTH

The tides, which the moon draws toward itself from the earth, are the symbol of the unending wonder and mystery of the earth's companion. Twice a day the moon gathers up the waters of the earth and sends them pulsing round the globe to sweeten and purify it, to help give birth to the winds and the rains, to cause the rivers to flow, to make life more varied. Twice a day, also, although we do not feel it, the moon lifts the crust of the earth a small fraction of an inch, as has been shown by refined experiments carried on at the Yerkes Observatory. Always the moon has been doing this. It was doing it when there was not a drop of water on the earth. In those days it pulled the earth's crust higher because the crust was then softer —more like the lava which flows from volcanoes. Farther back in time it was pulling the earth's crust higher still; and at the same time the earth was pulling up the moon's glue-like surface.

If we go back as far as calculation will take us, we reach a time when these semi-solid crustal tides of the earth and the moon were of enormous size. They were very slow tides, for the two bodies were probably closer together than they are now. That was many million years ago. Each was pulling at each, and the sun was pulling at both, while each was spinning round in about the same time. The speed of the spin was much greater then. But the solid tides that were being raised began to slow both earth and moon down, not much at first, but more and more as time went on. As they began to slow down they drew farther from one another, till the moon reached the place where she now is, her speed of turning so reduced that it occupies more than 27 days, while the earth now rotates in 24 hours. Both speeds will go on diminishing till both become alike again, but it will be a very long time before this happens.

A DEAD WORLD IN THE HEAVENS, WITH NOT A BREATH OF AIR

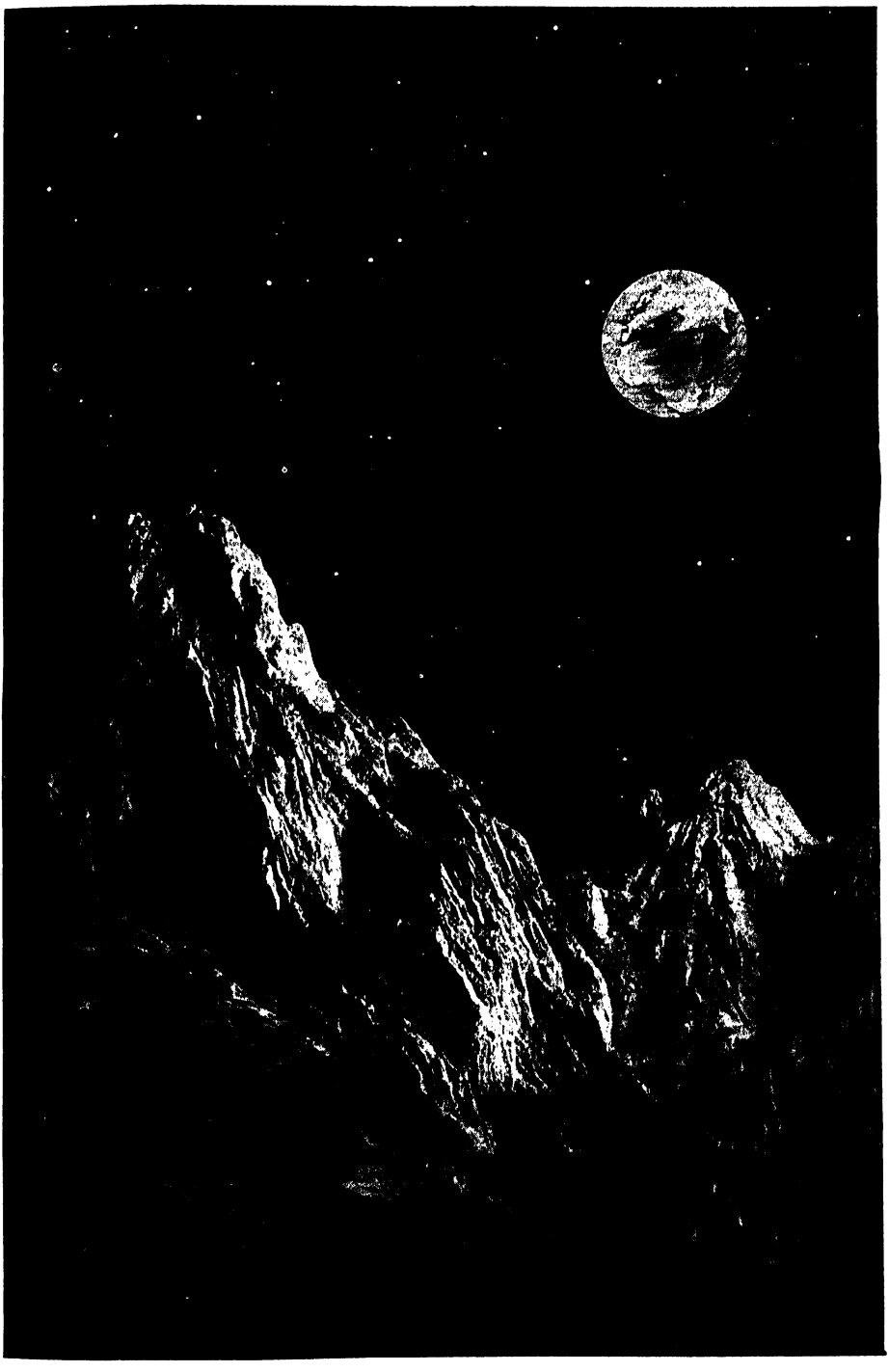
That is a leap into the future; now let us look one step farther into the past. How came it that the moon and the earth were so close together? One explanation is that once they were one. When we scan the moon's scarred face at night we look at a dead world, a world that does not know the stir of air or water, on which not a flower blooms, not a tree grows, not an insect creeps. Not a sound is heard, not a thing is moving, save that perhaps from the fierce heat that beats upon it, some shuddering crack of its strained, tortured surface may take place.

As it has been, so it will be; no imaginable accident can alter its state save one which would overwhelm earth and moon and sun alike in "unremorseful clouds of rolling fire." As it is, our moon is likely to see the sun's light go out.

THE MOON MAY ONCE HAVE BEEN A PART OF THE EARTH WE LIVE ON

We can never know for certain just how the moon began. There are several explanations. Some scientists think that once the spinning earth was shaped like a pear. As it spun the shape became more like that of an hourglass, though one end was larger than the other. The neck of the hourglass became thinner, until finally it separated into two parts. These astronomers think that for ages the earth and the great broken-off fragment spun side by side. Then under the influence of the sun's attraction, and later of the two fragments' own actions, the moon drew farther away in the manner

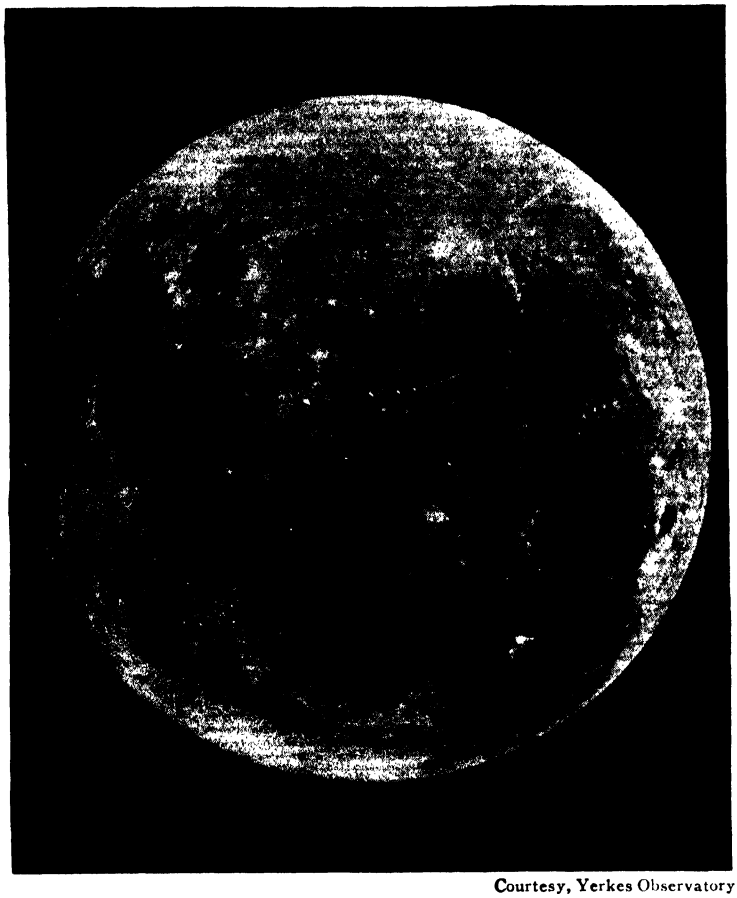
THE EARTH SEEN FROM THE MOON



The massive mountain peaks of the moon and how the earth would look from them.

we have told. When the fragment broke away from the earth to begin its own independent career it had five billion cubic miles of matter; and possibly the gap it left is now the bed of the Pacific Ocean.

Another explanation of the birth of the moon is that it was once a little knot in the nebula that became our solar system. It was so near the earth that the two planets have revolved around the sun at about the same distance from it, each of them pulling a little on the other.



Courtesy, Yerkes Observatory

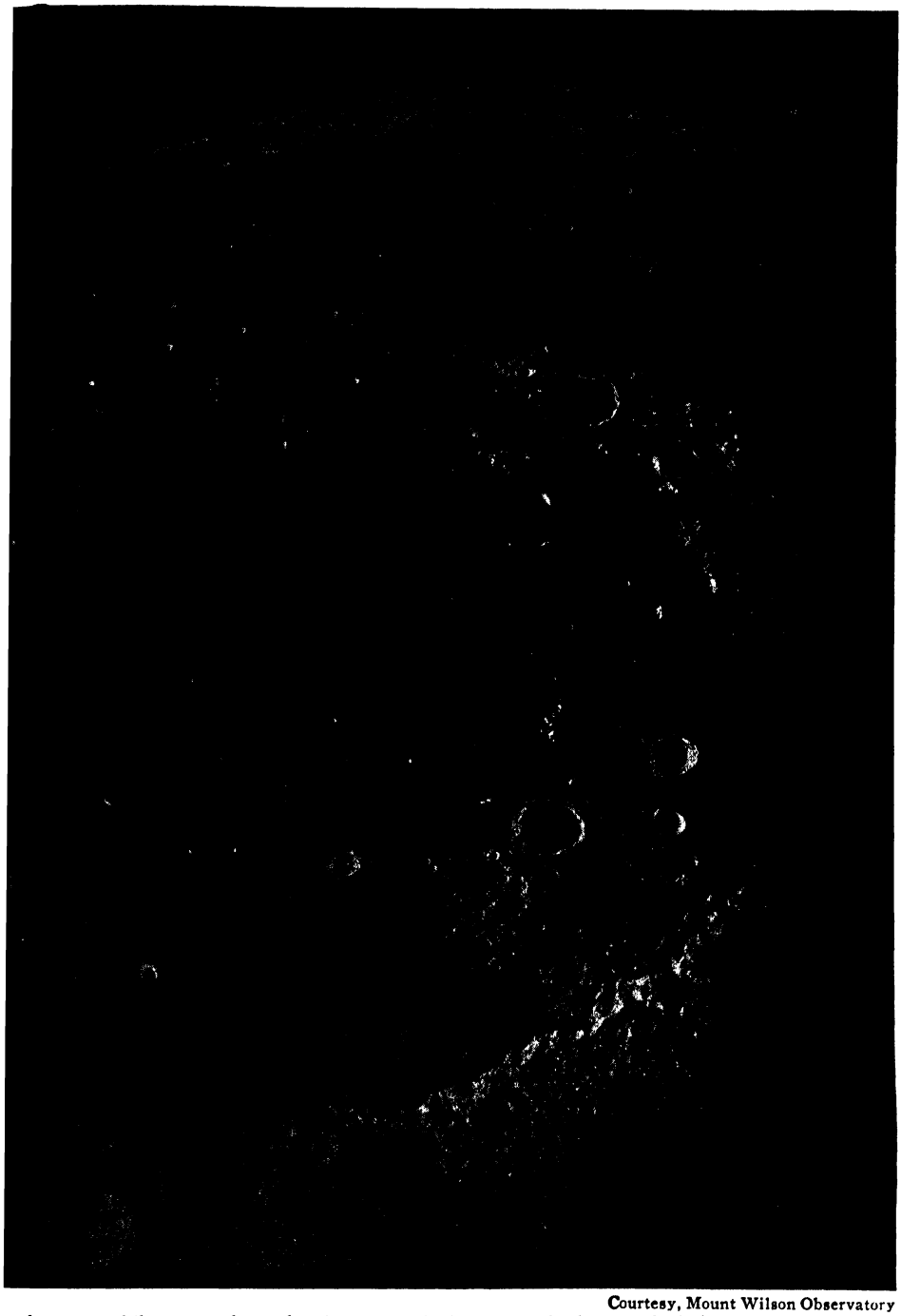
About the middle of the lunar (moon) month the full moon, lighted by the sun, faces the earth. Gradually the bright disc turns away from us. Presently we see no light. Then, slowly, the lighted disc turns toward us again.

On the face of the moon shown to us is written the story of long ages of the most fierce turmoil, a story we can guess but dimly. Of the moon's present condition we know a great deal. The sun pours down on it unceasingly through a day of 300 hours. For most of the moon's sunlit side at any moment the heat received from the sun is so great that water would boil, and no life like our own could exist. On the dark side the moon is as cold as liquid air, and no life that we know could endure a cold like that. A man living on the moon would spend his day in the tropics and his night in the Arctic. He would have to endure alternate periods of heat and cold such as mankind has never known.

The moon has so very slight an atmosphere that the fierce heat of the sun pours down on it unchecked. There is no blanket to break its heat or to soften its dazzling light and there is no sky light, so that the sun shines on the moon from a dense black sky. To a man on the moon, the sun would look like a great white ball shining in pitch-black night. When the sun withdraws its light and the moon is wrapped in night, the darkness there must be the darkness of a pit. A day and a night on the moon are equal to a month on earth, so that for fourteen of our days a man on the moon would live in light and heat unknown to us, and for fourteen days more he would have to exist in darkness and in cold that we can scarcely imagine.

We can hardly think of a world like that as anything but dead, and if the moon was born when the earth was born, we may ask why it has died so soon. Why is the earth still covered with green trees, and carpeted with flowers, and throbbing with the life of a myriad living things, while the moon is dead and bare? It is because the moon is smaller. The earth, owing to the powers of attraction

MOON MOUNTAIN AND VALLEY



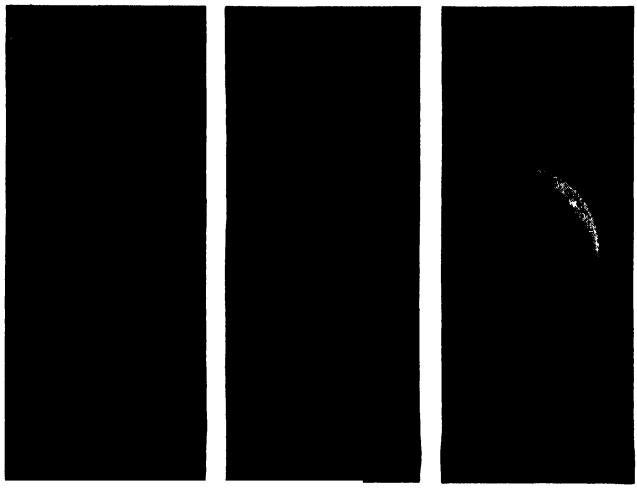
Courtesy, Mount Wilson Observatory

en have mapped the moon and named various areas. The large crater in the upper half of the picture is Plato; to
e right are the Alps, with the long Alpine Valley running through them. Though there is neither water nor rain
the moon, the great plains on the left are called Mare Imbrium (Sea of Showers).

which are conferred on it by the law of gravity, can hold to itself an atmosphere, and clothe itself with life-supporting air as with a garment; but the moon can not retain a hold on these lighter gases. The moon can hold only the heavier ones, such as carbon dioxide; and carbon dioxide alone will not support any form of life.

There are four sorts of worlds we know:

1. We know the sun, a mighty mass of glowing gas moving about the universe like millions of other suns in their journeys.



Courtesy, Yerkes Observatory

An eclipse of the moon occurs when the earth comes directly between the sun and the moon, interrupting the sunlight. At this time the shadow of the earth is cast over the moon. The picture shows three stages of such an eclipse. Note the earth's curved shadow.

2. We know the planet Jupiter (and some of the other planets) covered with frozen hydrogen and ammonia snow, and surrounded by a dense atmosphere of noxious gases.

3. We know the earth itself, with its core still hot, but its surface fitted for life and enveloped in an atmosphere that makes life possible.

4. And we know the moon, an extinct and barren world, a world of death, as the earth may one day be.

The moon is in the fourth of these stages. At the most it can have but a continually freezing "atmosphere," which is not a thousandth part as ample as the atmosphere of the earth. No sound could travel there. No speech is possible; the Man in the Moon, if there were one, would be deaf and dumb, for sound depends on air, and air the moon has none—or if there should be any at all, it must be thinner than what we on the earth call a vacuum.

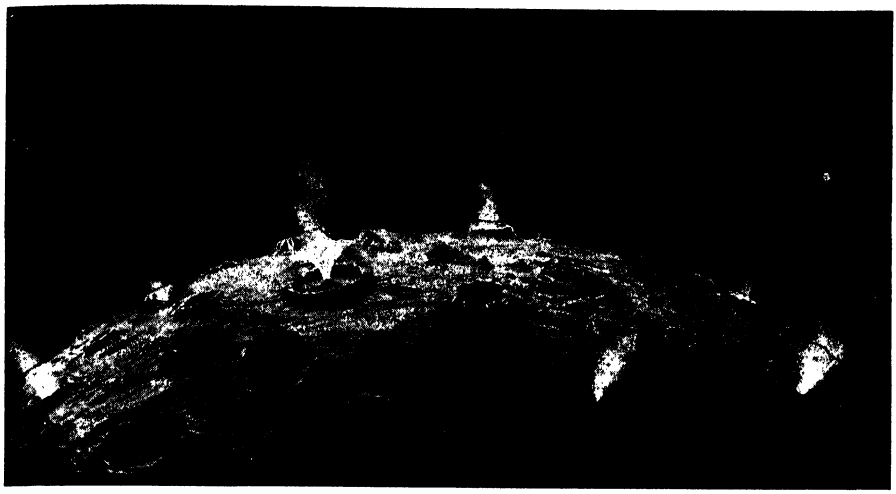
Weird and strange indeed are the scenes on that dead world, and it is one of the triumphs of the human mind that we know them well. Long before we knew the North Pole of the earth, men knew the North Pole of the moon. The first thing men began to study in the heavens was the moon. It filled men with dread in ancient times. It gave them their first ideas of anything beyond this world and their first glimmering of the outer universe. The shepherds of Chaldea would sit and look at it, and think it a sort of mirror in which the image of the earth was reflected. After Calvary men thought they saw the figure of Judas in the moon, suffering exile for his treason to mankind.

Long after that, wise men looking at the moon through telescopes imagined that the marks they saw were made by men, just as some today think they see the work of men on Mars. Kepler used to think that the huge crater walls on the moon were built by men; they looked to him like the walls of pits built as shelters from the action of the sun.

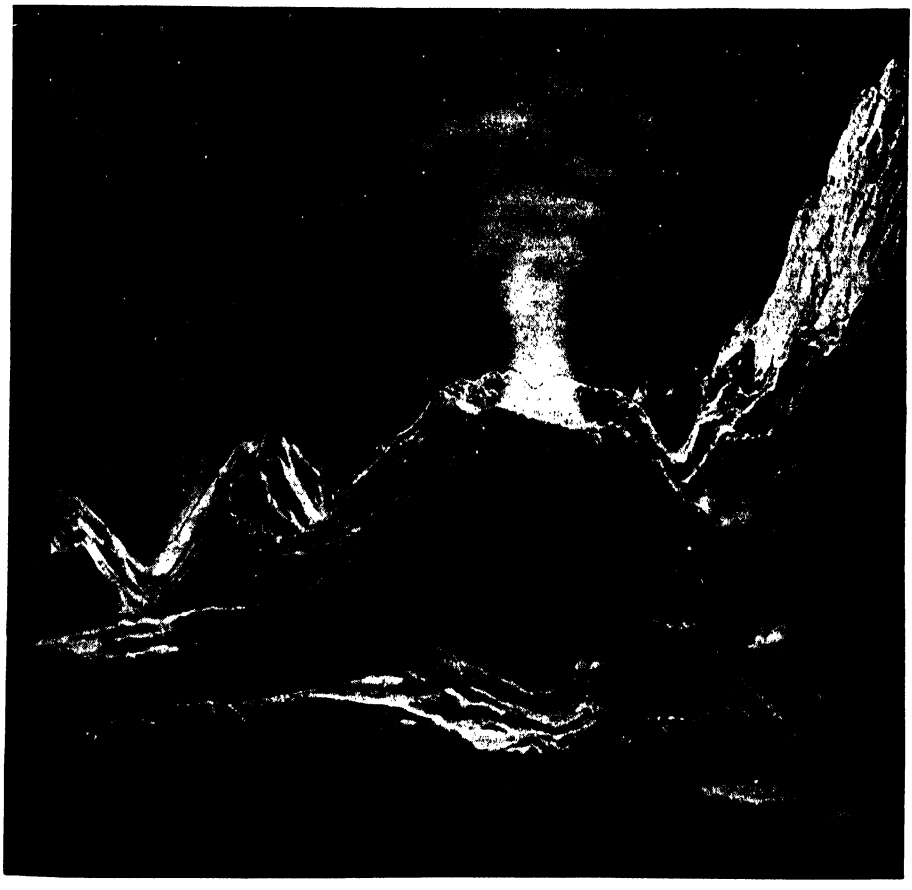
But Kepler did not know the nature of the things he saw, their vastness and their age. Let us look at them as Kepler never saw them. A boy and girl today can see what Kepler and Galileo would have given their lives to see. We can see the moon through a telescope that brings it as near as New York is to Washington. There are telescopes that bring it within 200 miles, so objects on its surface are magnified more than a thousand times. Seldom is the earth's atmosphere steady enough to permit such a high magnifying power, however.

Is there anything more enthralling than a walk about the moon? It is not a mere fancy, for we can see the way to go. We can fancy ourselves climbing up steep cliffs, and running through valleys, and roaming over hills. The very places are named, and we can find them on the map of the moon. We can watch the sunrise and the sunset, we can see the shadows stealing over mountain peaks, and trace them like church steeples for miles and miles and miles. We know how big they are, how steep they are, how deep they are. It is all like a miracle when we think what it means, for a thing on the moon must be thirty miles wide to be seen

IMAGINARY VIEW OF THE MOON LONG AGO



An imaginary picture of lunar volcanoes ages and ages ago.



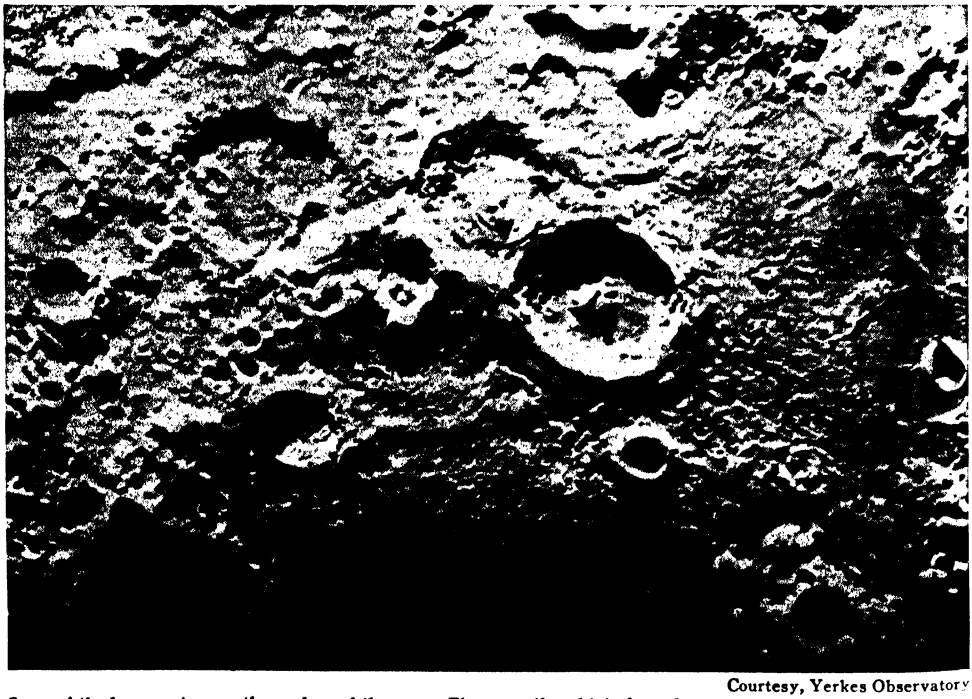
An artist's conception of a crater pouring out fire and smoke on the moon.

as a pin-point with the naked eye on earth; but the telescope *is* a miracle. It gives a man new eyes, eyes that take him to another world. Many a man lives now who has traveled in imagination on the hills and valleys of the moon more widely than on the earth. Men know the Alps of the moon who have never seen the Alps on earth, and many a man has seen a crater on the moon who has never seen one here.

It is these craters that seize the imagination. They are the handwriting on the moon. They are gigantic beyond anything seen on earth, and the forces that made them are beyond our understanding. There are hundreds of them. Their walls rise up miles high, and some of them are so wide that two men standing on opposite sides would be a hundred miles apart. The walls inside rise steeply, but the outer slopes fall away more gently. One explanation of the causes of these craters is that they are the results of great volcanoes. Another explanation of these craters is that they mark the places where great explosions of gas burst out through the thin crust of the moon without throwing out much lava.

The earth can hardly have known explosions to equal these. The moon is much smaller than the earth, and parted with its heat more quickly, and gravity there has only one-sixth of its force on earth. Explosive forces on the moon, therefore, would be six times as effective as on earth. Everything on the moon is very much lighter—a brick that weighs six pounds here would weigh one pound there; a man who can clear a bar at six feet on earth could clear it at twenty-one feet on the moon; a gun that fires ten miles here would fire sixty miles there.

We can imagine, therefore, that those internal forces that seem almost to have torn the surface of the moon to bits must have been beyond all human experience or conception; in parts the surface of the moon is thick with craters, and rising from the floor of the craters we find enormous cones. Sometimes they are a mile high, and sometimes there is another crater inside the outer one. Some craters have cracks across that are a mile wide. One great crater, over fifty miles across, is filled to the brim with lava, as if it had oozed out after the walls had been formed until it filled the huge round pit with a mass of solid rock. Some astronomers estimate that sometimes, in these explosions on the moon, a single eruption may have



Courtesy, Yerkes Observatory

Some of the huge craters on the surface of the moon. They are thought to have been caused by gigantic volcanoes.

sent forth, crashing out of the red-hot depths, a thousand cubic miles of matter. We read of a regiment of soldiers encamping in the crater of Vesuvius in the days before the destruction of Pompeii; but the whole of one of our counties could be contained in a crater of the moon. There are gaps across the surface which are sometimes a mile wide and 150 miles long, and at least a mile deep. There are on the side of the moon that we can see at least 30,000 craters, and about 500 of them have been given names.

BOMBARDMENT OF THE MOON MAY HAVE BEEN THE CAUSE OF THE CRATERS

There is still a third explanation of these craters. It is that the rough surface of the moon may have been caused by external bombardment and not by internal explosions. This explanation is based on what is called the Planetesimal Hypothesis. Some men believe that the craters were formed by collisions with wandering masses of material. Even today small masses sometimes strike the earth. Great masses might have struck the moon's surface with a speed from fifty to a hundred times that of a rifle bullet. By firing projectiles of various materials at targets of different kinds experiments have duplicated in miniature the craters of the moon.

LIKE A SNOWBALL ROLLING DOWN A MOUNTAIN THE EARTH GREW BIGGER AND BIGGER

According to the Planetesimal Theory the nebulae were formed by the collision or else the close approach and tidal pull of two stars. The denser portions of nebulae are called nuclei. As these nuclei moved around the star from which they had come, they slowly swept up scattered outlying particles and thus became larger and larger, like rolling snowballs. In this way, say some astronomers, the earth started and grew. The moon was formed from a smaller nucleus which was near the nucleus of the earth and controlled by it. This smaller nucleus, like the earth, grew in size by adding particles encountered in its motion around the parent star—the sun. It is thought that the earth's atmosphere acted as a cushion and screened the earth from the heavy bombardment which the moon suffered. Even if the earth did suffer such a bombardment, the rains, snows and winds have had time to wear down and destroy the evidence. The moon did not have these and remained as it was. That is one theory. We can not say for certain how the moon came to be as it is.

There are ten great mountain ranges on the moon; and we have reason for believing that some are continued on the unseen side of the moon, which in all probability resembles the side that we can see. Some of these mountain ranges have been named for chains on the earth.

One mountain chain has 3,000 mountains packed together. The range we call the Alps has 700 glorious peaks, and an immense valley 80 miles long and 5 miles wide that seems to have been cut with a knife. Astronomers watch the sun rise on these peaks as travelers watch it rise in Switzerland. The Apennine chain, reaching out 450 miles, ends in a precipitous face which at sunrise throws a shadow over the plain for 80 miles.

But more amazing than these mighty shadows are those white pathways that seem to creep wherever we look in the moon. From one great crater we can trace them for a thousand miles. One is said to be 1,700 miles long, and they are sometimes 25 miles wide.

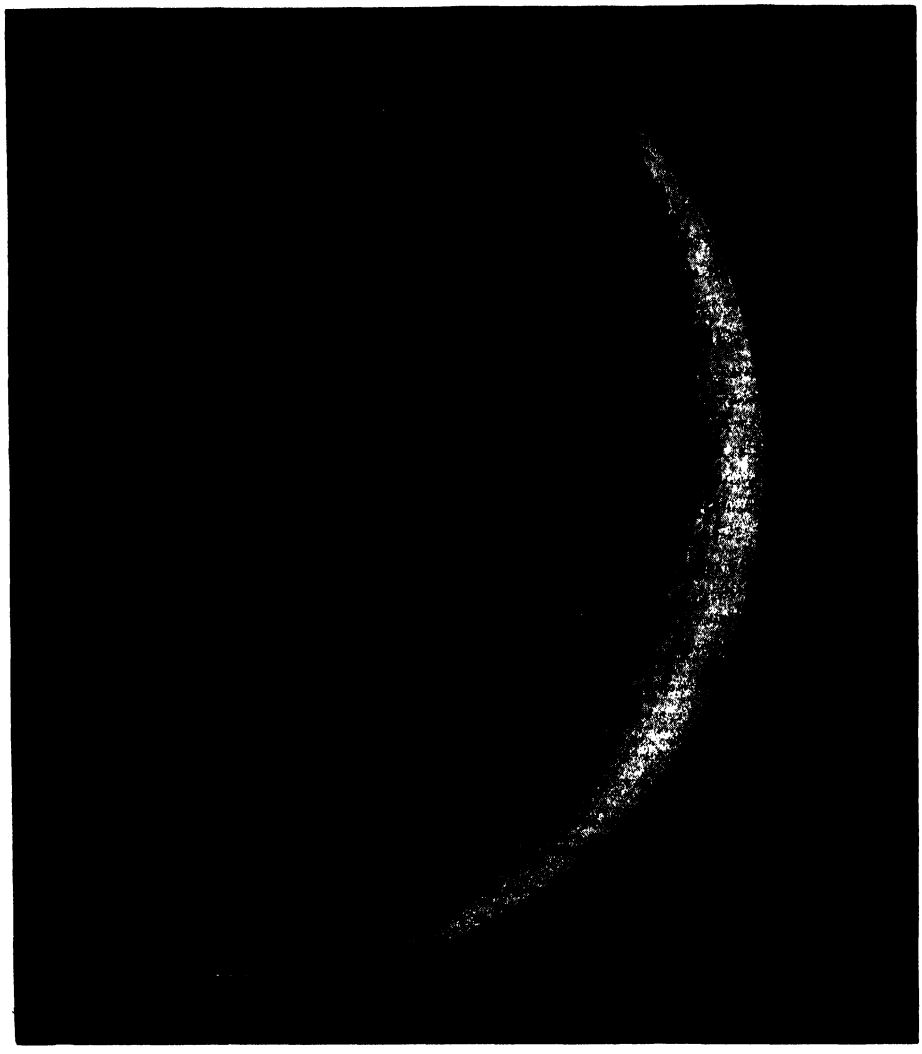
THE MYSTERY OF THE GREAT WHITE STREAKS ACROSS THE MOON

They go over mountains and plains, over craters and through valleys. Somebody has said that if a brush had been drawn across the face of the moon in a thousand directions, the effect would be to give us these white streaks. They are among the mysteries of the lunar world. Astronomers are much puzzled by them. They are also puzzled by those enormous areas on the moon which look like seas. They are not seas, for there is no water on the moon. But perhaps these great, smooth surfaces may be due to the falling of the thin crust into the molten bed below. What we see may be a molten lake turned solid. Of course they are not so smooth as they seem, but are broken by ridges and cracks.

THE COLOSSAL CRATERS OF THE MOON ARE UNLIKE ANYTHING ON THE EARTH

It should be noted that some astronomers have pointed out that the great craters of the moon, and the enormous number of them, are totally unlike anything which volcanic action has produced on the earth. There are some craters in Hawaii which continually well up and form crater walls; and these Hawaiian craters, though so much smaller—only a few miles round at most—are the only ones much resembling the great lunar features. Our explosive craters, like those of Vesuvius or Etna, are not in the least like those on the surface of the moon.

But the long, strange story of the past tells of a strange service that the earth owes to the moon. As far as we can know, the whole of human history would have been changed, and every individual life on the earth would have been changed, but for the moon. The greatest influence it has had on the earth in its millions of years has been to slow earth down, so that a day on the earth, which used to be four or five hours, has now become twenty-four. What life would have been with four or five hours of light and four or five hours of dark, we can hardly think—nor can we think what life will be on earth when the moon has slowed us down still more, so that our day becomes as long as a month, and one side of the earth will be for a month in sunlight while the other side has a month of dark and cold. However, the change in the length of a day can not be more than a second in many thousand years.



The shining White Lady of the Sky—a rare and lovely view of the new moon taken by Philip E. Belas at University College, Cork, Ireland. It is just becoming visible as it begins its monthly journey.

Article prepared with the assistance of Roy K. Marshall, Director, Fels Planetarium.

THE NEXT STORY OF THE EARTH IS ON PAGE 3665.

HOW MAN LEARNED TO WRITE

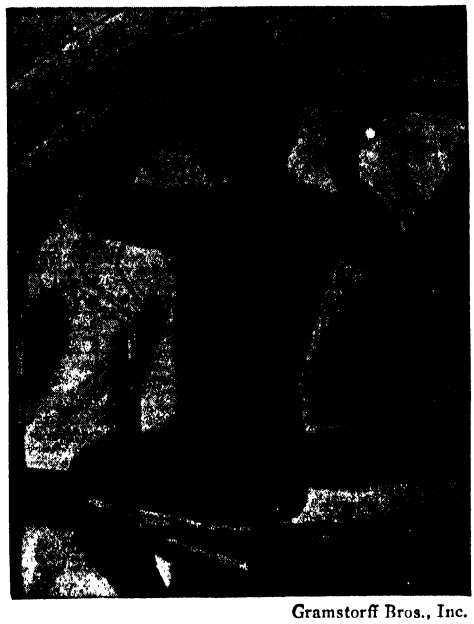
WHAT a different place the world would be if no one had ever learned how to write! There would be no science worthy of the name, and therefore we would have none of the wonderful things that science has brought us—trains, automobiles, steamships, airplanes, electric lighting, telegraphs, telephones, radios, plastics, electric and gas refrigerators and the like. There would be no books to tell us about the past. There would be no newspapers to give us information about present happenings in all parts of the world. We would live like savages, ignorant of what was going on except in our own little corner of the world.

You will begin to think, perhaps, that writing is the greatest invention in the world. As a matter of fact the art of writing was such a gradual and natural development that it can scarcely be said to be an invention at all. Of course, like everything else that man does, writing had a beginning. But it was such a beginning as a baby makes when he "draws pictures."

From very early times it was desirable to keep count of possessions, such as oxen or goats or sheep, and also to mark the passage of time. For this purpose men used to make notches in sticks or knots in strings. Later these notches and knots were used, in some way that we do not understand, to record laws or historical events. The Incas of Peru kept their records by means of knotted cords called *quipus*.

In very early times people began to make pictures of the animals that they hunted in the chase, or that roamed through the woods about them. At first, no doubt, the pictures were just as crude as the pictures made by baby hands, but by and by the skill of these early artists increased. The cave-men ornamented pieces of bone and horn and the walls of the caves in which they lived with pictures of men and animals.

Some of the bone and horn pictures were very well done, and must have been greatly prized by their owners. Probably they were sent sometimes as gifts of friendship from



Gramstorff Bros., Inc.
An Egyptian stonecutter inscribes the wall of a tomb.

the head or chief of one tribe to the head or chief of another. Later the pictures were used as symbols, or signs, to give messages. Of course it would have been unfortunate if the man who received a message misunderstood it; if he mistook an invitation to a feast, for example, for a threat of war. So it was agreed that the pictures of certain parts of the body, or plants or animals should always be used as symbols to mean certain things, and that is how writing began.

The Indians of the New World developed elaborate systems of picture-writing which some of them have used even down to the present day. Thus the Indians learned to tell the story of a battle or some other event; they also learned to express various ideas. For example, hunger was shown by drawing the picture of a man with his ribs showing. Sorrow was represented by an eye from which tears were falling. The Indians did not go much further with their writing.

In the Old World, however, as the years went on, and the chiefs of tribes became great men and kings of nations, they were not satisfied that their deeds should be handed down only by word of mouth. They feared that men might forget what they had done, or that an enemy might tell another tale. So they began to set down the record

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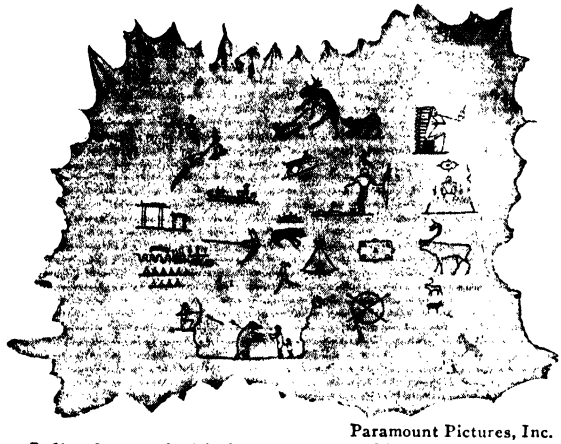
The American Indians had no paper. They did their writing on birchbark or, as shown here, on animal skins.

of their deeds, not in books such as we have, but on stone, or, if they had no stone, on bricks or tiles.

The ancient Egyptians used beautiful picture-writing, which was carved or painted on the walls or pillars of their palaces, temples and tombs. This picture-writing was called hieroglyphics (hy-er-oh-glif'-iks; from two Greek words meaning sacred carvings). In this kind of writing, pictures of men and women, animals, birds, plants, clothing, tools and weapons originally stood for definite objects. A picture of an arm would stand for an arm; a picture of an owl, for an owl.



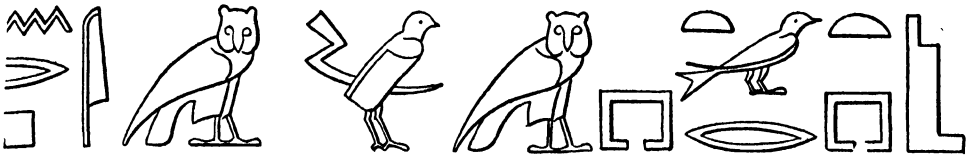
Paramount Pictures, Inc.

Indian boys and girls learned to read this picture-writing.

In time this or that picture would come to represent, not merely a single definite object, but all things pronounced in the same way. That is, a certain picture would stand for a definite group of sounds. It was as if we drew a picture of a carpenter's plane and then used the picture to represent not only this tool but also plane, meaning a kind of tree, and plain, meaning level land, and plain, meaning homely. In other words, the picture of a carpenter's plane would represent the sound group: *p* plus *l* plus *ay* plus *n*.

Later certain picture signs came to represent single sounds in Egyptian hieroglyphics. The picture of a palm leaf stood for the consonant *y*; the picture of an owl, for *m*. This represented the earliest known form of an alphabet. Even after certain pictures came to represent single sounds, the Egyptians continued to use other pictures which stood for sound groups. That is one reason why it is so terribly difficult to read Egyptian hieroglyphics.

In addition to hieroglyphics, the Egyptians also used hieratic (hy-er-at'-ik) writing, an



Hieroglyphics on the wall of a temple at Luxor, telling the historian something about life in ancient Egypt.

abridged or shortened form of hieroglyphics. Later they also used demotic (dee-mot'-ik) writing. This was a simplified form of hieratic writing and it was used for the ordinary business of life—for business correspondence, contracts, civil documents and so on. Hieratic and demotic writing was done chiefly on a material called papyrus. It was made of the pith of the papyrus plant (a kind of reed), cut into slices and pressed together. We get our word paper from papyrus.

The Sumerians, who lived in Mesopotamia, in western Asia, wrote on clay tablets or cylinders because there was no stone. The writing was done by pressing a sharp pointed instrument, called a stylus, into damp clay. This made the clay spread at one end, so that the mark looked something like an arrowhead or wedge. Hence this kind of writing came to be known as cuneiform (kiu-nee'-ih-form), or wedge-shaped. In the beginning cuneiform was picture-writing. In time, however, the pictures were made with such simple lines that they no longer looked like birds or animals or plants.

The Babylonians learned this kind of writing from the Sumerians and then passed on their knowledge to the Assyrians. While Athens was yet unbuilt, and the seven hills of Rome were wooded slopes, the Assyrian capital of Nineveh had a great library, with thousands of books written on clay tablets lining its shelves.

We must remember that few people who lived in the days of which we have been reading could learn to read, and fewer still knew how to write. There was no such thing as an easy alphabet of twenty-six simple letters, such as we have in English—an alphabet from which all the words in the language could be built up. It is true that the Egyptians, as we have seen, used certain signs to represent single sounds. But they did not realize how greatly they would simplify their language if they kept these signs and threw out the rest. They continued to use other signs which stood for whole words or syllables. Every one of these signs had to be learned and remembered, and there were hundreds of them.

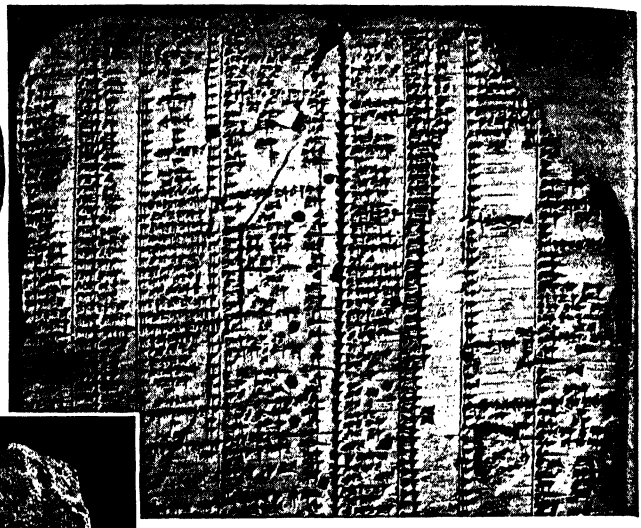
It was the Phoenicians, a people living on the coast of Syria, who perfected the first practical alphabet. They did not invent the signs that they used in their alphabet. They took the simplest signs from an earlier system of picture-writing, and they used them to represent the sounds that they heard in the human voice.

Many scholars think that the Phoenicians

Metropolitan Museum of Art
A scribe of ancient Egypt.

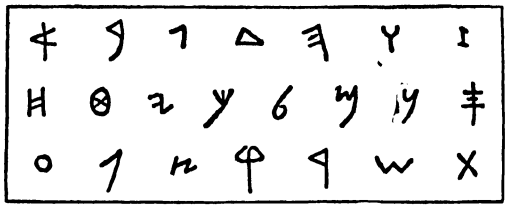
The Pierpont Morgan Library
A page from the BOOK OF THE DEAD, an ancient Egyptian book inscribed on papyrus. It was left in tombs for the dead to read.

Oriental Institute, Chicago
If you had gone to school in Iraq in 2500 B.C. you would have used a copybook very much like this one.



Oriental Institute, University of Chicago
This clay tablet is a page from a Babylonian dictionary.

Pennsylvania University Museum
The oldest writing we now know is Sumerian cuneiform.



The Phoenician alphabet, from which our own a b c comes.

got these signs from the Egyptians; others say the Phoenicians learned them from some of the Syrian peoples; others again say that the Phoenicians took the alphabet from Crete. At any rate, the Phoenicians taught this new way of writing, with an alphabet, to the Greeks, who changed it somewhat and added signs for vowel sounds which the Phoenicians had not used. The name of the first Greek letter is *alpha* and the second *beta*. So you see where the word "alphabet" comes from.

The Romans took over the Greek alphabet, making so many changes in the written letters that you could not tell by looking at them that they were related. The Latin tongue, used by the Romans, became the official language of the Roman Catholic Church. Missionaries spread a knowledge of the Latin alphabet throughout Western Europe, and it was adopted everywhere in that area. Today we use this alphabet, as do many of the other people of Europe and the Americas. The Russians do not use it, nor does Gaelic, the language of Eire, use the Roman alphabet. Greece does not use the Latin alphabet. Modern Greek still uses the old Greek letters, with some changes.

You remember the beautiful story of how the learned Bede, in his old age, translated part of the Gospel of St. John into the English tongue. You must not think, however, that even if we could see his writing we could read it without much study. Not only was his language different from the English that we now use, but all the letters were capitals, there were no spaces between the words and there was no punctuation. As books multiplied and libraries grew larger, the monks, who copied most of the manuscripts, learned to make their letters smaller, and large letters were used only as capitals for the beginning of sentences and for names. However, the monks continued to write each

letter more or less by itself as a separate unit.

Of course many men besides the monks learned to write in the Middle Ages. Merchants and lawyers, the secretaries of great men and many others found it necessary to learn to read and write. These people could not take time to write beautiful manuscripts, and rapid writing, with the letters of each word joined to one another, came into use. When the printing-press was invented, however, it was the beautiful "book hand" writing of the monks that was adopted by the printers. Later it was simplified, and many different styles of type were cut.

In the ninth century the Moravians and Bohemians, Slav peoples of whom we read in the story of Czechoslovakia, were converted to Christianity by a Greek monk named Cyril. Cyril, who was a learned man, made an alphabet in Greek characters for the Slav language, so that his new converts could learn to read and write. The Russians, who are also Slavs, learned this alphabet, and Russian writing still bears a strong resemblance to the Greek. Many other people developed alphabets of their own.

The Chinese have never had an alphabet. Countless generations of Chinese children have had to learn thousands of characters, each standing for a word or a syllable. The Japanese borrowed this method of writing from the Chinese. However, though they use many Chinese characters in their writing, their language is altogether different from Chinese.

In recent years a simplified kind of writing has been introduced in China, in order to bring education to the masses. The number of characters has been reduced to a thousand; and anybody mastering these forms can get along quite well. However, in order to be really well educated, a Chinese must learn the older system of writing. Otherwise he would not be able to read the great classics of literature and philosophy of his native land.

What materials have been used for writing purposes throughout the ages? We have already mentioned some of these materials: the clay tablets of the Sumerians, Babylonians and Assyrians, the papyrus of the Egyptians. The Egyptians also used parchment, a substance made from the skins of goats, sheep and other animals.

The ancient Greeks and Romans wrote their laws and public records in early days on stone and bronze tablets. Later they used parchment and papyrus for ordinary writing purposes. The Romans had a very ingenious way of taking notes and writing personal messages. They carried with them tablets made of wood or metal and covered with wax. They wrote upon them with a stylus of metal bone or ivory. When the material written on the tablet had served its purpose, the wax surface would be smoothed with the

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Monks—scholars of the Middle Ages—copying and illustrating their beautiful books by hand.

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The Chinese invented paper. Their books were long sheets which could be rolled up when not in use.

blunt end of the stylus. The tablet would then be ready for other writing.

The men of western Europe continued to use papyrus for some time after the fall of the Western Roman Empire in 476. Then when papyrus became scarce, parchment came into general use. All the beautifully illuminated manuscripts of medieval times were written on vellum. (See Manuscripts, Illumination of.) Vellum was a fine kind of parchment, made from the skins of very young animals.

Today we do practically all our writing and printing, not on clay or stone tablets, or on papyrus or on parchment, but on the substance called paper. Though the word paper comes from the Egyptian papyrus, most scholars hold that this ancient writing material was not really paper. It is said that paper was invented in China by a man called Tsai Lun, a high official who lived about 2,000 years ago. He used the beaten fibers of the inner bark of the mulberry tree; when these fibers were matted together, they formed a white sheet. This was much better for writing purposes than the silk fabrics and flat pieces of bamboo upon which the Chinese had formerly written. The use of paper in China became widespread.

In the eighth century the Arabs of Bagdad and Damascus began to make paper. It is generally thought that this substance came to Europe by way of Spain, which the Arabs and other Mohammedan peoples had conquered in the eighth century A.D. At any rate, we know that there were paper mills in Spain, Italy and France in the twelfth century. As time went on, paper gradually replaced parchment, which is now used only for special purposes and in very small quantities. We discuss modern methods of manufacturing paper in another article.

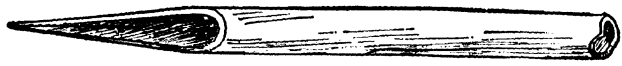
We do not know a great deal about the kinds of pens that the ancients used. The inscriptions on stone were cut with stone instruments at first, later with instruments of bronze and iron. Pens made from reeds and split at the ends to form a kind of brush were used by the Egyptians to write on their papyrus rolls. Brushes made of the hair of animals were also used, and the Chinese and Japanese use them to this day. The Egyptians invented ink, which they made from nutgalls and sulphate of iron.

Reeds were also employed for writing on parchment, and their use continued down to about the thirteenth century. However, before this time some copyists had found that the wing feathers of large birds made better pens, and for hundreds of years these quills were almost the only pens in use. During colonial days, and long after, a part of the duty of a teacher was to make quill pens for his pupils.

The Romans attempted to make metal pens, and bronze pens have been found at Pompeii, but they were not very satisfactory. A few brass pens were made in England in the seventeenth century, and a few steel pens in the eighteenth, but they did not become common until much later. About 1820 the manufacture of steel pens was

THE DEVELOPMENT OF THE PEN

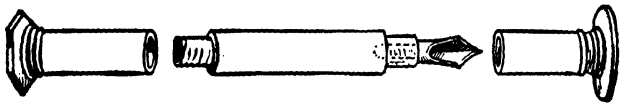
A ROMAN STYLUS OR GRAVER



THE REED PEN—STILL USED IN THE ORIENT

THE GOOSE-QUILL OF OUR GREAT-GRANDPARENTS

THE STEEL PEN—STILL WIDELY USED TODAY



AN EARLY TYPE OF FOUNTAIN PEN

THE FIRST SUCCESSFUL FOUNTAIN PEN

A MODERN FOUNTAIN PEN

Courtesy L. E. Waterman Co.

Cutting the slit in the gold point of a fountain pen.

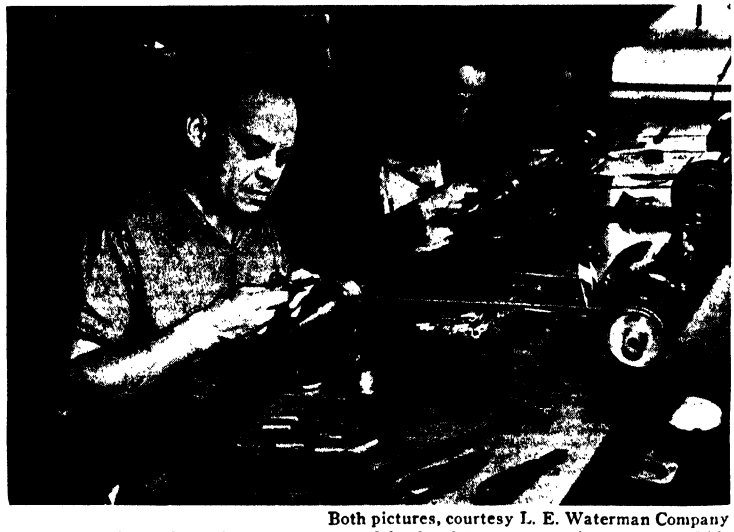
begun in England by a man named James Perry. At first they were made by hand, and were very expensive, but a few years afterward James Mitchell began to make them by machinery. He was followed by Joseph Mason and Joseph Gillot, who helped to improve steel pens and make them flexible.

The first pen factory in America was established at Camden, New Jersey, by Richard Esterbrook. Steel pens quickly took the place, in Europe and America, of the less durable quill. Many million gross of pens for use in holders are now manufactured every year. For a long time the specially hardened steel used in the manufacture of steel pens was made only in Europe. Now American firms supply much of this material. Though the great majority of pens used in holders are made of steel, other metals are sometimes used. These include brass and other alloys and even precious metals, such as gold.

A pen which is attached to a separate holder has quite a number of disadvantages. It has to be dipped in ink frequently and the separate ink supply can not be carried about conveniently. Long ago people began to think about ways of giving a pen its own supply of ink, to make what we today call a fountain pen. The great French king, Louis XIV, used a primitive pen of this sort, but for many years, even after the introduction of steel pens, no satisfactory solution of the problem was found. The ink would always clog or splatter or dry up. In the United States alone over a thousand patents for fountain pens were granted before one was invented that really worked well.

The inventor was Lewis Edson Waterman of New York, who was at the time a life-insurance salesman. Waterman had found it very helpful in his work to have a pen ready when he had persuaded someone to sign a contract. He used one of the early fountain pens. One day, when a particularly important policy was at stake, the pen failed and Waterman lost his customer. At once he decided to make a pen that would always work. By 1883 he had developed such a pen. He connected the nib with the ink supply in the hollow barrel of the pen by means of hair-fine ridges cut into a hard-rubber feed, so that the ink could flow freely and air at the same time could enter.

The early fountain pens had to be opened and filled with ink by means of a medicine dropper. Soon, however, self-filling pens were made. The type now generally used has, inside the barrel, a little rubber sac which may be flattened by means of a lever.

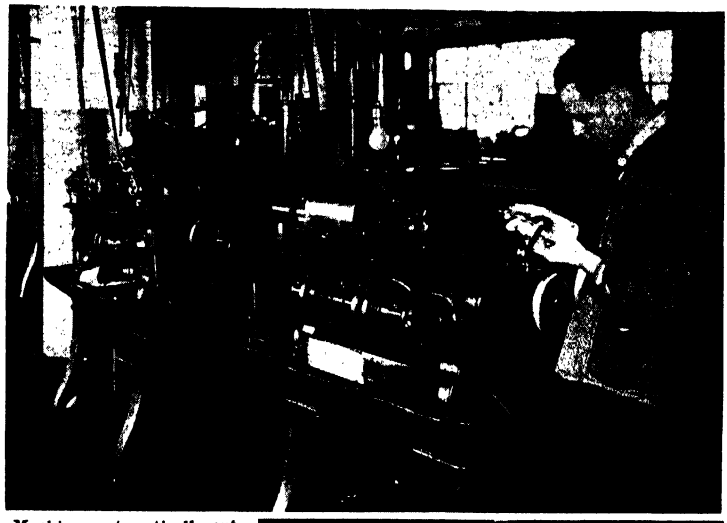


Both pictures, courtesy L. E. Waterman Company

The points of fine fountain pens are ground by hand to assure perfect writing. This delicate work must be done under a magnifying glass by a master craftsman.

When the lever is released—the point of the pen is dipped in ink—the sac fills with an ink supply that will last for quite a long time.

You may notice that when steel pens have been used a long time, they become pitted and discolored. This is because the ink corrodes, or eats away, the steel. It is impractical to use steel points for fountain pens, since the point is always in contact with the ink. Nibs are therefore needed which do not corrode and only the precious metals answer this requirement. The points for the better fountain pens are therefore generally made of gold. Pure gold, however, is far too soft; it must be alloyed with silver and copper—14 parts gold, 4 parts silver and 6 parts copper. Even this 14-carat gold is not hard enough to resist the constant friction against hard-finished writing-paper surfaces. So the very tip of the pen consists of still another metal, the rare and expensive iridium, one of the hardest metals known, which takes a mirror-like polish and makes the pen glide easily over the paper.



Machines automatically cut into proper lengths the composition rods for caps and barrels of fountain pens.

Both pictures, courtesy L. E. Waterman Co.

Delicately adjusted grinding wheels grind the barrels and caps to precise shape.

There are more than eighty separate steps in making a gold pen point. In many of these operations some of the gold and iridium is wasted. It is ground or polished off as fine dust which clings to the walls and floors, and to the bodies and clothes of the workmen. Much of it, however, is recovered. The water in which the workmen wash is carefully filtered after using. The discarded overalls, waste paper, oil and sweepings are burned. What is left is then refined until the precious metals are regained.

The point, of course, is not the only part of the fountain pen, although it is the most important. It takes many steps to cut, shape and drill the barrels and caps, to stamp and assemble the metal parts, to check and test the finished pen. Pictures in the article show you how the gold point is slit and finished, also how the barrels and caps are cut and shaped. These are, however, only a few of the operations.

The ball-point pen works on a different principle. It has no pointed tip, like the ordinary pen; a tiny steel ball, moving around freely in a socket, applies the ink to the paper. A special thick ink is used. This ink flows through a small hole to the steel ball; the ball then "rolls" the ink onto the paper. The ink supply of the ball-point pen is generally carried in a cartridge, which is inserted in the barrel of the pen. Ball-point pens sometimes write for months on a single filling.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 3562.

THE UPPER RESPIRATORY SYSTEM

OUR body is made up of countless small units called cells. These are so tiny that they can not be seen except with a powerful microscope. Each cell has its own work to do in order to help maintain the body in a state of health. There are many different kinds of cells. The cells of the muscles are different from those of the liver; the cells of the heart are different from those of the nerves, and so on through all our organs and parts. But there is one thing that all cells have in common: they need oxygen. Oxygen is necessary for the life processes of each cell; and in using up the oxygen the cell produces carbon dioxide; this is a harmful substance to the body and must be removed.

How do the cells receive their oxygen and get rid of their carbon dioxide? The body receives oxygen from the air into the lungs by breathing it into the lungs. The blood takes oxygen from the lungs and carries it through the body so that all the cells get their share. The blood also, in its tour of the body, picks up the carbon dioxide which the cells have produced and carries it back to the lungs. From there it is breathed out of the body.

How does the air get into the lungs from the outside? Of course, there must be a passageway; and this passageway is formed by a collection of organs which carries the air from the outside, through our nose and mouth to the lungs, and carries carbon dioxide back again. This collection of organs is called the upper respiratory system and consists of the nose, the nasopharynx, or throat, the larynx, or voice-box, the trachea or windpipe, and the bronchi. These form a continuous corridor through which air travels from the nostrils to the lungs. We shall consider these parts separately. Remember that nasal means "having to do with the nose."

The Nose

The framework of the nose is made of bone and cartilage. The hard upper part, or bridge, is made of bone and connected to the forehead. The lower part, which is somewhat softer, is composed of cartilage. Just below the tip of the nose are two openings leading to the inside. These are the nostrils, or anterior nares. Their inner edges have a number of stiff hairs which trap dust and other harmful substances that enter with the air we breathe.

The nostrils open into two chambers called the nasal cavities. The walls of the front part of the nasal cavities are formed of cartilage; while at the back part, the chambers are really cavities in the skull and are surrounded on all sides and separated from each other by bone. The wall separating the two nasal cavities is called the nasal septum; the front part of it is cartilage and the back part is bone. Other cavities in the facial bones, called sinuses, open into the nasal cavities. At the back of the nasal cavities are two openings into the throat. These are called the posterior nares to distinguish them from the anterior nares at the front.

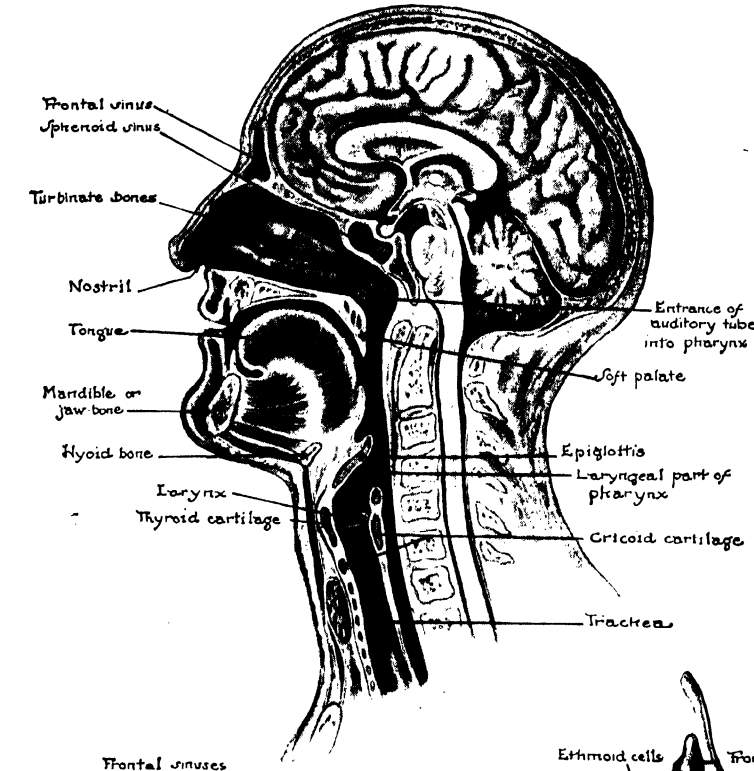
The nasal cavities have a smooth, shiny lining of mucous membrane, which produces a thick, slippery liquid called mucus. The surface of the mucous membrane has fine, hair-like structures, cilia, which constantly move in a sweeping motion toward the nostrils. Dust and bits of dirt are trapped in the sticky mucus and swept toward the outside to prevent them from continuing on into the lungs. The mucous membrane of the nasal cavities continues into the sinuses to form their lining and also continues into the nasopharynx. Many blood vessels and nerves are found in the mucous membrane.

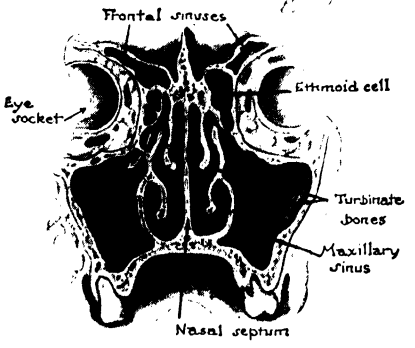
It is possible for you to breathe through your mouth, and that is what you do when your nose is closed by a cold or by some other obstruction, such as adenoids. However, it is better to breathe through the nose because then the air is filtered by the hairs around the nostrils and by the cilia; also, when you breathe through your nose the many blood vessels in the lining of the nose warm the air before it passes on to the lungs.

The nose is very important in producing a natural and pleasant voice. If the nose is closed off by a cold, for instance, so that the air can not pass through it, the voice is changed. It becomes unpleasant to hear, and we say the person "is talking through his nose." This is not true, however; what we really mean is that he is *not* talking through his nose. He can not do so because his nasal passages are stuffed up.

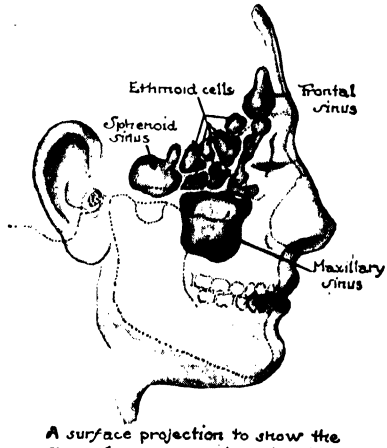
When we have a cold the membrane of the nose produces a great deal of mucus which closes off the nose. Sometimes the infection may spread along the mucous membrane to the sinuses and cause a painful condition

THE UPPER RESPIRATORY SYSTEM





Frontal section through nasal cavity



A surface projection to show the general arrangement of the sinuses

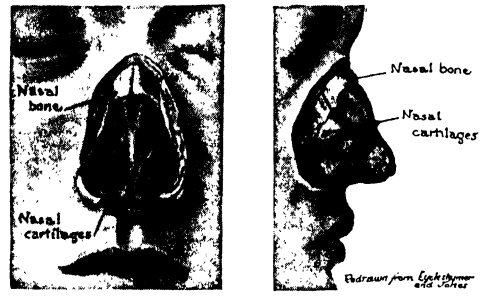
The picture at the top shows "the inside of our head." Let us trace the passage of air. The air is taken through the nostrils where it is filtered by hairs growing just within the nostril openings. It then passes around the turbinate bones, where it is warmed, and on behind the soft palate into an area known as the posterior pharynx. Before being carried further, it must pass the epiglottis, just behind the tongue. The epiglottis acts as a trap door to prevent food from entering the larynx when we swallow. While we are breathing the door is raised and air passes freely into the larynx just below it. Ordinarily, the vocal cords of the larynx are relaxed leaving a large opening. When we speak, however, the vocal cords come together and are made to vibrate by the air. Finally, the air passes into the trachea and thence down to the lungs. The bottom pictures show our sinuses.

called sinusitis. Or the infection may pass into the pharynx (throat) by way of the continuous mucous membrane, and from the pharynx it may pass to the mastoid bone of the ear by way of the Eustachian tube, a passageway from the throat to the middle ear. Infection of the mastoid bone is very serious. Sometimes the infection will travel from the nose along the olfactory nerve (nerve of smell) to the brain and cause meningitis. So, you see, the "simple cold" can become very dangerous.

In addition to forming a passageway for the air we breathe, the nose is the special organ of the sense of smell. Just under the bony roof at the back of the nose is an area of mucous membrane containing many nerve fibers. These are branches of the olfactory nerve, or nerve of smell. These fibers pass through small openings in the roof of bone and enter the olfactory bulb. This is a collection of nerve tissues. From the olfactory bulb the fibers from the nose go to the region of the brain which takes care of the sense of smell. This is called the olfactory lobe.

On the lower part of the mucous membrane of the nose are other nerve branches, but they do not connect with the olfactory bulb; they have other pathways to the brain. These nerves have nothing to do with smelling; they help us to recognize other sensations in the nose, such as pain, cold, heat, tickling and pressure.

An odor is probably a collection of tiny particles floating through the air as a gas. When these particles enter the nose they affect the nerve cells in the small fibers of the olfactory nerve. An impulse travels along the fibers into the olfactory bulb and from there to the olfactory lobe, that part of the brain which makes us aware of the smell.



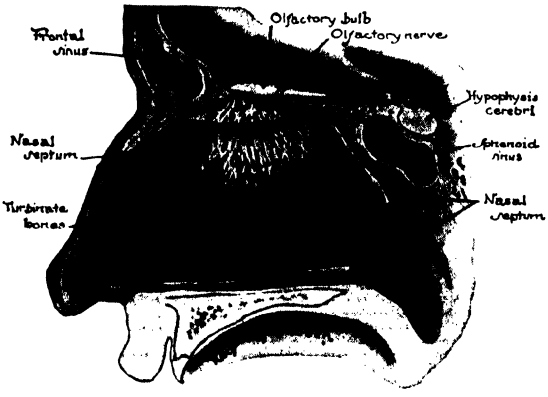
The framework of the nose is made up of bone at the top and somewhat softer cartilage in the lower part.

Odors can also enter the mouth and travel up the throat into the nose through the posterior nares. Many flavors that we call tastes are really odors which travel up the back way to the nose when we eat. That is why our food does not taste so good as usual when our nose is blocked by a cold.

The Nasopharynx The throat, or pharynx, is a tube-like structure lined with mucous membrane like the rest of the respiratory system and the mouth. The upper part of the pharynx, called the nasopharynx, is just behind the nose, and into it open the posterior nares. Air coming from the nose passes through the posterior nares into the nasopharynx and from there to the voice-box.

On the back wall of the nasopharynx are the adenoids, or pharyngeal tonsil, which is quite large in children but grows smaller later on. Sometimes the adenoids may become very large due to infection and then they must be removed.

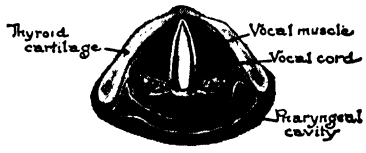
On either side of the nasopharynx are the Eustachian tubes, which are passageways leading into the middle ear. They serve to equalize the air pressure on either side of the eardrum. When you go down in an elevator the air pressure grows greater and you feel an uncomfortable pressure on your eardrums. You automatically swallow to allow the greater pressure to travel along the Eustachian tubes to the inner side of the eardrums. Sometimes infection in the nose spreads along the continuous mucous membrane of the Eustachian tubes into the middle ear. Pain in the ear and deafness may be important signs of middle-ear infection. See the article on the Ear and especially the drawings on pages 3306 and 3309.



Just under the bony shield at the back of the nose are the many olfactory nerve fibers, which carry the sensation of smell to its special sense organ, the olfactory bulb.

The Larynx

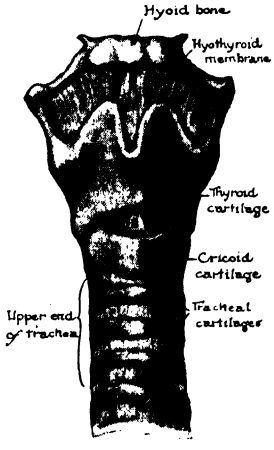
We talk with our larynx. For this reason it is called the voice-box. It is frequently called the Adam's apple in men. In some thin people you can easily see the voice-box move as they swallow. If you could look down into the throat of a person who is talking or singing, you would see how the larynx works. Within this box-like structure, made up of nine cartilages and associated ligaments, are two folds of tissue that vibrate when we talk. Your doctor can look into your larynx with a small round mirror and see these vocal cords. When you breathe deeply these folds of tissue relax and open wide, so that air can go into the lungs easily. When you say "ee" the vocal cords become tight and draw close together and vibrate. This vibration given to the air as you breathe out is the sound of your voice. All of our speech and our singing is produced in this way.



A cross section of the voice box, or larynx, seen from above. The thyroid cartilage is particularly large in men and makes what we sometimes call the Adam's apple.

The passageway into the voice-box that permits the air to go between the vocal cords and thus into the lungs is called the glottis. A tiny trap-door arrangement closes over the glottis to prevent our food from going down the wrong way when we eat. The trap-door arrangement is called the epiglottis. Every time we swallow the epiglottis closes and we can not breathe during the moment of swallowing. Let us explore the passageway of the glottis. After going through the open epiglottis you enter the larynx and you can see on either side of each vocal cord a fold of tissue called the ventricular folds. These give a small amount of support to the vocal cords and cover them partially to protect them as we breathe.

There are tiny muscles in the vocal cords which have connecting nerves to the brain. These nerves enable us to control the vocal cords so that we can make sounds of varying pitch. If we want to sing a high note, our vocal cords pull very tight and very close together. When we sing a low note they relax and separate a little. When boys get to be fourteen or fifteen years old their voices change, because the larynx becomes larger and the vocal cords become thicker and longer. This gives men a deeper voice than women. During the first few months of changing voice, boys can not control the vocal cords accurately.



The trachea, or windpipe, which lies just under the larynx and connects with it, allows air to pass through the voice box and on down into the lungs.

The Trachea

After passing through the larynx we enter the windpipe, or trachea. This is a moderately rigid tube that looks like a "Y" turned upside-down. Lower down in the chest it divides into two main branches, one going to each lung. The trachea is made up of alternating rings of cartilage and connective tissue. These rings go almost, but not completely, around in a circle and are joined at their ends by muscular tissue. The trachea not only permits the passage of air into the lungs, it also acts to carry out tiny solid particles which may enter the upper respiratory system. The surface of the trachea is lined by a thin layer of cells with tiny hair-like cilia. These cilia are constantly sweeping in an upward direction to carry particles out into the throat. Sometimes, if mucus and tiny solid particles collect in the trachea, the irritation causes us to cough, and we bring up this material to our throats.

The Bronchi

The bronchi are the two main subdivisions of the trachea and they in turn divide into smaller branches called bronchi and bronchioles. The words mean branches and little branches, and indeed the structure of the trachea and bronchi resembles the branching of a tree. In the bronchi and bronchioles are rings of muscular tissue which are very important in the treatment of asthma. When a person has an attack of asthma, these muscles contract and breathing is very difficult because air can get neither into nor out of the lungs. This condition can be treated by certain drugs which relax the muscles.

We tell you about bronchi and the lungs in the article beginning on page 1325.

By A. Gale Borden, M.D.

THE NEXT STORY OF OUR OWN LIFE IS ON PAGE 3801.

374.1 Proctor, William Martin
Vocations. c.1929.

A sample author card for the catalogue.

HOW ARE LIBRARY BOOKS ARRANGED?

SUPPOSE you have a gift of five thousand books which were owned by an elderly neighbor who decided to travel and to give his books to you. The books are at your door, nicely packed in large boxes. When your new shelves are ready, how are you going to arrange your books?

Your aunt suggests that they would look best arranged by colors—all blue ones, all red ones, all green ones and so on. You know that is not the way to do because you could not possibly remember which color a special one might be. You think it would be better to arrange them by authors, and you start out happily placing all Adams, Browns and Churchills in order. Before long, you notice that fiction, history and science books are side by side, and that seems confusing. A better arrangement must be found.

A bright thought comes! You will go to the public library to see how the books are arranged there, for you have noticed how quickly librarians find books when you ask for them. You see neat numbers on each book, making an even line of numbers about an inch from the shelf. There is also a letter under the numbers on each book.

The librarian tells you that the numbers stand for special subjects, and that your books may be so divided. The letter under the numbers is the first letter of the author's last name, and here is an example of a number and a letter—973. Let us say it marks a history of the United States by a man named Elson. You notice that all histories of the United States have this same number and are all together on the shelf. You are now curious about the other numbers, and you trace them backward, seeing that each number has its special subject, ending with the 100s, where you see the label, Philosophy and Psychology.

E

You are delighted at this discovery, and ask the librarian who thought of this very helpful system. She tells you that the inventor was Melvil Dewey; so the system is called the Dewey Decimal System, and is generally used. You hesitate at the thought of decimals but find that they are very simple ones, merely dividing subjects a little more easily. For example, 973.2 is the number given to a book when all of it is about the Colonial days in United States history; 973.3 about Revolutionary days, and so by decimals up to 973.9, a history of United States in our own times. If we have 973 without any decimal following, it means that the history of the United States is given, including all of the periods, not just one period as are the others, with decimals.

Perhaps you are wondering what number is

given to magazines and encyclopedias, since they have articles about history, art, science and a great variety of other subjects. That brings us to the first numbers in the Dewey Decimal System, the 000s, which are for books containing many subjects. For example, encyclopedias are numbered 030, magazines, 050.

When your books are grouped by subjects and so numbered, you should make a card catalogue for them, so that at any time you can locate any book in the shortest possible time. If you were to make this list on sheets of paper as some of the very oldest libraries in Europe still do, think how it would look when you add new books and must write between the lines. Also, if a book were lost or ruined, you would have to make a black line on your page. If you use a card file instead of sheets of paper, you can easily remove or add a card and not disturb the other cards.

A CARD FOR EVERY AUTHOR
A CARD FOR EVERY TITLE

You make a card for every author of your books and place the Dewey number in the lefthand corner where it may be seen at a glance. You make a card also for every title of your collection; then, in case you forget who wrote a book, you can locate its number by the title card. There might be a time when you forget both the author and title of a book, remembering only the general subject, such as Birds, or Aviation, and in that case you would need to have a subject card for each book. Each card will have the number of its book, and the only difference in the cards will be that the *subject* comes first on a subject card, then the author and title are given below the subject. The title card will have the *title* on the top line and the author below. On the author card, the *author* is on the top line. The cards are then filed, all in one long alphabet. It is much better to have them all alphabetically filed according to what is on the top line, for then you cannot fail to locate a card for every book you have.

You now have your books on their shelves, by subjects, and the catalogue is completed. But what about the boxes of bound magazines? How are you going to list the interesting articles which they contain? It would be almost impossible to catalogue every article and every poem in the many magazines, and perhaps you will be adding new ones, each week or each month. Necessity is the mother of invention again, for many other people have had the same problem and so have all the libraries. The answer is the Readers' Guide to Periodical Literature. You can buy the bound volumes, which index magazines for three years, all in one alphabet, telling you the name of the magazine, the volume, date and page of every important article in over a hundred magazines.

A student at Yale University, William F. Poole, started this handy index of magazines about a hundred years ago. His name is almost forgotten, but he was a real inventor just the same. For a time his index was called Poole's Index. It has grown from the work of one person to that of a large staff and the separate parts are sent to thousands of libraries twice a month.

HOW SETS LIKE THE BOOK OF KNOWLEDGE ARE CATALOGUED

Your library now seems complete, but several more large boxes have just arrived. They were packed separately from the others, and they contain your reference books. You find an encyclopedia and arrange its many volumes in numerical order. Now you will be able to find the lives of famous people in history and literature and science and art. You can look up geographical names and find just where a city or mountain is situated. A general encyclopedia covers so many kinds of subjects that it makes us think of the doctor who knows something about any kind of illness we may have, although he may send us to a dentist or to a nose and throat doctor for special help.

In the same way there are special reference books which have more for us than an encyclopedia. An atlas gives us maps; a year book gives us very recent information. A set of books devoted just to biography, will give us detailed lives of famous persons, and there are reference books devoted to history alone. Just as there is an index to magazines, so is there an index to tell us in what collections all famous poems may be found. This too saves hours of what might be wasted time searching for a needed poem.

In your school or public library, you have noticed that the reference books carry numbers, just as other books do, to bring all of one kind together. There is one difference. There is a letter R before each number, and that tells us that such a book is a reference book and belongs with books in a reference alcove or room especially for reference books. R 973 would be a reference book for United States history, and R 821.08 a reference book to tell us where to find our many thousand poems.

ADAPTATION OF THE DEWEY DECIMAL CLASSIFICATION FOR USE IN SMALL LIBRARIES

000	GENERAL WORKS
010	Aids in book selection Home reading lists
020	Library economy
030	General encyclopedias; Cyclopedias
070	Journalism
100	PHILOSOPHY
150	Psychology
170	Ethics; Conduct of life
179	Thrift
200	RELIGION
220	Bible; Bible stories
290	Mythology
300	SOCIOLOGY
325	Immigration
330	Economics
333	Natural resources; Conservation
352	Government, State, County, City
353	Government, United States, National
354	Government, Foreign countries
367	Clubs, Scouts, Campfire, etc.
370	Education
373	High schools
374.1	Vocations; Vocational guidance
380	Commerce and industry
383	Postal service; Stamp collecting
395	Etiquette
398	Folklore; Fairy tales (All fairy tales may be classed merely as fiction, or those based on folklore classified under 398.)
400	LANGUAGES
421	English spelling
425	English grammar
500	NATURAL SCIENCE
510	Mathematics; Arithmetic; Algebra; Geometry
520	Astronomy
530	Physics
540	Chemistry
550	Geology
551	Physical geography
570	Biology
580	Botany; Flowering plants; Plant life; Trees
590	Zoology
595	Insects
597	Fish
598	Birds
599	Animals (for domestic animals see 636)
600	USEFUL ARTS
608	Inventions
613	Hygiene; Physiology; Gymnastics
614.8	Safety; First aid
620	Engineering
621.3	Electricity
621.38	Radio
629.1	Aeroplanes
629.2	Automobiles
630	Agriculture
636	Domestic animals (for wild animals see 599)
636.5	Poultry
640	Home economics
641	Food; Nutrition; Cook books
645	Interior decoration
646	Dressmaking; Sewing; Clothing
647	Home management
650	Business; Office methods; Stenography; Bookkeeping; Accounting; Advertising; Printing
680	Manual training; Shop work
700	FINE ARTS
720	Architecture
730	Sculpture
740	Drawing; Design; Lettering
744	Mechanical drawing
750	Painting; Pictures
770	Photography
778	Moving pictures
780	Music
785	Orchestra
790	Amusements; Recreation
792	Theatre; Plays for acting
793	Indoor games
796	Outdoor games
800	LITERATURE
808	Rhetoric and composition
808.1	Poetry collections
808.2	Drama collections
808.5	Oratory; Debating
808.8	Collections of verse and prose; Readers
810	American literature
811	American poetry (All collections of poetry or drama by more than one author are classed under poetry or drama collections disregarding nationality.)
812	American drama

820 English literature
821 English poetry
822 English drama

900 TRAVEL, BIOGRAPHY, HISTORY
909 World history; Prehistoric times
910 Geography; Travel in many countries; Voyages round the world
912 Atlases
914 Europe—Travel
914.1 Scotland
914.2 England
914.3 Germany and Austria
914.4 France
914.5 Italy
914.6 Spain and Portugal
914.7 Russia
914.8 Norway; Sweden; Denmark
914.9 Other countries of Europe
Belgium
Bulgaria
Czecho-Slovakia
Greece, Modern
Holland
Iceland
Jugo-Slavia
Roumania
Serbia
Switzerland
Turkey
915 Asia—Travel
915.1 China
915.2 Japan
915.4 India
915.5 Persia
916 Africa—Travel
916.2 Egypt
917 North America—Travel
917.3 United States
918 South America—Travel
918.1 Brazil
918.2 Argentine Republic
918.3 Chile
919 Oceania; Arctic and Antarctic regions
920 Collective biography
921 Individual biography (The books are arranged in this class under the name of the person written about. In some libraries the letter "B" is used instead.)
929 Flags
930 Ancient history
937 Rome
938 Greece
940 Europe—History
940.3 World war (1914-1918)
941 Scotland
942 England
943 Germany and Austria
944 France
945 Italy
946 Spain and Portugal
947 Russia
948 Norway; Sweden; Denmark
949 Other countries of Europe
Belgium
Bulgaria
Czecho-Slovakia
Greece, Modern
Holland
Iceland
Jugo-Slavia
Roumania
Serbia
Switzerland
Turkey
950 Asia—History
951 China
952 Japan
954 India
955 Persia
960 Africa—History
962 Egypt
970 North America—History
970.1 Indians of America
973 United States—History
973.1 Discovery and exploration
973.2 Colonial period
973.3 Revolutionary war
973.4 Constitutional period
973.5 War of 1812
973.6 War with Mexico
973.7 Civil war
973.8 Later 19th century
973.9 Early 20th century
980 South America—History
981 Brazil
982 Argentine Republic
983 Chile
990 Oceania; Arctic and Antarctic regions

THE NEXT WONDER QUESTIONS ARE ON PAGE 3577.

This is a classification table for a small library, made according to the Dewey Decimal System by Margaret L. Carpenter, Cataloguer of the Schools Department of the Chicago Public Library. You will find it both interesting and useful to classify the books in your own home according to this method. Of course, you may not have books that fit all of these classifications, but, on the other hand, you may have some which belong to classifications not listed here. In this case it would be advisable to go to your public or school library and ask the librarian to tell you the numbers which you need to complete your catalogue.

FROM LEATHER TO SHOES

A cobbler working at his trade in the days when all shoes were made by hand.

A FAMOUS old saying is "There is nothing like leather." This is not quite so true as it was in days gone by, for men have made clever substitutes. But not one substitute has been invented that can equal leather in all respects to beauty, strength, durability and wide range of usefulness.

As we tell you elsewhere, most leather is really a "by-product." Generally it comes from skins of animals killed chiefly for their meat value. We speak of "skins" in the case of smaller animals, such as calves, goats and the like, and of "hides" when we mean larger animals, such as cattle. Every bit of leather in the world was originally a part of a living creature.

Leather-dressing was one of the most important trades among ancient Egyptians, and at Thebes, in the days of Egypt's glory, a special quarter of the city was set apart for the tanners. So great was the demand for leather that Egypt itself could not provide enough skins. One of the forms of tribute exacted from conquered nations was a number of skins, to be delivered every year for the making of leather by skilled Egyptian tanners. In our museums we can see today splendidly preserved leather straps and belts used for binding round the mummies of men who lived far back in the days of Solomon. The mummies themselves, as they were carried to burial, were often covered with a pall, or canopy, of soft leather dyed a delicate blue. The Egyptians used leather for making sandals, braces, belts, bags, shields, harness, sails, cushions and chair seats. From them Israelites learned the art of tanning, and although the word leather occurs in the Bible only twice, there are many references to "skins," which clearly mean leather.

The Greeks and Romans made leather, and indeed it is difficult to find any nation, ancient or modern, civilized or uncivilized, to whom leather has not been known. The most extraordinary things have been made of it. The Romans at one time had coins of leather, and some of the early cannon were made of leather.

The skins of animals differ greatly. Animals living in hilly countries, where there are great changes in temperature, are provided by nature with a heavy, hardy overcoat, others living nearer the seashore have skins that are less tough. These different qualities are preserved in the leather that is obtained from the different animals.

All animal skins in the raw state are largely composed of gelatine which spoils if exposed to air and moisture. In making leather from them various processes are used, but they are all based upon the same principle, namely, to change the hide or skin from something which would easily decay to a material which will last almost indefinitely. Modern science and invention have transformed the process of making leather as the centuries have rolled by. We can make it better and more quickly today than was ever done in olden times. Processes have been improved and simplified. Most hand processes are now done better by machine, although the hand of man still directs and cares for much that is done with machines. Many substances are used today

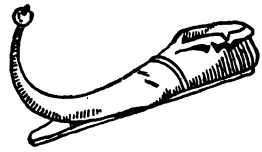
CURIOUS FOOTWEAR OF THE PAST

Greek

Roman

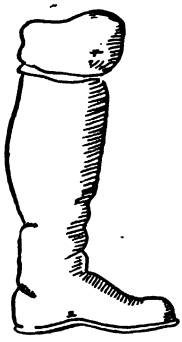
Ancient British

10th Century



14th Century

15th Century

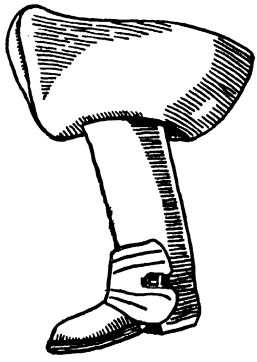


15th Century

16th Century

16th Century

17th Century



18th Century

18th Century

Mid 19th Century

Early 20th Century

Photographs on pages 3564, 3566, 3567 and 3569, courtesy, The Armour Leather Co.

After arriving at the tannery, skins are soaked and then put in a lime solution to loosen the hair or wool. Next, they are put through a machine resembling a clothes wringer, which scrapes off most of the hair. A similar machine is used to remove the flesh from the other side. If any remains, it is taken off by hand.

in making leather from hides and skins, but they may be divided broadly into vegetable agents and mineral agents.

Water—plenty of water—for cleanliness! Before anything else is done to the hides and skins, when they are brought to the place where they are to be made into leather (tanneries, we call them) they are thoroughly washed and all dirt is removed. Then come various ways of loosening the hair, though sometimes the leather is tanned with the hair on. For centuries ordinary lime, dissolved in water, has been used for this purpose and there are other chemicals which help the lime sometimes. It has been only lately found out why lime does this. Bacteria, the tiny creatures that we can see only through a very powerful microscope, are in this lime solution and make their way down through the skin, loosening the roots of the hair so that they come away easily. This process has been known and used for a thousand years, though men did not know the reasons behind it.

We can follow the skin through some of the other processes by the pictures. They differ somewhat according to the general method of tanning and according to the kind of skins. Generally the odor around a tannery is not very pleasant.

The old method in use for thousands of years was to soak the skins in liquid containing tannic acid, a brew very much like tea. This is obtained from the bark of many trees, and the wood of some also contains a considerable amount. Oak and hemlock bark have been long used. The bark of the mimosa contains much tannin and the acorns of an evergreen oak found in Greece and Asia Minor have even more. One variety of the quebracho (or "axbreaker"), a South American tree, furnishes much tannin.

Galls, which are abnormal growths found on oak trees, were known to the ancients as a source of tannic acid. Formerly the chestnut trees of the Appalachian Mountain region in North America furnished much tanning extract; but a fungus growth has killed off most of these trees.

As in all other great industries, many improvements have been made in tanning during recent years, so that we can make more and better leather from the same quantity of raw materials. Many new processes

and machines are used. Many other vegetable substances have been found to be of value as tanning agents. The waste from paper mills, for instance, is sometimes used.

About a half-century ago a great revolution in leather-making began. Some thoughtful man found that chromium compounds could be used for tanning. This material makes tough, long-wearing leather. Its use shortens the time of tanning and today almost all of the upper leather which goes into shoes is made by this process, called chrome tanning, which uses minerals instead of vegetables. The methods and results differ somewhat from those of vegetable tanning.

Many other methods of making leather are used. Chamois leather, for instance, is made by working oil into the skins after the hair has been taken off. Russian leather gets its pleasant odor from the birch oil which is used in preparing it.

LEATHER IS EVEN MADE FROM THE SKINS OF SNAKES AND FISH

The skin of almost every animal can be tanned. All over the world we go for the skins of these animals. Of course, cattle, young and old, sheep and goats are the main source of supply. But we make leather out of reptile skins and fishskins; even sharkskins are tanned. Horsehide makes an excellent leather. The skin of pigs is much used for saddles, bags and also gloves. The skins of snakes, lizards and alligators make leather for shoes, bags, letter cases and the like. Glove leather is made from deerskins and the skins of kids and lambs, and sometimes even dogs give their skins for making gloves. Much fine leather is made from the skin of seals—not the fur seal but the hair seal caught in the Atlantic Ocean. Walrus skins make a very heavy leather which is used for wheels to polish silver goods. The same is true of elephant, rhinoceros and hippopotamus leather. Porpoise leather, full of oil, is sometimes used for special purposes. Kangaroo skins also make a very important shoeleather, tough and hardy, like the animals themselves. The skins of antelopes make particularly fine handbags, sturdy, yet soft and pliable.

MANY SUBSTITUTES FOR LEATHER HAVE BEEN DEVELOPED

Because leather is a by-product and few animals are raised or caught for their skins only, the supply of leather has been more constant than the growing demand. As a result, man a long time ago began to try to develop substitutes for leather.

Most of these substitutes are based on cellulose in one form or another. As we tell you on page 2747, cellulose is one of the most wonderful substances known. It forms the greater part of the framework of all plant life. We use it chiefly as paper and cotton and rayon. To make leather substitutes, a strong cotton fabric is generally coated with some tough, pliable substance.

The first attempt to make something to take the place of leather resulted in the old-fashioned oilcloth. This was simply canvas painted or printed with linseed oil and certain color materials. Later cork was mixed with the linseed oil and the result was called "linoleum." The next step was to drop the natural oil and use a cellulose solution similar to those used for rayon, cellophane and glossy automobile finishes. This dries like a piece of skin and can be colored to any desired shade. The coated fabric can be passed between rollers which stamp it to represent the grain of any leather.

Such coated fabrics are today widely used to bind books, cover furniture and seats in automobiles, for automobile tops, bags and purses, and for many other purposes. Other leather substitutes have even been used to make shoes. While these substitutes are satisfactory for some purposes, for others they are quite often most inadequate.

Courtesy, United States Leather Co.

Cleaning the flesh side by hand is done on a rounded board, known as a "beam," with a curved two-handled knife. This process is called "beaming."

Most of the leather produced is used for shoes, in fact, it is said that 80 per cent of all the leather is used up on the feet of the world's population. Leather has been found to be the ideal material for shoes. If hard substances like metal or wood are used in its place, we can not walk easily. If we use soft substances to make shoes, like cloth, or canvas, or rubber, our feet are not well protected. Shoes made of leather support the feet well and help to maintain an even temperature because they permit the skin of the feet to breathe. No material is so well adapted for shoes as leather, for no material has ever been made that has all its properties. Let us follow some of the leather into a large factory to see how it becomes a pair of shoes.

Enormous revolving drums like those shown above are used for more than one purpose during the process of tanning leather. In the group in the picture the skins are tumbled about in tanning solutions which make certain changes that give added toughness to the hides. This is a special process known as chrome tanning.

If you look at your shoe, you will notice three parts, the upper, the sole and the heel. You may think the story these parts have to tell is simple and brief, but when you learn that they may have passed through 160 different machines and 209 different pairs of hands, you begin to realize that the making of shoes is not a simple matter. All the different kinds of shoes worn at the present time have interesting stories of their own. The "peg" shoe gets its name from small wooden pins, or pegs, which are driven through the soles and uppers to hold them together. The "nailed" shoe, which is very strong and heavy, has its sole attached to the upper by nails. The "McKay sewed shoe" took its name from Gordon McKay, through whose interest the McKay sewing machine was perfected. The "turn" shoe, invented centuries ago and still used in making fine shoes for women, is made wrong side out and is later turned to the right side. More important than any of these is the Goodyear "welt" shoe, so called because a narrow leather strip, or welt, is sewed into the seam between the edges of the uppers and the inner sole. The Goodyear welt shoe is worn by a great many people, and is now considered the best machine-made footwear. Some people still have their shoes made by hand, because they believe hand-made shoes are superior to those made

SPLITTING AND STRETCHING HIDES

The thick parts of a hide are shaved off to give it uniform thickness, and the "splits" are used for less fine grades of leather. Sometimes two layers of leather are produced. The grain side is the finer.

Much of the natural oil in hides has been taken out in the early processes, and in order to restore it, they are put into another set of drums and whipped about in a solution called "fat-liquor." Dyes are sometimes added at the same time. After standing for several days, they are stretched, tacked to boards and left to dry.

by machinery. As it is, hand-made shoes usually have the outside stitched to the welt by machine.

FOR THOUSANDS OF YEARS ALL SHOES WERE MADE BY HAND

In the early days all shoes were made by hand. The chief tools used were the hammer, lapstone, needle, knife and awl. Tools of this description were used by the Egyptians. They appear in the drawings in a temple at Thebes, built about 1400 B.C., showing the arts and crafts of the time. In any shoe-repairing shop you may still see the shoemaker working with these tools, which have not changed very much. But during the nineteenth century machines were invented for every important process in the manufacture of shoes, and large factories have been established where millions and millions of pairs of them are made every year. In this country few shoes are made except in these great factories.

The first shoemaking recorded in America was by Thomas Baird, or Beard, who arrived at Salem in 1629. He was engaged by the Massachusetts Bay Company to make shoes for the colonists. For this purpose he brought with him different kinds of hides and the various tools. It is recorded that a planter in Virginia in 1636 employed six shoemakers to make shoes for his slaves.

Early in the history of New England, Lynn, Massachusetts, became a shoemaking center. Philip Kertland, an experienced Welsh shoemaker, came there only a few years after Baird reached Salem, and taught his art to many of the colonists in the vicinity. In a few years Lynn was making many of the shoes then sold in Boston. John Adam Dagyr, another celebrated shoemaker, also settled there in 1750. He secured the best samples of work from abroad and taught many apprentices. The fame of New England shoes, now known all over the world, is due largely to training by these men.

A SKILLED SHOEMAKER TOOK SEVEN YEARS TO LEARN HIS TRADE

Before the introduction of shoemaking machinery the young man who wanted to learn the trade was apprenticed for a term of seven years. He was instructed in every part of the trade, and when he had served his time he became a full-fledged shoemaker and started out for himself. He was called a journeyman, because he journeyed from place to place in search of work. A family needing shoes would engage him to come into their home to make shoes out of their home-tanned leather, and he would remain with them, working until he had made a year's supply of footwear for customers in this way. This was called "whipping the cat," and the custom persisted for a very long time.

A master workman soon realized that he could increase his income greatly by employing other men to do certain portions of the work while he directed their efforts. He could get materials cheaper by buying in large quantities. This gradually led to a division of labor, and was the beginning of the factory system, which has steadily developed since that time.

THE BEGINNING OF THE FACTORY SYSTEM IN SHOEMAKING

In 1795 there were in Lynn more than two hundred masters employing over six hundred journeymen, or shoemakers who had learned the trade, and they manufactured shoes at the rate of about one pair a day per man. This work was often done in little shops, usually located in back yards, where from three to eight men worked together. Factory buildings such as we have today were practically unknown then.

Some of the work was often given out to women, who sewed together the different parts of the uppers of the shoes by hand in their homes. Lucy Larcom has given us a vivid picture of one of these workers in HANNAH BINDING SHOES, from which the following verse is taken:

> Poor lone Hannah,
> Sitting at the window, binding shoes!
> Faded, wrinkled,
> Sitting, stitching in a mournful muse!
> Bright-eyed beauty once was she,
> When the bloom was on the tree.
> Spring and Winter
> Hannah's at the window, binding shoes.

John Greenleaf Whittier, the Quaker poet of New England, was a shoemaker in his youth. He praised the gentle craft in a BALLAD TO SHOEMAKERS and also wrote COBBLER KEEZAR'S VISION.

THE INVENTION OF MACHINERY BRINGS ABOUT GREAT CHANGES

Previous to 1845 there had been little change in the tools used; the lapstone, the hammer, the crude knife and the awl were the most important. But in that year a rolling machine was perfected. It took the place of the lapstone and hammer, which the shoemakers had used to make the leather tougher. By the use of this machine a man could obtain in half an hour the same results

TRIMMING AND PRESSING LEATHER

The rough edges and tack holes are trimmed off, then the leather is ready for finishing, either by machine or by hand. Machines which exert a pressure of 300 tons on the leather give it a smooth finish, while glazing, which follows, gives it a luster. To glaze leather, the surface is rubbed with a glass cylinder.

Courtesy, United States Leather Co.

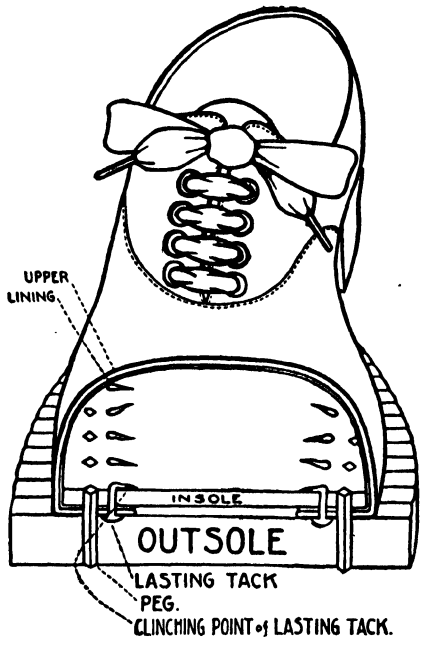
Thick leather, such as sole leather, is put under large heavy rollers, like the one shown here, which runs back and forth over the surface until the fibers are all packed closely and the leather is firm and solid. There are other methods used in finishing leather as each kind of skin requires somewhat different treatment.

as a workman could in a whole day by the old method of pounding.

The first McKay sewing machine was established in Lynn in 1861. At that time there was a great demand for boots for soldiers engaged in the Civil War. As the war also took many men from the shoemaking trade, more and more machinery was used. This increased demand for shoes and the scarcity of labor led to many improvements in shoemaking machinery, the most important of which was the Goodyear welt sewing machine, for which patents were obtained in 1861, though the machine did not come into general use until many years later. It was the basis for the now-famous Goodyear welt system of manufacturing shoes, which has been constantly improved and now includes many machines. This system was not really accepted until the early 90's.

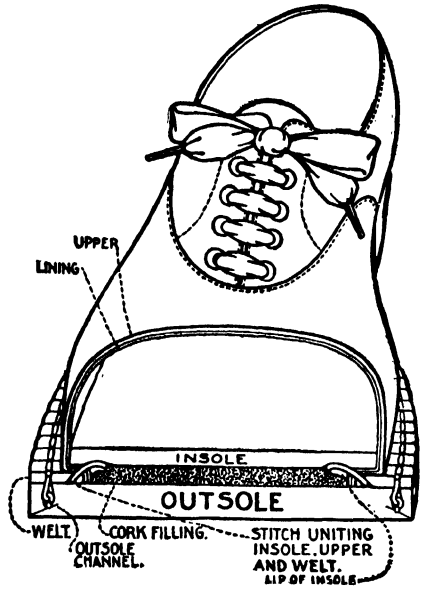
Many factories were built, chiefly at Brockton, Boston, Beverly, Haverhill and Lynn, and were equipped with all the modern machinery. Though many shoes are made in other states, particularly in Wisconsin, Missouri, Illinois and Ohio, the production of Massachusetts is still by far the largest. Making shoes by machinery began later in Canada than in the United States, but now there are many well-equipped factories, which supply the largest part of the needs of the people. These factories are chiefly in the provinces of Ontario and Quebec.

Now let us see how a pair of Goodyear welt shoes is made in a modern factory. When an order is received at the factory very careful specifications are made, telling the size and style and the quality of the material to be used. Similar descriptions, or specifications, of each part are sent to the foreman who has charge of the making of that part. From careful measurements of these parts the patterns of the soles and parts of the uppers and linings are cut out. They are all made to fit the last, which is one of the most important factors in the making of shoes. It is the wooden form which determines the size and shape of the shoe, and which has much to do with its "fit." All of this requires great care.



CROSS SECTION OF A PEGGED SHOE

In this type of shoe, wooden pegs, wire or nails are driven through the outsole, the upper and the insole. The tacks used in lasting are driven way in and clinched against the metal bottom of the last to help hold the upper and insole together. The ends of the pegs and tacks, which show on the inside, leave the surface rough, until the pegs are cut off.



CROSS SECTION OF A WELT SHOE

In this type of shoe the tacks used in lasting are all withdrawn and a machine with a curved needle sews the welt and shoe upper to the insole without going inside the shoe. The outsole is then stitched to the welt. By this method the inside is left perfectly smooth for the foot. Such a shoe does not wear out stockings as a pegged or nailed shoe does.

The parts of the upper are cut out of leather which is tough but soft and pliable. The machine which does this work cuts more quickly and accurately than any human hand. The edges of these parts are "skived," or thinned down to a beveled edge, then given a coating of cement, and afterward folded on a machine which turns back the edge and pounds it down flat so that it presents a smooth and finished appearance. The toe-caps are stamped out and perforated by a machine. On one of the top linings is stamped the order number and size of the shoe. Then the parts of the upper are sewed together with the linings and stays. A machine rapidly puts in the eyelets, placing them on both sides at once, directly opposite each other. This finishes the upper.

The outsole, or outer sole, is cut from sole-leather, which is thicker and stronger than that used for the upper. It is then passed to a heavy rolling machine, where it is subjected to tons of pressure between heavy rolls. This pressure, which takes the place of the hammering which the old-time shoemaker gave his leather, brings the fibers more closely together and greatly increases the wearing qualities. The outside is then passed through a machine which reduces it to a uniform thickness.

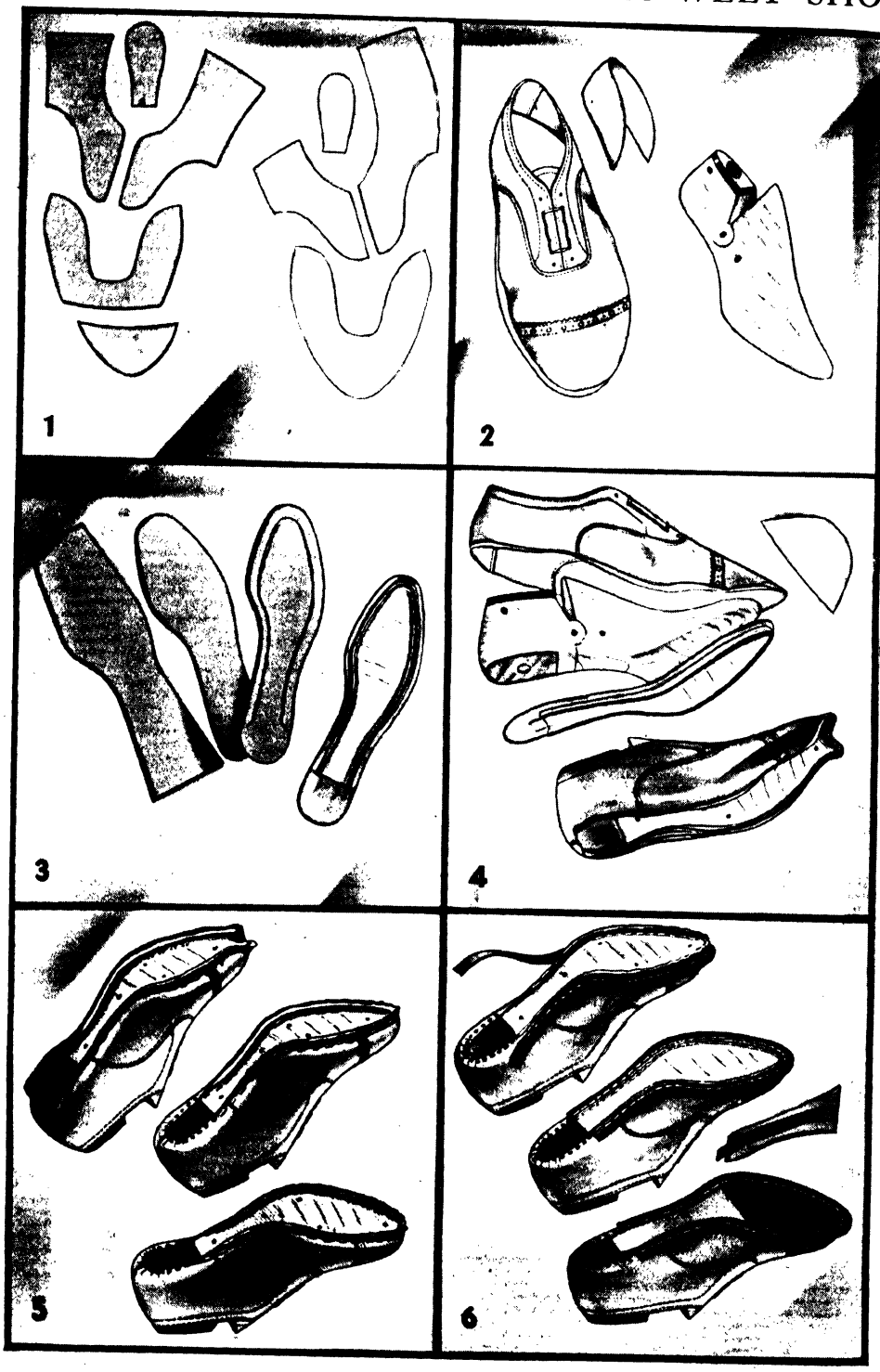
The insole, which is made of much lighter leather, is prepared in a similar manner and is also reduced to a uniform thickness. A machine cuts a slit which extends half an inch into the edge of the insole, separating the edge into two parts. One of the edges is called the lip. The same machine cuts a small channel, or groove, along the surface inside the lip. The lip is now turned up by another machine so that it stands at right angles to the insole. To this lip the welt and upper are sewed later on, and the groove made by the channeling machine inside the lip then serves as a guide for the skillful operator of the sewing machine.

The heel is made of different lifts, or layers, of leather cemented together. It is then placed under great pressure, which gives it form and makes it stronger. Women's shoe heels are mostly of wood. The counter, which stiffens the back part of the shoe, and the toe-box, or stiffening which is placed between the toe-cap and vamp, are made in the same room. When all parts are completed they are sent to the making or bottoming room and the next process begins.

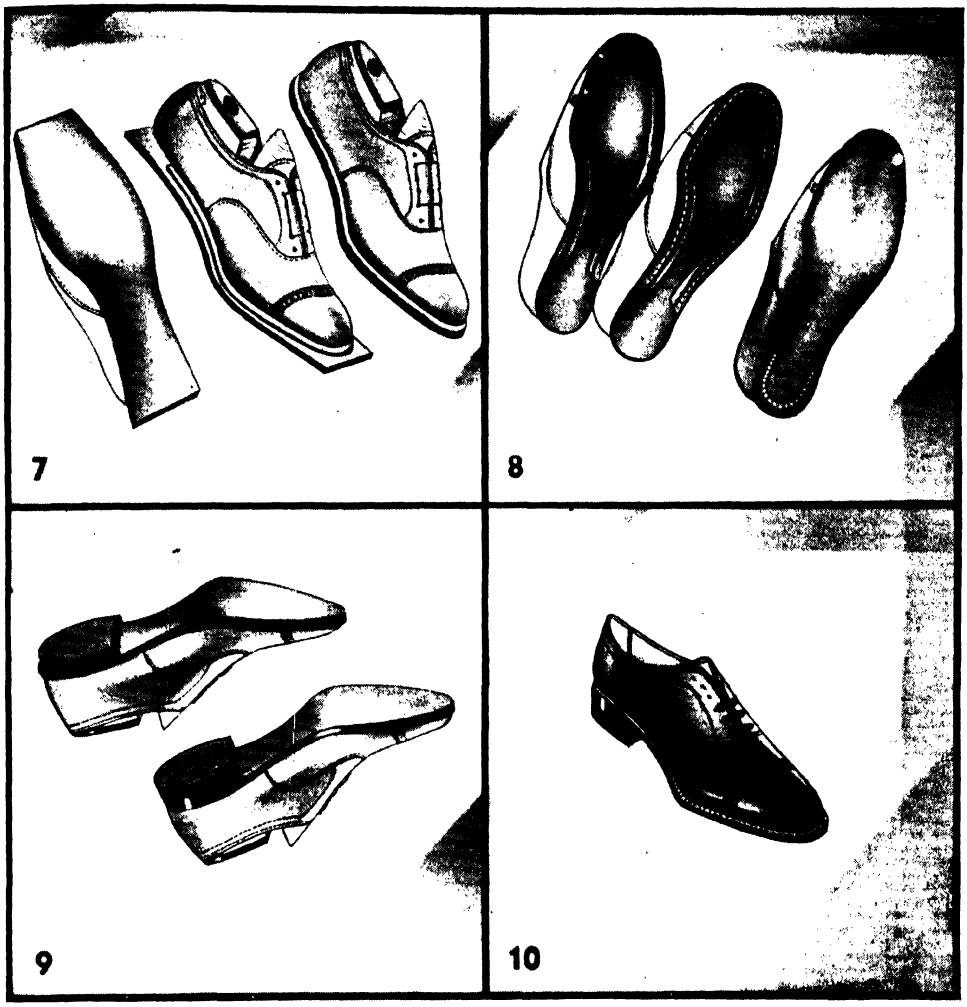
Ewing Galloway, N. Y.

Patterns for the parts of men's shoes are usually made by machinery, but for shoes that require special lasts and for new styles that are to be made up, the patterns are cut by hand. This is an expert pattern-cutter.

STEPS IN MAKING A GOODYEAR WELT SHOE



STEPS IN MAKING A GOODYEAR WELT SHOE



1. The parts of the shoe upper, which include the tongue, quarters, vamp and tip, have been cut by machinery.

2. The upper has been completely assembled and stitched. In the center is the counter (heel piece) and at the right the shoe last over which the shoe is made.

3. Making the insole. The insole blank is shown first, then the rounded insole, then the insole channeled and finally the completed insole with canvas reinforcement.

4. The shoe upper, the box toe, the last and the insole are assembled, then the "pulling over" operation brings them together as seen in the lower illustration.

5. The lasting operations. The first shoe shows the side lasting; the next, the heel seat and toe lasting; the third, the completely lasted shoe.

6. The first shoe shows the process of inseaming (sewing the welt to the shoe); the second, the inseam trimming. Next is the shank piece; and fourth, the shoe with the forepart filler and shank in place. The shoe is now ready for sole-attaching operations.

7. Sole laying. This shows the bottom and then the appearance from the top. The final picture shows the sole rough-rounded, that is, after the surplus has been cut off.

8. The outsole channel has been cut by a machine and the edge, or leaf, turned up in the first picture; in the second, it has been stitched. The third shows the channel leaf cemented and laid and the heel seat fastened.

9. The leather heel has been attached and in the second illustration, a rubber heel has been added.

10. The completed shoe with the last, which has been in the shoe since the process shown in illustration 4, removed.

[Courtesy, United Shoe Machinery Corp.]

Ewing Galloway, N. Y.

When shoes are made by machinery, all of the different parts that go to make the uppers and the linings for them are assembled and stitched together, so that they are practically completed before they are attached to the soles. The number of operations necessary to make the uppers varies with the type of shoe and the design.

There a machine passes strong twine through the eyelets and ties it automatically. This keeps all the parts of the upper in their proper position while the shoe is being made. Another machine tacks the insole to the bottom of the last. A workman then places the toe-box and counter in their proper places and draws the upper over the last.

A wonderful machine pulls the upper smoothly down to the last. The pincers of this machine grasp the leather at different points on each side of the toe. The operator, standing where he can see when the upper is placed exactly where it belongs, presses a foot-lever and the pincers close, drawing the leather securely against the wood of the last. By moving different levers the workman adjusts the shoe accurately, so that each part of it lies in the exact position intended for it when the shoe was designed. The operator again presses the foot-lever; the pincers move toward each other and draw the leather securely around the last. At the same time three tacks are driven automatically on each side and one at the toe, which hold the upper securely in position. These tacks are driven in only part way, so that they may afterward be removed.

The shoe is now ready for lasting. This is one of the most difficult and most important parts of the process, for upon the success of this operation largely depends the beauty and comfort of the shoe. Beginning in the shank of the shoe, the pincers of this machine draw the leather tightly around the last, where it is held by little staples which go first through the shoe upper and then through the lip raised on the insole. Tacks were formerly used for this process, but they have been eliminated by the recent important invention which permits the use of little staples.

The heel and toe portions of the shoes are lasted on machines of a different type and are fastened securely in place. The surplus part of the shoe upper and lining is trimmed away around the insole.

The shoe is now ready to receive the welt, which is a narrow strip of leather that is sewed all along the edge of the shoe except where the heel is placed. This welt is sewed from inside the lip of the insole, so that the curved needle passes through the lip, upper and welt, uniting all three securely and allowing the welt to protrude evenly along the edge. In making the stitch the needle does not go inside the shoe, but

passes through only a portion of the insole, leaving the inside perfectly smooth. This part of the work was formerly one of the most difficult tasks in shoemaking.

The invention of the Goodyear welt sewing machine changed all this. Auguste Destouy had invented a curved-needle machine for sewing outsoles to welts, but it was not successful until taken in hand by Charles Goodyear, son of the well-known inventor of vulcanized rubber. This device was first used in a machine for sewing "turn" shoes, but later was adapted by Goodyear in the famous sewing machine which bears his name. This machine has revolutionized the manufacture of shoes. It makes stitches of equal length and measures them automatically; it draws the strong linen waxed thread evenly and forms a stitch which holds the welt, upper and insole securely together. After sewing, the surplus portions of the lip, upper and welt are trimmed off, and the welt is beaten so that it stands out evenly from the side of the shoe. The tacks holding the insole to the last are now withdrawn, leaving the inside of the shoe smooth.

A shank is now tacked on the insole between the heel and the forepart of the sole and the bottom filled with ground cork or rubber cement to make up for the difference in height caused by adding the welt. Insole and welt now receive a coating of rubber cement, as does the top or flesh side of the outsole, cut from heavier leather to approximately the required size. The outsole is then pressed firmly and with the greatest care to the bottom of the shoe, where it is held by the cement.

Outsole and welt are now trimmed or "rounded," so that they protrude the right distance from the edge. This very important operation gives the shoe its correct shape and style. In this process a slit is cut along the edge of the outsole. This is turned back to allow a clear track for the Goodyear stitching machine which finally unites welt and outsole in lockstitch with strong waxed thread.

The heel is now put on. The rough lifts are trimmed to the desired shape, and the breast of the heel is cut to the correct angle and curve. Wooden heels have been finished beforehand and are securely fastened by a special process which it would take too much space to describe in detail.

The edges of sole and heel are trimmed and scoured smooth by special machines. They are then coated with a special blacking and burnished to a high finish. An indenting wheel passes over the top of the welt, impressing the familiar ripples. The

Ewing Galloway

Sewing the welt, upper and lining to the insole after the upper has been put in position by the pulling-over machine. The outer sole is placed in position and is sewed to the welt. Then the "leaf" will be cemented flat.

Ewing Galloway, N. Y.

The heels, which have been shaped elsewhere, are fastened to the shoe by this machine. Afterward, they are rubbed smooth on a revolving wheel, then dyed black or brown. The finished shoe is cleaned, boxed and sent to the shop. Shoes are made in many different combinations of length and width, to fit all kinds of feet.

bottom of the shoe is brushed to a high gloss. The trade-mark or trade-name of the manufacturer is then stamped on the sole or shank.

In making a welt shoe the last remains inside until the finishing operation so that the shoe has a chance to conform to the last. Now it is removed, and after a final brushing the shoe is packed in a pasteboard box, ready for the buyer.

There are, as you have learned, many kinds of leather made from the skins of different animals. Most fine shoes are made from the skin of the calf or the kid. Heels and soles are made from the skin of the ox or cow, and some heavy uppers also. Much goatskin is also used, and some shoes are made from the skin of the horse.

Other leathers are occasionally used. A few shoes are made from monkey skins, and the skins of alligators and lizards are sometimes used. In recent years snakeskin has been frequently used for women's shoes. Sometimes the entire upper is made of these reptilian leathers, though often the shoe is merely trimmed with them. Many shoes are also made wholly or partly of cloth (except the sole, of course), and some very beautiful fabrics have been designed for shoe use. Soles are nearly always made of strong leather, though some leather substitutes have come into use both for the soles and the uppers.

Shoes are made in twenty-six different lengths, numbered in two series, from 1 to 13. One-third of an inch is a size; that is, the difference in length between a number 8 and a number 9 shoe is one-third of an inch. Between most of the sizes, half-sizes are made. Usually there are five different widths for each size, A, B, C, D and E, and in fine shoes there are also half-sizes. One-twelfth of an inch is a width, as, for example, the difference between a B and C width is one-twelfth of an inch.

While shoes protect our feet, they may also injure them unless we are careful to get shoes that really fit. One pair of shoes of the wrong shape, or too short, or too narrow, may injure our feet to such an extent that they will never be normal again.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 3673.

HOW IS A LIGHTHOUSE BUILT?

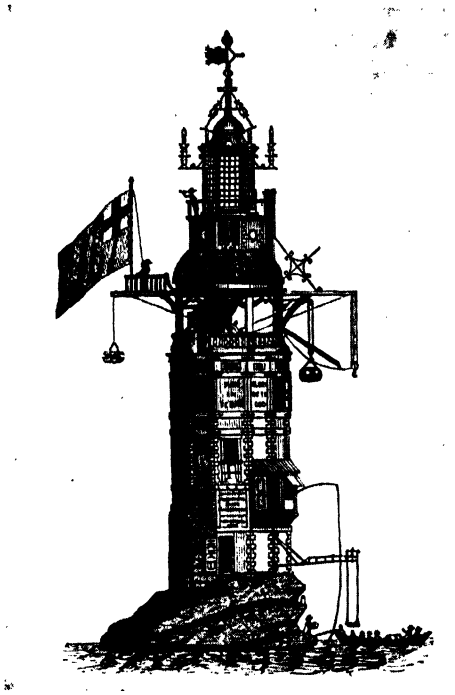
WAVE-SWEPT lighthouses are built on dangerous rocks and reefs, always lonely and often far from shore. To build those difficult towers is an adventure unlike any other, and the builder, besides being skillful, must know the sea and its ways.

At Tillamook Rock, where thousands of sea lions used to play, heavy seas wash over the rock and may batter the lighthouse tower. Landings used to be very dangerous on that steep, rocky islet, which rises sharply out of the Pacific about a mile from the Oregon coast. When the time came to build a lighthouse there, the construction foreman who set out to examine the site was drowned in attempting a landing.

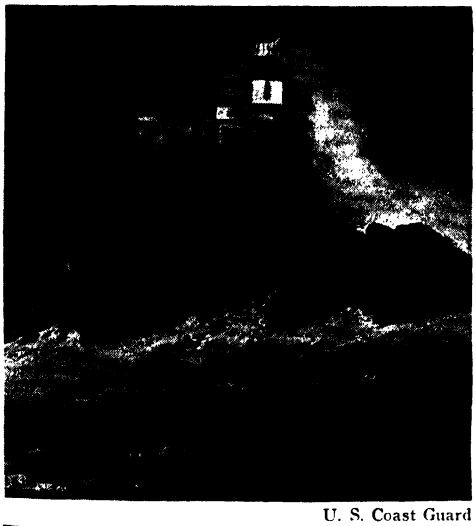
The hazards of landing are almost always the first peril that must be met in working on rocks or reefs that are washed by the sea. At Tillamook, the problem was solved by carrying the men and materials from the supply ship to the rock by means of a cable and traveler run from rock to ship. Later, a derrick was set up on the rock, and vessels were brought within reach of its boom. Today the hoisting derrick on Tillamook Rock is a familiar sight and is taken for granted as the proper way to land men and materials.

If most of the workmen are landsmen, as they were at Bell Rock, the builder has his hands full in caring for their safety. Bell Rock, Scotland, is a famous sunken reef. A good-sized area is exposed at low water, but the tides are tremendous. At high water spring tides—the highest of all—the rock is covered to a depth of as much as sixteen feet. To make a landing, the workmen had to fight their rowboats against strong currents, and at least two seamen had to be stationed in each boat to help them do it. Seaweed flourished all over the rock, and the slippery stuff had to be cleared away so that the men could go about their business without breaking their legs or falling into the water.

Skill in engineering is another necessity. Faulty towers are no match for the sea. There was once an iron tower where Minot's Ledge Light now stands, on the sunken reefs of Cohasset not far from Boston harbor. It was the first lighthouse in the United States to be placed where the full sweep of the



The earliest Eddystone lighthouse, completed in 1699, "a strange pagoda, with . . . florid scrolls."



U. S. Coast Guard

Wave-swept Tillamook Rock, sturdy Pacific sentinel.

Standard Oil Co. (N. J.) photo by Badger

Hatteras Light, North Carolina, marks one of the most dangerous points on the Atlantic coast.

Atlantic Ocean's heavy seas could pound it.

Those sinister reefs had been the scene of many grievous wrecks. One of the ledges, the Outer Minot, was just barely exposed at low tide and was chosen for the site of the tower. Landings on the ledge could be made only at low spring tides, and, even so, could not be made except when the sea was smooth. Under such circumstances, only a few hours of work could be done on the foundations in a year. At length, holes were drilled in the solid rock, wrought iron piles were wedged into them and an iron-frame tower was completed. Its light was shown on January 1, 1850. The balance of the structure seems to have been all wrong, or perhaps there was some other weakness. Its light was last seen from Cohasset at 10 o'clock on a stormy night in April 1851. When morning came, the tower and the keepers who were in it had vanished.

The tower that now stands on Minot's Ledge is one of the finest pieces of lighthouse engineering in the world—a granite cone, nearly ninety feet high, built with great mass and strength. Its door, forty feet from the base, is reached by climbing up a ladder. Minot's Ledge Light was completed in 1860, after five years of bulldog persistence.

There are many famous wave-swept towers: Skerryvore, which was the work of Alan Stevenson, Robert Louis Stevenson's uncle; Bishop Rock, Wolf Rock, Dhu Heartach, off the Cornish and Scottish coasts; and Fastnet, off the southwest coast of Ireland. There are Wolf Trap Spit in Chesapeake Bay, Spectacle Reef on Lake Huron, and The Graves in the approaches to Boston.

If we think of lighthouses that are well known in literature, we are back, at once, at Bell Rock. This is the rock of Sir Ralph the Rover. Southey tells in his ballad, THE INCHCAPE ROCK, how Sir Ralph cut down the warning bell and how, because of this villainy, his ship struck the rock and sank.

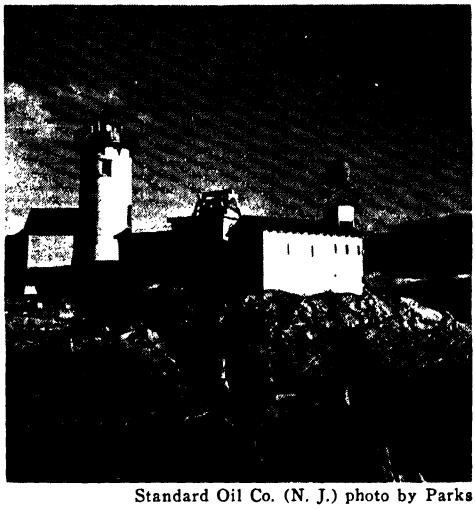
Inchcape or Bell Rock lies off the east coast of Scotland, some miles from Dundee. There had been several attempts to set up a beacon on the rock, but none of them succeeded until Robert Louis Stevenson's grandfather, Robert Stevenson, was appointed to build a lighthouse there. He wrote the story of the building of the tower, telling about every little happening in the course of the work, much as Robinson Crusoe tells about his daily life on the desert island. Many people spoke of Stevenson's ACCOUNT as The Robinson Crusoe of Civil Engineering.

Eddystone is probably the most famous lighthouse in existence. The storied rocks of Eddystone lie fourteen miles off Plymouth, a port in the south of England. They were a

menace well known to Sir Francis Drake a century and more before the first lighthouse was built there. Altogether, there have been four towers on the Eddystone Rocks. The designer of the first one was Winstanley. France was at war with England while the building of the tower was going on, and French privateers captured Winstanley and his men and took them from the rock. That was in 1697, during the reign of Louis XIV. The story goes that the King ordered their release because, said he, he was at war with England but not with humanity.

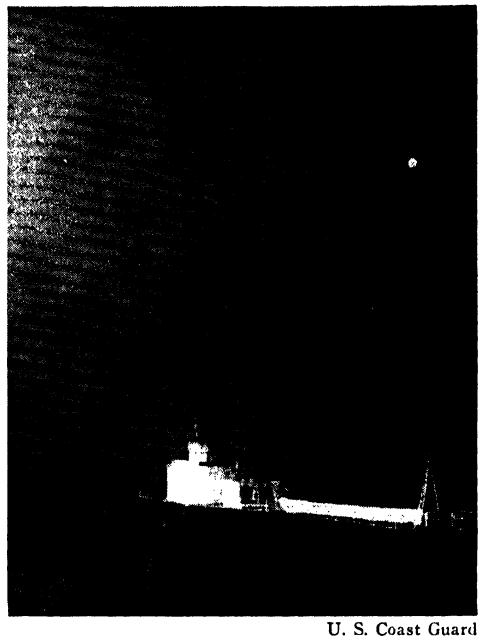
Poor Winstanley! We would laugh at his timber tower today. Stevenson calls it a "strange pagoda, with its open gallery, its florid scrolls and candlesticks: like a rich man's folly for an ornamental water in a park." Yet Winstanley had such faith in this creation that he wanted to be in it during a mighy storm. In 1703 his wish was granted, but he and the tower and the others who were in it—all were swept away.

The next Eddystone lighthouse was simpler, but still made of wood, and before fifty years had passed it was destroyed by fire. Then came Smeaton's tower, made of stone. The famous engineer, John Smeaton, was the first to use dovetail joints for the stones of a lighthouse, and the stones he chose averaged a ton apiece. As time went on, however, water began to undermine it. A higher tower was wanted, and so the fourth Eddystone Light was begun. This time the builder, Sir James N. Douglass, took particular pains with the base. He made it solid and vertical, a massive cylinder that breaks



Standard Oil Co. (N. J.) photo by Parks

Light station at East Gloucester, Massachusetts.



U. S. Coast Guard

Point Bonita Light, on the coast of California.

up or turns back heavy seas, so that even in storms nothing but spray rises up to the lofty lantern. His tower, completed in 1882, is still in use today.

One of the tallest of the reef lighthouses is the iron skeleton tower at Sombrero Key, Florida, 160 feet in height. Tall towers are required on the generally low-lying Atlantic coast. Very short towers are more common on the rugged Pacific coast, for there they are often built on high bluffs. Lights more than 500 feet above the sea include those at Lehua, Hawaii (707 feet); Point Ritidian, Guam (573 feet); Kaula Rock, Hawaii (562 feet) and San Nicolas Island, California (556 feet).

The earliest lighthouses used to be made of masonry, but steel is more generally used in new construction today. There are a few made of wood, such as the one on Seal Island, off the coast of Nova Scotia. In many places where warnings are needed it would be sheer folly to try to build a lighthouse, so lightships are used instead, permanently stationed and riding at anchor in every weather. Ambrose Lightship, for instance, marks the entrance of Ambrose Channel, through which the largest ocean liners enter New York Harbor.

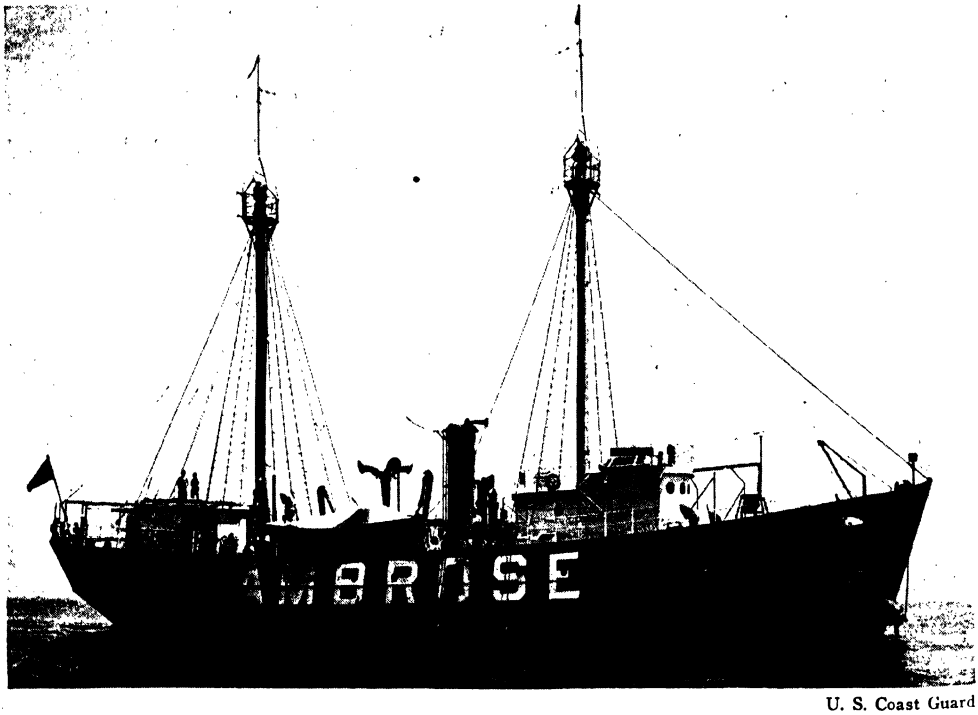
Lighthouses built on land often have comfortable houses for the keepers and their

families, but rock towers seldom have room for so much luxury. Living quarters, storerooms and everything else must be fitted inside the tower. The rooms follow the shape of the walls, one above another, with steps winding higher and higher until they reach the light itself. Most of these lonely towers have a staff of four keepers. Three tend the light while the fourth is on shore, turn and turn about.

Wrecks have often occurred because of mistaking one lighthouse for another. To prevent such disasters each tower is identified in a number of ways: by its light, its fog signal, its color and shape or—more recentiy—by its radio beacon. Radio stations installed at lighthouses, on lightships, or at other points well-known to mariners, work automatically, sending out signals in all directions. Passing ships that receive the signals can identify the station and get their bearings by means of direction finders.

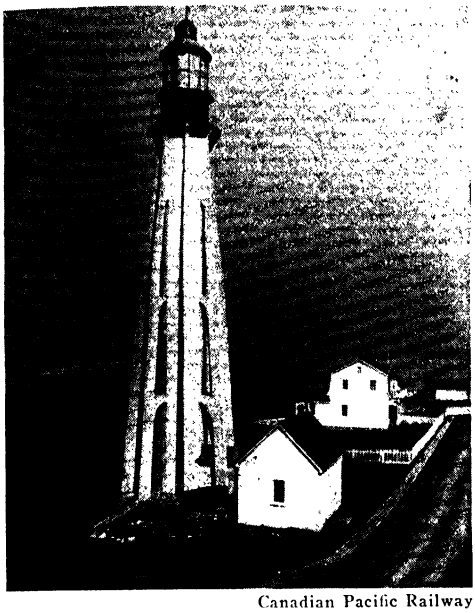
The color of a lighthouse is chosen to make it stand out clearly against its background. The old Portland Head Light is sparkling white against dark, Maine rocks. The red brick tower of Jupiter Light, Florida, gleams like a jewel against a background of sand and water. Bold patterns also help. There is no mistaking the barber-pole bands of Hatteras and St. Augustine. At Sankaty Head, Nantucket, and Montauk Point, Long Island, the towers are girdled with a broad band of color. Diamond shapes mark the tower at Cape Lookout, North Carolina. On many minor light structures, color marks the channel. As you enter it from the sea, red marks the right and black marks the left, just as these colors do on buoys.

When fog shuts down, the foghorns begin. Each fog signal station is known by the number of its blasts and by the silences in between. The various kinds of fog signals differ in sound, which helps to tell them apart. Most familiar is the great, hoarse bellow of the diaphone—often two-tone blasts, first high, then low. A diaphone has a piston with a slot in it and is worked with compressed air. Diaphragm horns sound altogether different; two or three may be used to produce a chime signal. Reed horns, sirens, whistles and bells are also used. Bell buoys are still used where the bell responds to the motion of the waves, like the bell in the poem about Sir Ralph the Rover. The



U. S. Coast Guard

Atlantic mariners know this lightship well. It rides at anchor in all weathers, and guides ocean liners and cargo ships to the deep, wide Ambrose Channel, through which they must pass to reach New York Harbor.



Canadian Pacific Railway
Father Point, Quebec, on the St. Lawrence River.

Wide World
The revolving lens at Montauk Point, Long Island.

bell is described in the following lines:

> On a buoy in the storm it floated and swung,
> And over the waves its warning rung.

The oldest form of warning is still the light itself. Ancient records tell of Egyptian towers, topped with fire and tended by priests. The most famous, the Pharos, was one of the Seven Wonders of the World. It gave its name to many a lighthouse built by the Romans and the French made it a part of their language. The French word for lighthouse is *phare*. The Pharos was built in the third century B.C., on the island of Pharos in Alexandria Bay.

There was no really brilliant light for lighthouse use until the ninteenth century, when Augustin Fresnel, the French physicist, developed his very wonderful system of lenses. The rays of the lamp shine on all the many pieces of beautifully cut and highly polished glass. As a result, the rays are focused so that they stream forth in the desired direction in a brilliant, horizontal beam. The first Fresnel lens in the United States was installed at Navesink Light, New Jersey, in 1841.

Nowadays, lenses are assembled in a wide variety of types, depending on the kind of light that is wanted. Fixed lights are continuous and steady. Others, called flashing lights, show a single flash at regular intervals, and the duration of light is always shorter than the duration of darkness. Occulting lights are the other way round—steady lights, eclipsed at regular intervals, with the period of light as long as, or longer than, the period of darkness. These characteristics are also varied in certain ways, for every possible means is used to give each light a special character of its own. In some situations, lights of different colors alternate regularly. Standard light colors for lighted aids to navigation are white, red and green.

In most of the larger lighthouses, electricity is now used for the light itself. Electric incandescent lamps shining on the larger lenses can produce lights of enormous candlepower. A recent list of the principal lighthouses maintained by the United States Coast Guard shows the great variety of candlepower in use today. Boston Light, Massachusetts, the first lighthouse built by any of the colonies in North America, has the brilliance of 100,000 candles; Fire Island, New York, 300,000; Cape Elizabeth, Maine, 500,000; Cape Charles, Virginia, 700,000; Cape St. Elias, Alaska, 1,000,000; Pully Point, Washington, 2,000,000. The three most brilliant lights on the list are White Shoal, Michigan, 3,000,000; Liston Range, Delaware, 5,000,000; and Hillsboro Inlet, Florida, 5,500,000.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3657.

AMERICAN TERRITORY ACROSS THE SEAS

YOU have learned how some of the people of the thirteen original states on the Atlantic coast climbed the mountains, floated down the rivers beyond and then crossed the Mississippi River, the "Father of Waters." Later wagon trains slowly toiled over the plains, reached the summit of the Rocky Mountains and, at last, came to the Pacific Ocean. The country which makes up the forty-eight states of the Union was now ours.

In the last half of the nineteenth century we began to acquire other areas; and today the list includes Alaska, the Aleutian, Hawaiian, Midway and Wake islands, Guam, American Samoa and some other Pacific islets, the Canal Zone, Puerto Rico and the Virgin Islands. We also control the Caroline, Marianas and Marshall islands, in the South Seas, though these are really United Nations trusteeships. Alaska, Hawaii and the Panama Canal are discussed elsewhere in our book. The other islands also are discussed in the articles on The South Sea Islands and the Islands of the West Indies. However, in this article we shall talk briefly about all the American territories so that you may see just how these widely separated areas are related to the United States.

The first possession in size and importance is Alaska. The Aleutian Islands are really a part of it. Including land and water, Alaska has an area of 586,400 square miles, equal to about one-fifth the size of the United States proper. When we bought it from Russia, it cost about two cents an acre; yet some people said we paid too much. Many of them called the territory "Seward's Folly" as the purchase was made largely through the efforts of William Henry Seward, Secretary of State at that time.

Alaska is a majestic country of lofty

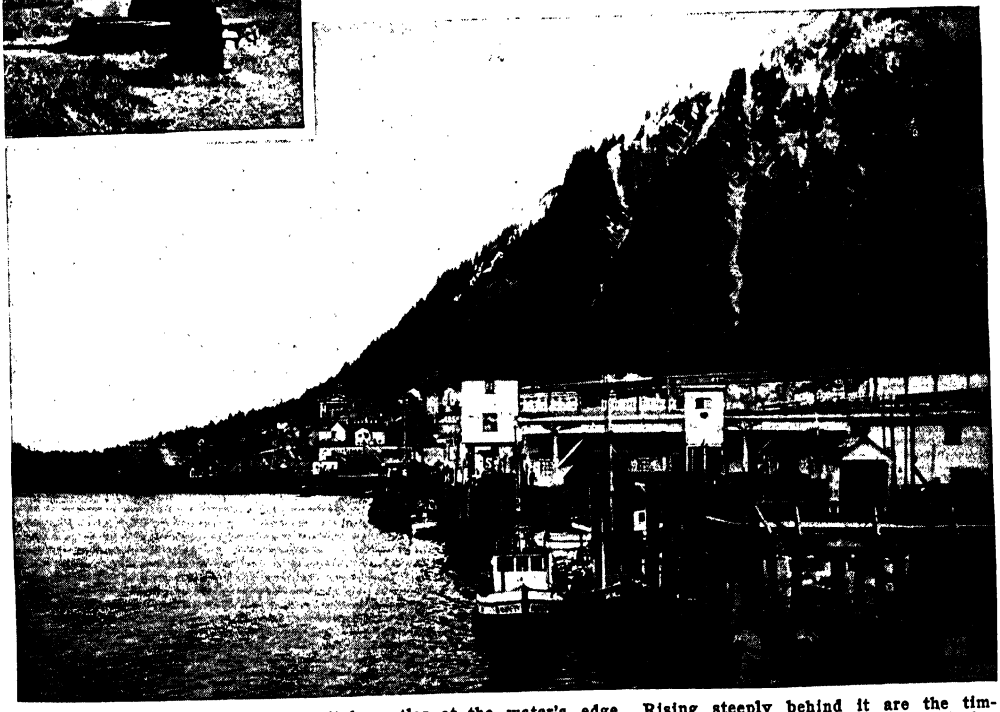
Army Signal Corps photo from Acme

The bitter cold, fog and gales of the Aleutian Islands provide a severe testing ground for Army equipment.

ALASKA, THE LAST FRONTIER

All pictures, Alaska Airlines photos by Oscar

This beautifully carved totem pole (left) dominates the harbor of Sitka. Above, an old-time prospector pans gold beside the pounding surf at Nome.



The little town of Juneau, the capital, nestles at the water's edge. Rising steeply behind it are the timbered slopes of Mount Juneau. A breakwater eighty feet high makes the harbor one of the best in Alaska.

mountains and broad rivers. From some of the summits, great ice rivers, or glaciers, slowly slide down to the sea. There huge sections break off and become icebergs. The highest peak in North America, Mount McKinley (20,300 feet), is in Alaska.

Along the coast, to the south, are more than eleven hundred islands, known as the Alexander Archipelago. Some of them are really mountains, rising from the sea and cloaked with forests. Stretching to the west more than a thousand miles beyond the mainland, and reaching almost to Asia, are the bleak Aleutian Islands. They are frequently fog-bound and often lashed with howling winds called williwaws.

Vitus Bering, a Dane, working for Russia, discovered Alaska and so it became a Russian possession, in 1741. On the maps it was labeled Russian America, and remained so for 126 years. But it was never profitable to Russia, and that country sold it to the United States in 1867 for $7,200,000. A few people in California and Oregon thought that the furs and the fisheries would be valuable, but nearly everyone else laughed and said we were buying polar bears and icebergs.

So little attention was paid to the territory that the United States did not even take the trouble to provide any sort of government until seventeen years later, though Alaska was supposed to be under United States laws. During the early years of American ownership, seal and whale hunters made camps on the islands stretching out toward Asia, and a few fishing vessels touched the coast. Trappers and hunters wandered through a part of the country, but there were many thousands of square miles never seen by white men.

Stories of finding gold in Alaska often came down the coast to Oregon and California; but they did not cause much excitement until 1896. Then the news leaked out that rich finds had been made on the Yukon River in the region known as the Klondike in Canada, and thousands of prospectors hurried there. Gold was found on the American side; and in 1898 still richer deposits were discovered at Nome, on the western coast.

With the cry of "Gold!" there was a rush like that to California fifty years earlier. Every old steamboat on the Pacific coast was pressed into service and carried impatient crowds toward the "Golden North."

Alaska Airlines

Alaska could hardly have been developed without the Eskimo dogs, who broke trail for the pioneers. The short pricked ears, bushy tails and wailing call of these handsome animals show their close relation to the wolf.

Once landed, on foot or with sledges drawn by dogs they strove to make their way toward the gold fields. There were no roads, only trails where the snow had been beaten down by the feet of men and the runners of sledges.

Eventually the other great natural resources of the country were revealed, and settlement began. Now plans are going forward to admit Alaska as a state in the Union.

Far to the south of cold Alaska are some Pacific islands where it is always summer. These are the Hawaiian Islands, which were annexed to the United States at the request of the people of Hawaii in July 1898. Eight of the islands are inhabited, and there are twelve smaller islands on which no one lives.

The total area of the whole group is only about 6,500 square miles. The largest island is Hawaii; but Oahu, where the chief city, Honolulu, is located, has more people. About 246,000 live in Honolulu itself. The territory has a population of about 492,000.

The Hawaiian Islands were made by volcanoes which pushed up from the bed of the sea and poured out their lava. This crumbling lava makes a rich soil, and since there is much rain, everything grows as if touched by magic. Some of the volcanoes are still active. Kilauea, on Hawaii, is the largest active volcano in the world. Its crater is about nine miles around, and in the center is a great lake of melted lava which rises and falls much as water in a reservoir rises and falls. At night this red-hot, quivering mass is one of the most wonderful sights to be seen anywhere

These islands had been discovered by Spanish navigators before the year 1550, but little notice of them was taken until Captain Cook visited them in 1778. He called them the Sandwich Islands in honor of the Earl of Sandwich.

American missionaries went to the islands in 1820, and soon the leading natives, brown-skinned Polynesians, called themselves Christians. The old royal family died out, and a man named Kalakaua was elected king in 1874. He was a very bad ruler, and tried to restore the idols and to take away the liberties of the people.

On his death, in 1891, his sister Liliuokalani tried to follow in his footsteps. By this time many people from the United States and Europe were living in the islands. Some of them were the children and grandchildren

Official U. S. Navy photographs

A school for Chamorran boys and girls—natives of Guam. Education is a very serious matter to the young people of the island, and classrooms are crowded. Right, washday in the bright sunny air.

of missionaries, and others had gone there to trade. They forced the Queen to give up the throne in 1893, declared themselves under the protection of the United States and asked to be joined to that country. This did not happen right away, but at last, in 1898, the islands were annexed to the United States. They have a delegate in Congress who may speak but has no vote. However, it is possible that the Territory of Hawaii will soon join the Union as a state.

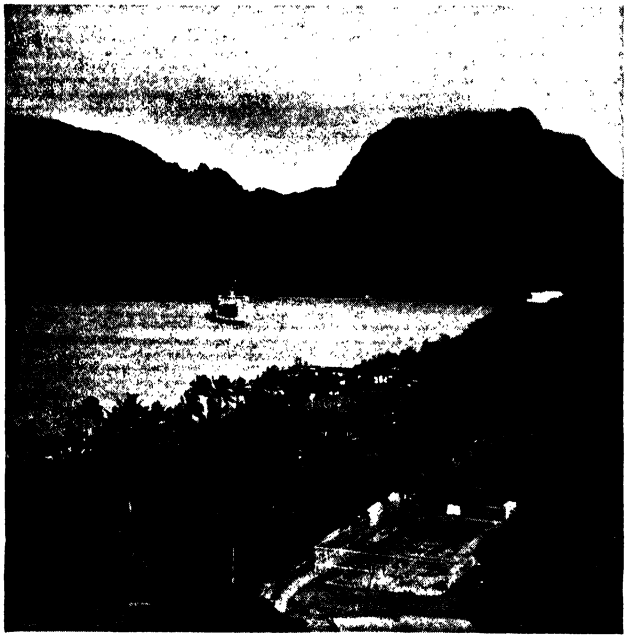
Midway and Wake islands lie to the west of Hawaii. The United States acquired these islands shortly before 1900, partly because no other country had claimed them. Wake Island has a large anchorage in the form of a horseshoe, which makes it an ideal haven for ships and flying-boats.

After World War I, Japan ruled the Carolines, the Marianas (except Guam) and the Marshalls as a mandate from the League of Nations. The United States conquered the islands in World War II and now administers them under United Nations trustee agreements.

Guam, one of the Marianas Islands, was acquired by the United States as a result of the Spanish-American War. A vast building program has been started to construct airfields and improve the harbor, a project which will make the island one of the most important bases in the Pacific.

To the southeast of Guam, below the equator, lies another bit of American territory, in the Samoan Islands. They were discovered in 1768 by a French sailor, De Bougainville, but France never colonized them. In 1839 Charles Wilkes, an American naval officer, surveyed the islands and made a sort of treaty with the chiefs. Before long Great Britain and Germany also became interested in them; and in 1889 these nations and the United States made an agreement to protect the native king. But the king died in 1898, and the agreement among the three nations was broken. The next year the islands were divided between the United States and Germany. The United States took Tutuila and the Manua group, altogether seventy-six square miles. Pago-Pago, on Tutuila, is one of the best harbors in all the Pacific. However, since there are only about 16,000 people in American Samoa, the trade does not amount to very much. It is more important as a naval base.

The Canal Zone, of course, is the narrow strip of territory which is cut by the Panama Canal. In 1903 the Republic of Panama leased this strip to the United States. It is five miles wide on either side of the canal.



Both pictures, © Ewing Galloway, N. Y.

The dream-like harbor of Pago-Pago, Samoa, fringed with rustling palms, is a haven for ships. Only light clothing is needed in the balmy climate; it may be of cloth woven from coarse fibers such as this man is pounding.

The United States has entire control over the zone for a hundred years, that is, until 2003, and then may continue the lease. The cities of Colon, on the Atlantic side, and Panama, on the Pacific side, do not belong to the zone. The United States has the right, however, to see that these cities are kept clean.

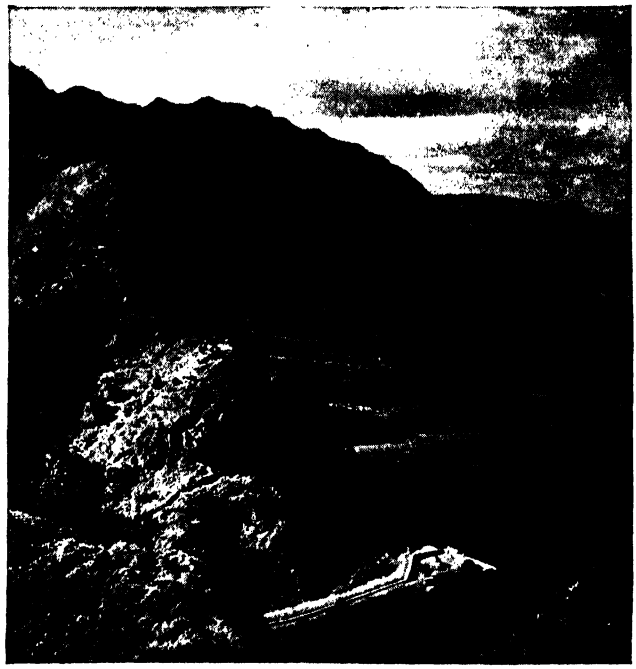
The island of Puerto Rico, in the Caribbean Sea, was once a Spanish possession. It was visited by Columbus on his second voyage; and later Ponce de Leon, the explorer of Florida, became governor. For a little while the island was held by the English, but afterward was returned to Spain. The United States acquired it as a result of the Spanish-American War.

Puerto Rico has an area of about 3,500 square miles, and three other small islands belong with it. The climate is pleasant though hot, except in the mountains; and the soil is rich. There are large forests of good timber, and the coffee tree thrives. Sugarcane, tobacco and coffee are the largest crops, and cotton also is grown. Oranges, lemons, limes, grapefruits and pineapples grow wild. However, the development of the island has lagged behind the other American territories. Gradually it is being given a greater measure of self-government.

The United States also owns three of the Virgin Islands in the West Indies, St. Thomas, St. Croix and St. John. Together they have an area of only 133 square miles and a population of about 25,000. They belonged to Denmark for a long time, but were an unprofitable possession. They could have been bought for $7,500,000 about the time Alaska was purchased, but Congress would not agree. However, the need of the excellent harbor at St. Thomas became greater after the Panama Canal was opened, and in 1917 the United States bought the islands for $25,000,000. The price seems high, but some unfriendly European power might have purchased the islands and threatened the canal, our gulf cities and Puerto Rico.

The inhabitants of the islands are nearly all Negroes. Most of them speak English and were glad to become a part of the United States. Much of the land is mountainous, but there are fertile plains on which sugarcane and tropical fruits grow well. The bay tree flourishes; and St. Thomas has long been noted for the production of bay rum, which your father may use after shaving. The largest town is Charlotte Amalie on St. Thomas, built on hills which cup a magnificent harbor.

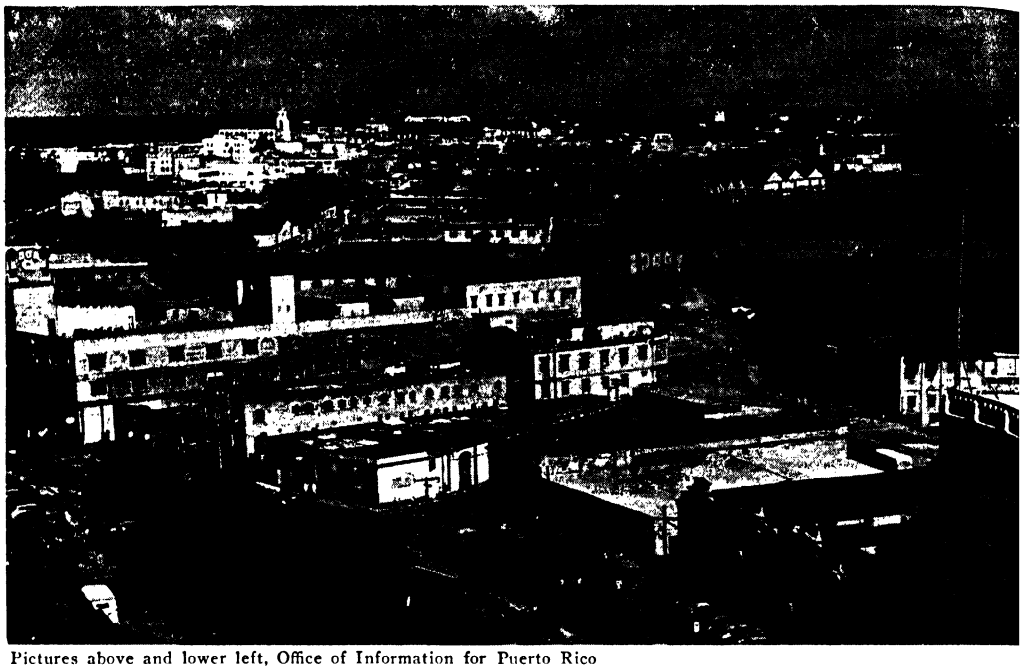
THE NEXT STORY OF THE UNITED STATES IS ON PAGE 3773.



Both pictures, Hawaii Visitors Bureau

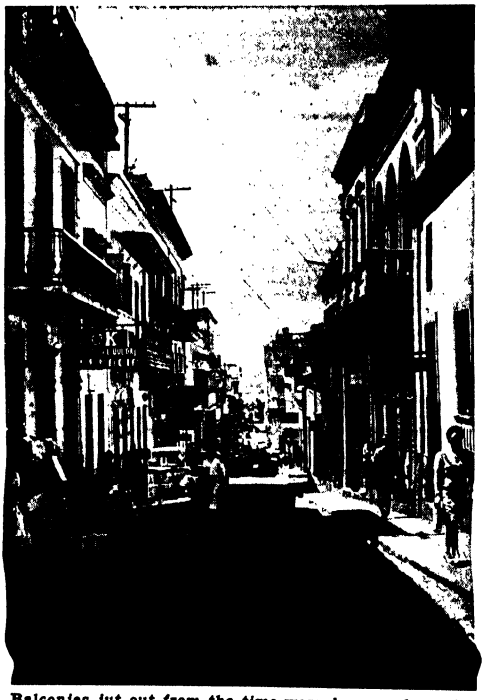
Looking toward the mountains up Bishop Street, Honolulu's banking center. Right, Nuuanu Pali, the world-famous rock cliff on Oahu. From its rim there is a breath-taking view of valley and mountains stretching to the Pacific.

SAN JUAN, CAPITAL OF PUERTO RICO

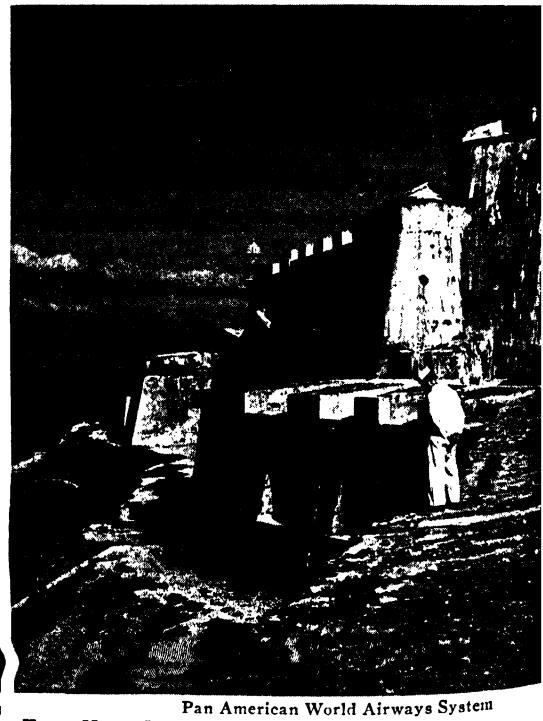


Pictures above and lower left, Office of Information for Puerto Rico

Part of the water front of San Juan, with docks and warehouses. The city is built on a small, rocky island, connected

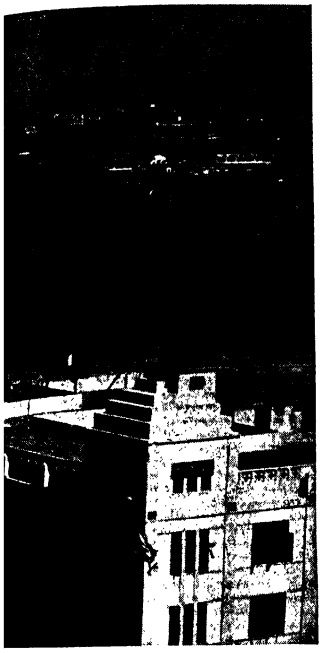


Balconies jut out from the time-worn houses along this steep street in the old section of the city.



Pan American World Airways System

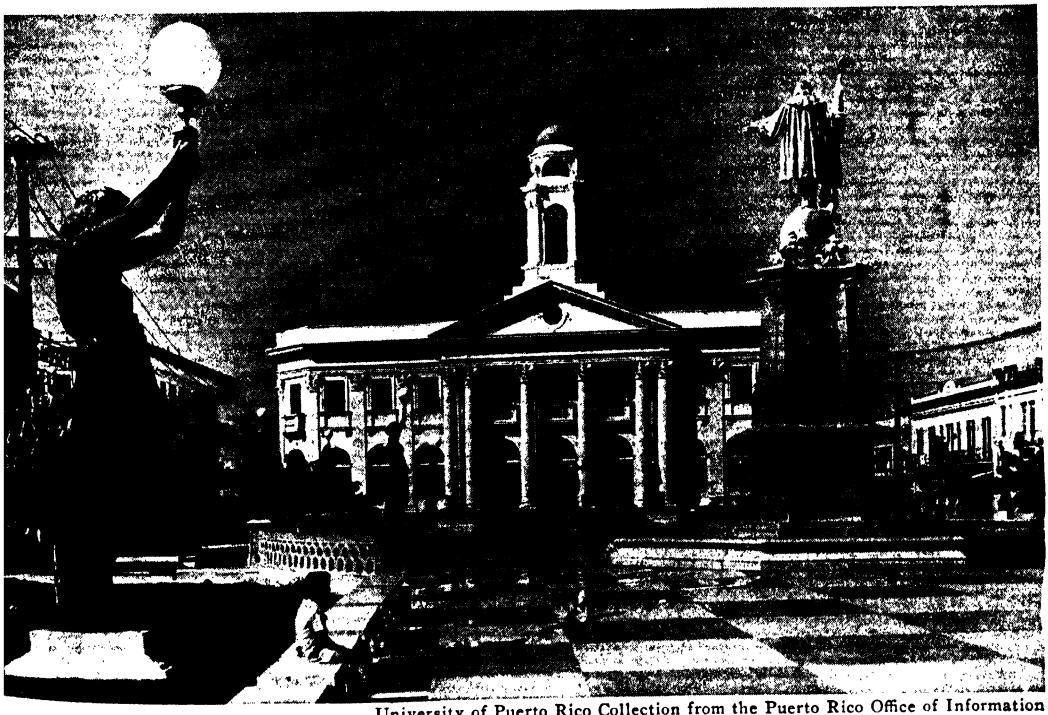
Hoary Morro Castle frowns at the bay's entrance.



with the mainland by bridges.

Pan American World Airways System

The dazzling modern Capitol in San Juan, built of white Georgia marble. It faces a wide avenue and is surrounded with beautifully landscaped grounds.



University of Puerto Rico Collection from the Puerto Rico Office of Information

A statue of Columbus dominates the City Hall plaza of Mayagüez, at the western end of Puerto Rico.

RIPE YELLOW FRUIT FOR SALE!

This stalk of bananas is a pretty heavy load for the Puerto Rican boy, but he will soon learn to carry bigger bunches on his head.

Pan American World Airways System

BUSY HOURS IN PUERTO RICO

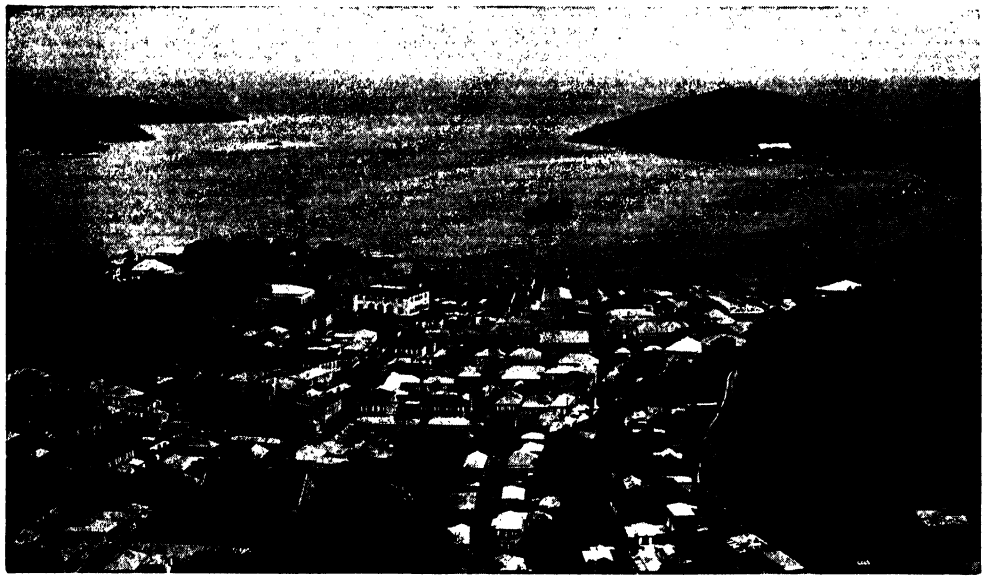
Puerto Rico Office of Information

Sorting dried vanilla pods, source of the delicious flavoring.

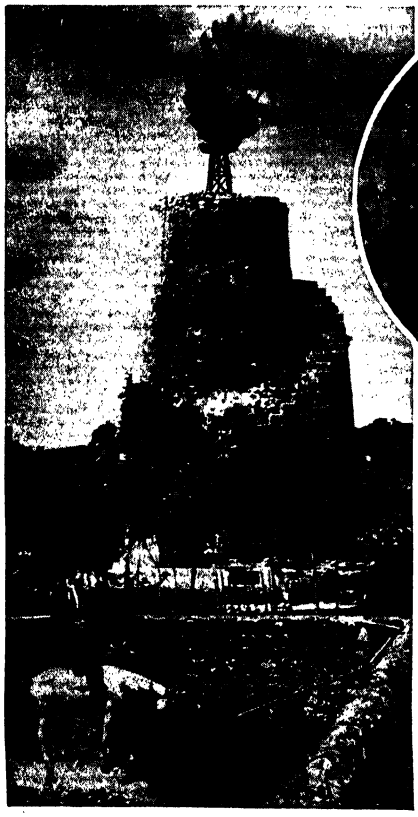
Pan American World Airways System

Learning new methods of farming and taking up such crafts as basket-weaving keep young Puerto Ricans busy.

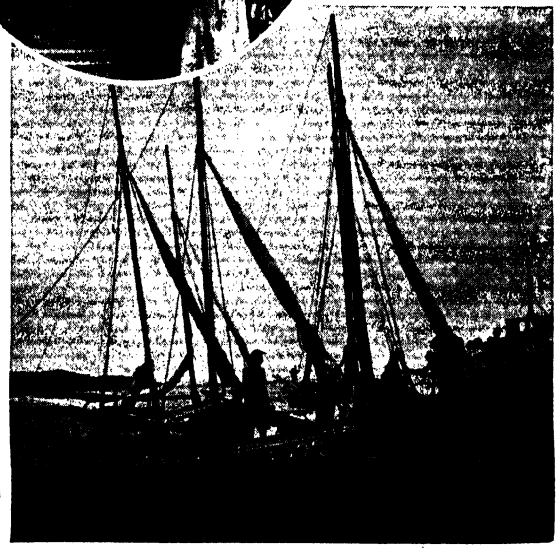
THE VIRGIN ISLANDS



All pictures, Pan American World Airways System



An old stone windmill with an outside staircase, and modern blades, on St. Croix.



Above, Charlotte Amalie harbor, cupped in green hills. Left, an islander of French descent. Below, sailboats like these carry cargo between the islands.

Pan American World Airways System

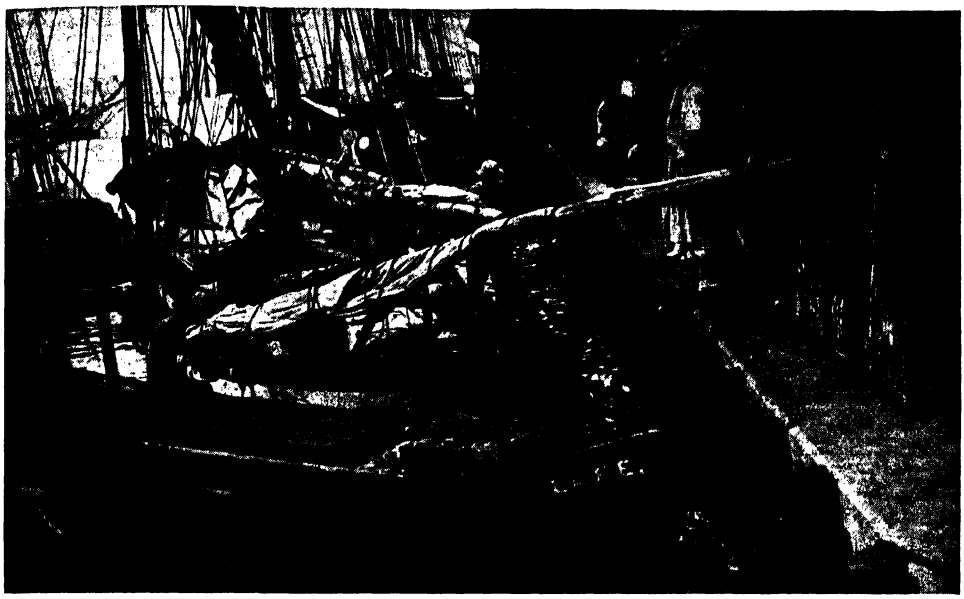
Sparkling waters and wooded headland, framed in drying fishnets, along the shore of St. Thomas Island.

All pictures, Pan American World Airways System

Making concrete blocks (above), a new industry. Right, streets of steps climb Charlotte Amalie's steep hills.

The islands are really the summits of mountains which have sunk. Though ages of wind and weather have ground the summits down, there are few level patches. Vegetable gardens and orchards are cultivated on terraces.

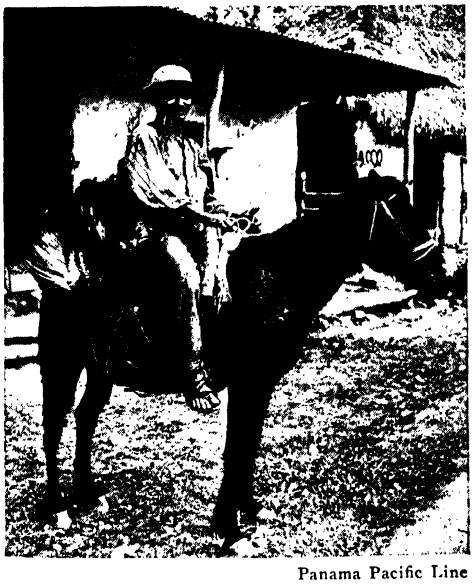
THE PANAMA CANAL ZONE



© Charles Phelps Cushing

Tiny fishing boats, which sail the warm waters of the Caribbean Sea, tied up at one of Cristobal's piers. The long wharves are the first sight of the city as one enters the canal from the Atlantic side.

Cristobal is the great port at the Caribbean end of the Panama Canal, on Limon Bay. It is within the Canal Zone, but tourists may step from its streets directly into the old city of Colon, in the Republic of Panama. Cristobal was once a part of Colon.



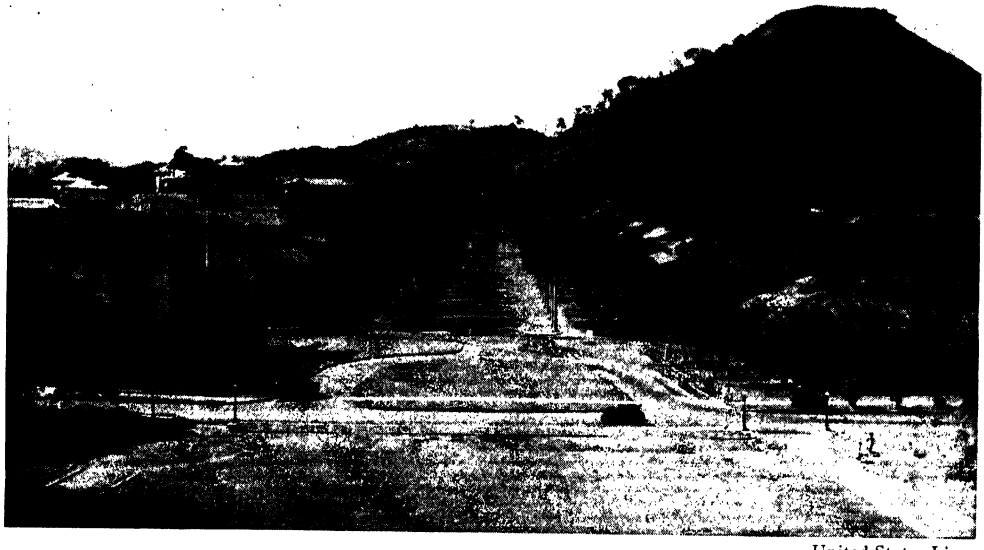
Panama Pacific Line

A native son of the interior of Panama, ready to set out for a profitable and pleasant day at the nearest market.

© Charles Phelps Cushing

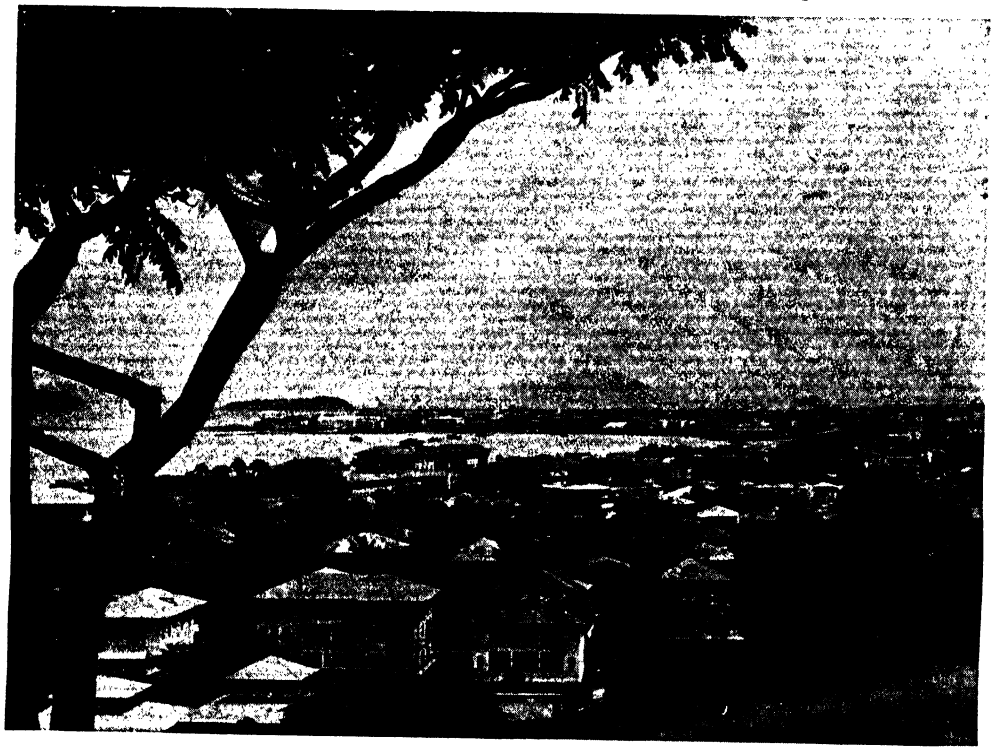
Some of the world's largest steamship companies have offices along this palm-shaded avenue in Cristobal.

ORDER AND SPACE HACKED FROM JUNGLE



United States Lines

This picture of the town of Balboa, in the Panama Canal Zone, was taken from the steps of the Administration Building. Balboa is situated near the Pacific end of the Panama Canal, on a stretch of high land.



© Philip Gendreau, N. Y.

Airy porches on the quarters for government workers in the Canal Zone make for comfort in the hot climate.

Jack and the Bean-Stalk

Illustrations by Garth Williams

A VERY poor widow once lived with her only son Jack in a little cottage on the border of a great wood. They were so poor that often Jack went supperless to bed; and at last things became so bad that Jack's mother made up her mind to sell their cow, the only possession they had left. So, when market-day came round, Jack set out, driving the cow before him, determined to make the best bargain he could.

On the way he met a man with a bag of beans in his hand. Jack took such a fancy to the beans that he begged the man to give them to him.

"No, indeed," replied the man. "They are magic beans. But you shall have them in exchange for the cow."

To this the boy readily agreed. The man took the cow, well pleased with his bargain; and Jack ran home to show the beans to his mother. The poor woman wept when she heard the story, and was so angry at Jack's stupidity that she flung the beans out of the window.

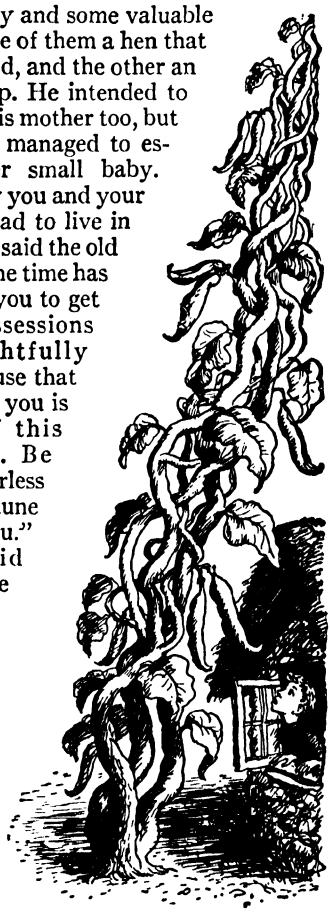
Jack went to bed very cross that night, but when he got up the next morning he was surprised to find something in front of his window. It looked like a huge tree; but on going nearer, he found that during the night the wonderful beans had taken root and grown enormously. The vines had twined together and shot up to a tremendous height; indeed, the top of the stalk was almost out of sight.

In a twinkling Jack sprang up the bean-stalk. Higher and higher, and still higher he climbed, until he began to lose his breath. When at last he reached the top, he found himself in a strange country. It appeared to be a barren desert; not a tree, shrub, house or living creature was to be seen. He walked on for many hours, growing very hungry and tired, but at last, just as the sun was setting, he saw a large house in the distance. As he turned toward the house Jack heard a voice speak his name, and there before him was a little old woman in a long red cloak.

The little old woman told Jack a strange story. Years before, when Jack was a tiny baby, his father had been wealthy and powerful, but his wealth and his good deeds had gained him the hatred of a wicked ogre. The ogre killed Jack's father and stole all of his money and some valuable possessions, one of them a hen that laid eggs of gold, and the other an enchanted harp. He intended to kill Jack and his mother too, but Jack's mother managed to escape with her small baby.

"That is why you and your mother have had to live in such poverty," said the old woman, "but the time has now come for you to get back the possessions that are rightfully yours. The house that you see before you is the home of this wicked ogre. Be wise and fearless and good fortune will attend you."

Having said this, the little old woman disappeared. When Jack had recovered from his astonishment, he walked on until he reached the ogre's house. It



was a stately mansion, and a great, tall woman was standing on the doorstep.

"Good-evening," said Jack. "Could you be so good as to give me something to eat? and a night's lodging?"

"Alas!" replied the woman, "I dare not take you in. My husband is an ogre, and if he finds you he will surely kill you and roast you for supper."

"But can you not hide me?" asked Jack.

"I will do my best," said the woman; "but you must promise to go away the first thing in the morning."

When Jack had promised, she took him into the kitchen and gave him a good meal; but before he had finished, there came a loud knock at the door.

"Quick!" cried the woman. "Jump into the oven, and don't make a sound till my husband has gone to bed."

In scrambled Jack, and a minute later the ogre strode into the room. He was a big one, to be sure. At his belt he had three calves strung up by the heels, and he unhooked them and threw them down on the table and said:

"Here, wife, broil me a couple of these for breakfast." Then he stopped short, and sniffed the air.

Then he cried out, in a terribly loud voice,

"Fee, fi, fo, fum,
I smell the blood of an Englishman!"

Jack trembled at the voice of the ogre.

"Nonsense, my dear!" he heard the wife say. "See what a fine supper I have prepared for you."

The supper was so good that the ogre instantly sat down and made a good meal, and when he had finished he told his wife to bring in his favorite hen. She went outside and returned with a beautiful hen, which she set down on the table.

"Lay an egg!" commanded the ogre; and the hen instantly laid a golden egg.

Soon after this the ogre fell asleep, and snored so loudly that his snores shook the walls. As soon as Jack heard them, he crept out of his hiding-place, picked up the hen, and ran away. On and on he ran until he reached the beanstalk, which he climbed down as fast as ever he could go. When he reached the bottom he flew to his mother and told her what had happened. The widow was overjoyed, and called Jack her "brave boy." They sold the golden eggs which the wonderful hen had laid, and lived very comfortably for some time on the money they were able to get for them.

But after a while Jack began to long for more adventures. So one day he disguised himself as well as he could, climbed up the bean-stalk, found his way to the castle, and again asked the ogre's wife to give him food and lodging. But the woman shook her head, and said that the last time she had befriended a poor boy the ungrateful wretch had repaid her by stealing the ogre's favorite hen. But Jack begged so hard that at last she consented, and this time hid him in a cupboard.

Presently the ogre returned to the castle. As he entered the kitchen he cried out in a terribly loud voice:

"Fee, fi, fo, fum,
I smell the blood of an Englishman!"

"Nonsense, my dear!" replied his wife, as before. "See what a fine supper I have prepared for you."

The ogre sat down and ate his supper. When he

had finished, he roared: "Bring me my money-bags!"

His wife brought the bags and laid them on the table. The ogre counted his money, put the coins back into the bag, and then fell asleep. Out jumped Jack, caught up the money-bags, ran out of the castle, and was soon back again in the cottage.

For three years Jack said no more of the bean-stalk, fearing to make his mother unhappy, but he could not forget it. He would arise at the first dawn of day and sit looking at the vine for hours. At last one summer day he woke as soon as it was light, and, without telling his mother, climbed up the bean-stalk. This time he dare not let the ogre's wife catch sight of him, but after waiting about for some hours he managed to slip in and conceal himself in the boiler just before the ogre returned.

"Fee, fi, fo, fum,
I smell the blood of an Englishman!"
roared the ogre, directly he set foot in the kitchen.

"Oh, no!" replied his wife. "You are always fancying there is something in the house. This time I am certain you are mistaken."

When the ogre had eaten his supper, he called for his harp. His wife brought it and set it on the table, and at a word from the ogre it began playing by itself.

As soon as the ogre was safely asleep, Jack jumped up, seized the harp, and fled from the room. But the harp was a fairy harp, and it shrieked out: "Master! Master!"

The ogre started up and rushed after Jack, who was running away as fast as he could. He reached the bean-stalk, and began to climb down quickly. When he reached the ground, the ogre was nearly halfway down. Jack saw that there was not a moment to be lost. "Mother! Mother! Bring the hatchet!" he shrieked.

Out rushed Jack's mother with the hatchet. Jack seized the hatchet, and with a single blow cut the bean-stalk right through. Down fell the ogre with a crash — dead.

Then Jack showed his mother his golden harp, and what with showing that at the fairs and selling the golden eggs, Jack and his mother became very rich, and they lived happily ever after.

THE NEXT STORIES ARE ON PAGE 3683.

An afternoon of music in Queen Elizabeth's time. The man is plucking a lute, and the girl fingers a virginal.

WRITERS *of* FAMOUS SONGS

FROM the earliest times men have found in song an outlet for their feelings. We have no written record of primitive music, but it is easy to guess the path that it followed. Songs were composed "by ear" and remembered "by ear," until musical notation (writing) made it possible to transfer the ideas by eye instead of ear. Probably dances expressing triumph or sorrow were accompanied by vocal sounds. These later became words that were remembered and sung again and again. Students of early music find that it was allied to other arts, especially dance and poetry.

We know that the Greeks made considerable progress in music. When the Olympic Games were first held in 776 B.C., there were competitions in singing as well as in sports. Even as late as 66 A.D. the Roman Emperor Nero went to Greece to enter the games as a singer. Modern scholars have succeeded in deciphering ancient records of Greek music, in spite of the fact that their notation was quite different from ours, which developed more than a thousand years later.

The earliest composer whose work we know is the Greek poet, Pindar (522-448 B.C.). Poets of that age were musicians. They accompanied their poetry on the lyre or kithara. Pindar's PYTHIC ODE is written in praise of the lyre. The famous HYMN TO APOLLO, the first Greek melody to be translated, celebrates the repulse of the Goths in 279 B.C.

From the Golden Age of Greece to the beginning of the music we know today there is a gap of nearly fifteen hundred years. Perhaps the history of the era, war following war, helps to explain why art had very little chance to thrive. Folk music, the songs and dances of the common people, went on, carried along from generation to generation by word of mouth. Church music, what there was of it, went on in the same way,

but there were no composers who are now known by name.

In the twelfth century the troubadours appeared in southern France. They were poets of noble birth who accompanied themselves on a stringed instrument as they sang delicate songs of love. Sometimes they employed professional musicians known as jongleurs to perform their songs. Richard the Lion-hearted (1157-99), who became Richard I of England, was a famous troubadour. He had a favorite jongleur, Blondel de Nesle. The two had written many songs together In 1193 Richard was captured by Leopold, Duke of Austria, on his return from the Third Crusade. None of his friends knew where the King was imprisoned. Blondel set out through Germany in search of his master. He sang the songs they had composed together outside castle after castle. After months of searching he was rewarded when Richard's voice sang the answering phrase from a lonely tower.

For several hundred years songs were composed in much the same way in other places. Northern France had a group of poet-musicians known as trouvères (which, like troubadours, means those who find). Adam de la Halle (about 1230-88), the Hunchback of Arras, was a trouvère. He wrote many songs, but his best known work is a comic opera, possibly the first ever written, called LE JEU DE ROBIN ET MARION. Some of the melodies from ROBIN AND MARION are still to be found today in collections of folk tunes and early music. They are simple and beautiful.

Culver Service

Pindar, the earliest Greek poet-composer whose music has been handed down to us.

At the time Richard the Lion-hearted became king of England many troubadours followed him there from France. The English loved music and had their own singing poets, whom they called minstrels. From this era in England we have an example of music which is far in advance of anything which was written for several hundred years after it. SUMER IS ICUMEN IN, probably the work of John of Fornsete in about 1240, is for six voices. The four upper parts are a perfect canon. In a canon one voice starts the melody. One phrase later the second voice comes in with the same melody, then later the third enters, and the fourth. (Rounds are simple canons.) It is difficult music to write because the parts must fit together even though they are different sections of the same tune. Below the canon, which is the principle part of SUMER, two voices carry what is known as a ground base. They alternate in singing two simple phrases which support the entire song.

In Germany the knights who sang of love were called minnesingers. Walther von der Vogelweide (about 1160-1227) is one whose work has been preserved. By the fourteenth century, however, a new group was becoming more powerful there. It was made up of burghers and artisans instead of knights and members of noble families. As men were required to qualify to belong to a guild of tradesmen, so they must qualify to belong to a guild of musicians or meistersingers (master singers). The most famous of all meistersingers was the Nuremberg cobbler, Hans Sachs (1494-1576), who wrote thousands of poems and hundreds of melodies. Richard Wagner (1813-83) made Sachs a chief character in his opera DIE MEISTERSINGER.

At the time Hans Sachs lived, Martin Luther (1483-1546) was reforming the Church in Germany. He broke away from the formality of the Catholic ceremony and developed a simple service in the language of the common people. The only form of art that he kept was music. He wrote new hymns because he wanted the congregation to join the singing. The melody was carried by the congregation in the tenor voice while the more expert singers in the choir wove beautiful musical patterns above and below it. One of his greatest hymns is sung today—*Ein' feste Burg ist unser Gott* (A MIGHTY FORTRESS IS OUR GOD).

In 1230 the universities of Oxford and of Paris added music to their regular courses of study. The invention of the printing-press in 1450 helped more than any other one thing to spread the work of composers from one country to another. The year 1476

is the date of the earliest known printed music, red notes on a black staff.

The English and the Welsh people had a great love for music. They read notes and sang in parts. The Tudor monarchs were skilled musicians. Henry V, born in Wales, who won the Battle of Agincourt, was known as the musician-king. Robert Fayrfax, who was awarded the degree of Doctor of Music at Cambridge in 1502, startled other composers and musicians of his day by breaking away from established customs of writing, just as other composers with new ideas have done since then.

A troubadour of the Middle Ages gaily sings his songs for all the woods to hear. Even his horse seems to be keeping time.

Queen Elizabeth's time was especially active musically. She played both lute and virginal well; music books were written for her by the men of her court. In 1575 she granted a music-publishing monopoly to Thomas Tallis and William Byrd, two of the most gifted composers of her reign. There was a great demand for "songs and ayres" and for madrigals (part songs), which hostesses passed around to their guests for an evening of music. The madrigals were often printed on large sheets of paper with different voices of the song facing different edges of the paper. The singers held the sheet flat in the center of the group and faced the side that held the parts they were singing. William Byrd had a pupil to whom he taught both mathematics and music. The pupil, Thomas Morley (1557-1603), wrote the melodies for many songs in plays by William Shakespeare. IT WAS A LOVER AND HIS LASS, from AS YOU LIKE IT, is one of them.

Many a famous composer has been a choirboy. The training is the most useful he could have. He must learn to hear sounds in his head, independent of instruments. He must learn to follow a line of melody, not only alone, but in relation to other melodies which surround it, a difficult thing to do.

The Chapel Royal in London, founded about 1135, is a famous choir school. The boys are chosen for their beautiful voices when they are very young. Up to a comparatively short time ago they lived at the school until their voices changed, studying everything from Latin and mathematics to musical composition. Henry Purcell (1658-95) was one of the "Children of the Chapel." His father, Thomas, was a "Gentleman of the Chapel" which made it natural that the son, who was unusually musical, be one of the chosen few. Purcell, a friend of the poet Dryden, was the first composer to realize the beauty of the English language and to try to make the music give added beauty to the words. One of his most delightful songs is the simple PASSING BY. With Nahum Tate as librettist, he wrote the opera DIDO AND AENEAS when he was only nineteen. Even though the little opera was written for a girls' boarding school in Chelsea, and was only in manuscript form until 1840, the aria WHEN I AM LAID IN EARTH, which Dido sings as she dies of a broken heart, is one of the most famous in operatic literature.

Purcell was only eighteen when he was appointed organist of Westminster Abbey. Because of his lifelong association with the Church he wrote much sacred music, but he always had time for secular songs, for instrumental music and settings for plays. He died when he was thirty-seven, and was buried in the abbey, beneath the organ he had played for so many years.

At the top of many printed Christmas carols like THE FIRST NOËL and others is the word "traditional." Such songs have been sung for so many years that no one knows who made them up. There are old carols whose composers are known, however.

One is FROM HEAVEN HIGH, which Martin Luther wrote for the children of his church, perhaps as early as 1525.

LO, HOW A ROSE E'ER BLOOMING, by Michael Praetorius (1571-1621), is almost as old. It was probably written without bar lines, like much of the early church music. Some arrangers put it in two-part time; others, in three. It sounds best if the singer follows the words and the note values and does not try to put accents in regular places. Praetorius was next in importance to Luther in the Protestant Church in Germany. Besides his work as a composer he wrote a complete history of the music of his era.

Isaac Watts (1674-1748) was an English minister until poor health made him leave the London church of which he was pastor. He moved to the quiet of the country. As he was both religious and musical it was natural that he become a famous hymn-writer. JOY TO THE WORLD is one of his best. The American composer Lowell Mason set the words to a melody by George Friedrich Handel (1685-1759).

On Christmas Eve in 1818, Joseph Mohr, the village priest in Hallein, Austria, was preparing his sermon for the midnight mass. He was called out into the snow to bless a newly born baby in the home of one of his poorest parishioners. He was so filled with the spirit of the season and with the simple beauty of the mother and infant that when he returned to his study he wrote the poem SILENT NIGHT. He showed it to his organist, Franz Gruber, on Christmas morning and before the day was over the friend had written the music. The melody is often credited to Michael Haydn, brother of Joseph Haydn. Since the younger Haydn, who lived from 1737-1806, was a composer of church music it is possible that Gruber adapted one of his melodies to Father Mohr's words.

In the United States, even as late as the middle of the nineteenth century, most of the music was for the church. Some of the hymn-writers turned their attention to Christmas songs. The Reverend John H. Hopkins, Jr., son of the Bishop of Vermont, wrote both words and music of WE THREE KINGS in 1859. It was widely used in carol services because it could be acted as well as sung. The more serious men of the Church did not allow it in the Hymnal for some years because they thought it too lively.

OH LITTLE TOWN OF BETHLEHEM was written for the children of Holy Trinity

A scene from Richard Wagner's opera, DIE MEISTERSINGER. The story is about the guild of musicians, or master singers, in Germany in the fifteenth century. The man at the left is the famous meistersinger, Hans Sachs.

Church in Philadelphia by their famous pastor, Phillips Brooks. He traveled in Palestine in 1865. Before the Christmas Eve service in Bethlehem he visited the fields where the shepherds had watched their flocks so many hundred years before. That was the inspiration for the poem that was sung three years later to music written by Lewis H. Redner, the organist of Holy Trinity.

The words of IT CAME UPON A MIDNIGHT CLEAR are from the pen of Edmund H. Sears (1810-76), a Unitarian minister and hymn-writer. The music was written some time later by Richard Storrs Willis (1819-1900) of Boston. Willis was, for his time, an unusually well-trained American musician. He graduated from Yale and then went to Germany for more study. He was a composer and the editor of several music magazines.

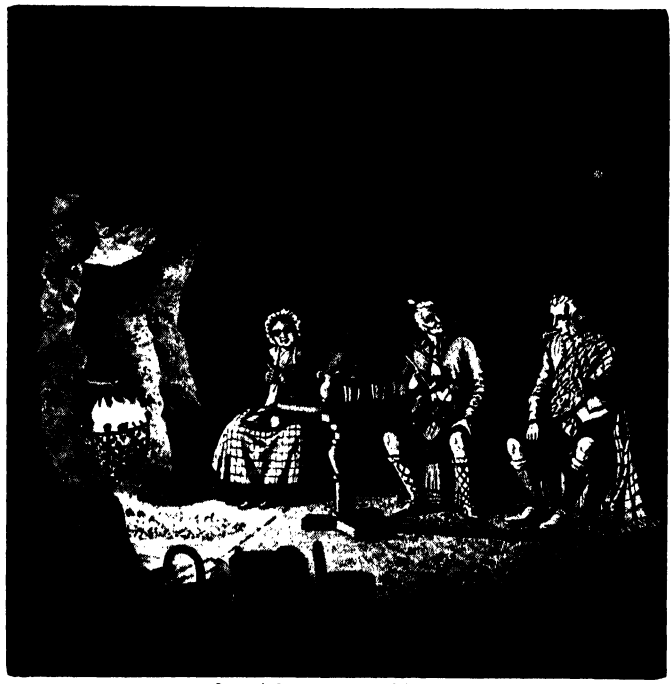
Adolphe Adam (1803-56), who wrote *Cantique de Noël* (O HOLY NIGHT), was really a French operatic composer. Perhaps that explains why his Christmas carol is less like a hymn than like an air from an opera. Adam's father, a musician, tried to make the boy become a lawyer. Like others before him, he finally found a way to persuade his father to let him do the work which made him famous. He wrote thirty-nine operas and fourteen ballets, besides managing a theater and being a professor at the Paris Conservatory and a music critic.

When Scotchmen have enjoyed a social gathering it is their custom to sing AULD LANG SYNE before they go their separate ways. The words of the first verse of this song were known as early as 1600, but Robert Burns (1759-96) revised them and wrote second and third verses. The old Lowland melody which we sing was arranged by George Thomson (1757-1851). Thomson was a business man who devoted many years of his life to collecting and publishing Scottish, Irish and Welsh songs. Burns, the poet of the common people of Scotland, wrote many other songs to old melodies, among them JOHN ANDERSON, MY JO and FLOW GENTLY, SWEET AFTON.

In the seventeenth century Sir Robert Laurie lived in Maxwelton, Scotland. His

The first singing of LA MARSEILLAISE, the stirring French national anthem, written by Rouget de Lisle. First called CHANT DE GUERRE, it later became associated with the revolutionary soldiers from Marseilles.

daughter Annie (1682-1760) was famous for her beauty. William Douglas of Fingland, in the Scottish Lowlands, saw Annie when she was in Edinburgh with her father. The two young people fell deeply in love, but because Sir Robert and Douglas had different political beliefs, the lovers were forbidden to meet. The poem ANNIE LAURIE was written when Douglas had to disappear for a time to save his life. They did not meet again, and later each married someone else and seemed to live happily ever after. The music was written more than a hundred years later by Alicia Anne Spottiswoode (1810-1900), who became Lady John Douglas Scott. Lady Scott was the composer of many famous Scottish songs, perhaps even of LOCH LOMOND.



Joseph Boggs Beale, Modern Enterprises, Phila., Pa.

Robert Burns's AULD LANG SYNE was written in memory of just such happy times as this, when good friends gathered in a Scottish cottage.

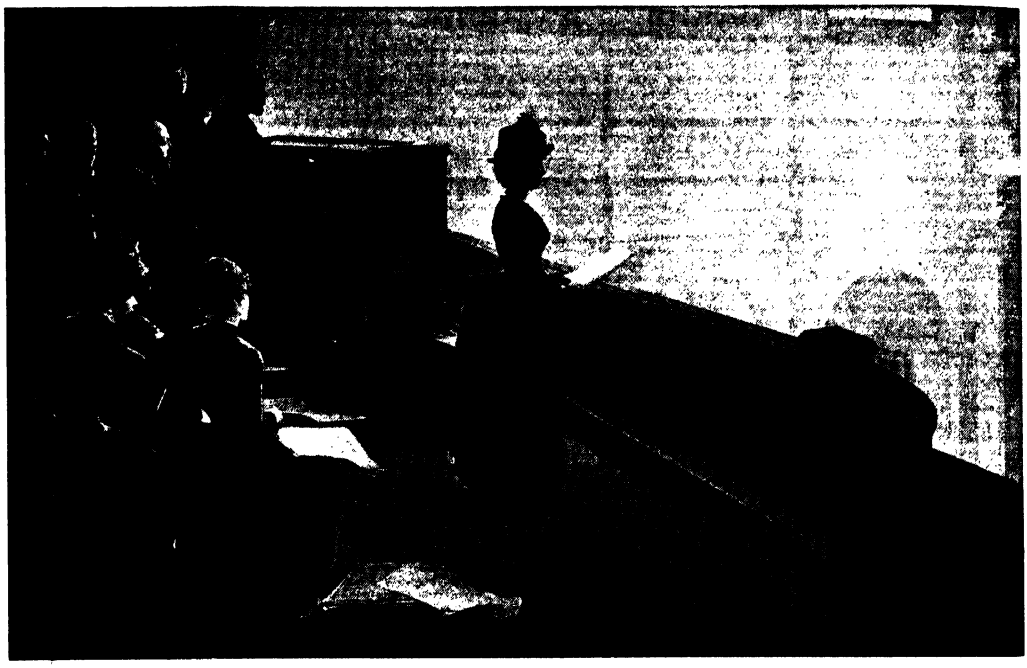
THE BLUE BELLS OF SCOTLAND was written by Annie McVicar Grant (1755-1838), when the Marquis of Huntley left for wars on the Continent in 1799. Mrs. Grant was a widow who supported her children by writing poetry. Dora Bland Jordan (1762-1816), of Drury Lane Theater, sang the song, using a melody that she either wrote or adapted.

Ben Jonson (1574-1637) was an English dramatist and poet. He turned a Greek poem into his famous song DRINK TO ME ONLY WITH THINE EYES. The melody is probably an old English folk tune.

Both the words and music of THE LONG AGO are by Thomas Haynes Bayly (1797-1839). Bayly was able to write poetry when he was seven years old. He was a great problem to his teachers in school because he was interested only in turning the rules of arithmetic and geography into verses. He wrote many other songs in his life, but few of them are remembered except perhaps GAILY THE TROUBADOUR and THE MISTLETOE BOUGH.

Thomas Moore (1779-1852) has been called the folk-poet of Ireland. He had a musical gift as well and enough training to be able to play his own accompaniments as he sang the songs that he composed. He edited and published collections of Irish folk tunes. His MINSTREL BOY is written to an old Irish air. This seems to have been his favorite. He composed both words and music of OFT IN THE STILLY NIGHT. In THE LAST ROSE OF SUMMER he used the old air THE GROVES OF BLARNEY. This famous song even found its way to the operatic stage when Flotow put it into the second act of MARTHA.

John Howard Payne (1792-1852) spent a happy and carefree childhood, most of it in Easthampton, Long Island, where his father was the head of a school. The old Payne homestead, which still stands, shows that the family lived in comfort, if not in luxury. Young John had many gifts but his greatest desire was to become an actor. The theater was frowned upon by many people in the early nineteenth century, but because they were in financial difficulties the Paynes allowed John to go on the stage when he was seventeen. From that time on he was associated with the theater in one way or another for most of his life. His work led him far from home, to England and France. For a time he served as United States Consul in Tunis. He was in Paris looking for French plays for the English stage when he wrote HOME, SWEET HOME as a part of CLARI, THE MAID OF MILAN. The tune is probably a



Many of the most loved songs are hymns. This tenderly humorous painting of a hymn-singer, by Henri Lévolle, captures the spirit of a sunny Sunday morning in a choir loft, in the period when bustles were in fashion.

Sicilian air which was adapted by Sir Henry Rowley Bishop (1786-1855), British conductor and composer who was working with Payne.

Some men have written one song that became famous, others half a dozen or so, but Franz Peter Schubert (1797-1828) in his short life gave us between six and seven hundred. Schubert's father earned too little as schoolmaster of a small town near Vienna to give his son much of a musical education; but fortunately, before he was eleven, Franz was accepted as a choirboy in the Imperial Chapel, Vienna. Here he had lessons in singing, composition and instrumental music.

Schubert's head was so full of beautiful melodies that he composed as rapidly as he could move his pen across the manuscript paper. One day, when he was sitting in a tavern with friends, one of them showed him a new translation of Shakespeare. He was delighted with the poem HARK, HARK, THE LARK and wished aloud for paper to write the song that had come into his head. Doppler, one of the friends, ruled out lines of the staff on the back of the menu, and in twenty minutes the song was written. It is hard to know which of Schubert's songs are most loved, but nearly everyone knows his SERENADE, AVE MARIA, WHO IS SYLVIA, THE ERL-KING and the lovely FOREST NOCTURNE.

National anthems have seldom been written because the government of the country decided to have one. Most of them have come from the pen of unknown men who were inspired by patriotic zeal in a national emergency.

The melody of GOD SAVE THE KING was known in England as early as the seventeenth century. In 1745 the supporters of King George II had good reason to believe that their political position was none too secure. Dr. Thomas Arne (1710-78), composer of RULE BRITANNIA and of several Shakespeare songs, was director of music in Drury Lane Theater, London. He arranged GOD SAVE GREAT GEORGE, OUR KING, and conducted its performance at Drury Lane on September 28 of that year. The results were all the Hanoverians (the King's supporters) desired. The words, which had been printed two years earlier, are attributed to Henry Carey (1685-1743), but this fact has never been proved. Carey is known as a writer of ballad operas, and of the song SALLY IN OUR ALLEY.

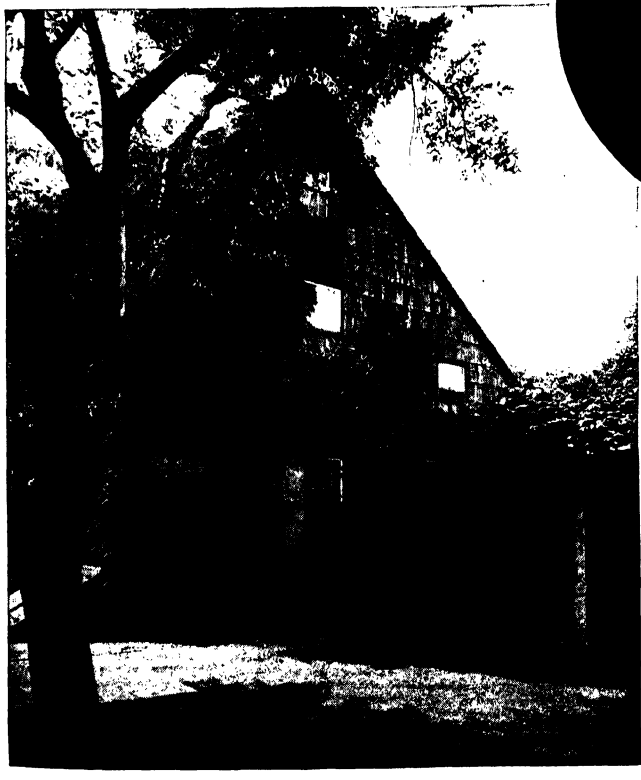
The melody of GOD SAVE THE KING is used in Switzerland for its national anthem. It is also the tune of AMERICA (My Country, 'Tis of Thee). Ludwig van Beethoven (1770-1827) wrote a set of variations for the piano, using the melody as a theme for the series.

LA MARSEILLAISE, the French national anthem, was first called *Chant de Guerre pour L'Armée du Rhin.* Baron Dietrich, mayor of Strasbourg, had a party the evening of April 24, 1792. Political feeling was strong in that famous Alsatian city. The Mayor requested one of his guests, Captain of Engineers Claude Joseph Rouget de Lisle (1760-1838), to write a song which would draw more men into the army, especially into a battalion of recruits called *Enfants de la Patrie,* which was commanded by Dietrich's son. De Lisle, an amateur poet and musician, spent the night writing the words and music of the song, which the Mayor sang the next day. Later that year the soldiers from Marseilles sang the *Chant de Guerre* as they entered Paris. It was associated with them and the name changed to LA MARSEILLAISE.

The monarchistic governments of Europe were frightened by the revolutionary quality of LA MARSEILLAISE. It was banned in many countries. Composers of the time who had democratic sympathies enjoyed slipping phrases of it into their compositions. Two famous examples are by Robert Schumann (1810-56), done especially to taunt the police of Vienna. One is in a set of carnival pieces for piano, *Faschingsschwank aus Wien,* and the other in the song *Die beiden Grenadiere.*

Franz Joseph Haydn (1732-1809), who was an Austrian, recognized the political value of GOD SAVE THE KING in England and of LA MARSEILLAISE in France There were many people in Austria who believed that a republic would be a better form of government than a monarchy. To offset this feeling Haydn composed the Austrian national anthem to celebrate the Emperor's birthday in 1797. The melody is probably the finest of any patriotic tune. The court poet, Hauschka, wrote the words *Gott Erhalte Franz den Kaiser* which were sung at the same hour in all theaters in Austria. These words were changed after World

John Howard Payne wrote the immortal HOME, SWEET HOME in a foreign city, Paris. The song will always appeal to those whom life has carried far from their happy childhood homes.



Both pictures, Culver Service

The inviting, vine-covered Payne homestead at Easthampton, Long Island. All Payne's memories of his family and the joyous hours of his boyhood were associated with this house.

War I, when the Empire was abolished. Haydn used his beautiful melody for a set of variations which make one movement of the EMPEROR Quartet, in the key of C major.

In 1830 the people of Belgium were struggling to break away from Holland. The province of Brabant, which includes the city of Brussels, was especially active in the revolt. LA BRABANÇONNE, the Belgian national anthem, is a tribute to the men of Brabant. François von Campenhout (1779-1848) composed the exciting and war-like music. Jenneval, author of the original words, was killed in one of the battles. The words of his poem suited the tense days in which it was written but was not practical for later years. In 1860 Charles Rogier wrote the words which are now sung.

A famous musical couple, the composer Robert Schumann and his wife Clara. She was a brilliant pianist.

Mexico had no national anthem until 1854. In that year twenty-five poets entered a government competition for a *himno nacional* (national hymn). Francisco Gonzales Bocanegra (1824-61) was the winner. The conductor of the National Military Band, Jaime D. Nuño (1825-1908), set the poem to music. Nuño was a Spanish composer and bandmaster who was known in Mexico, Cuba and the United States. He spent the last years of his life in Buffalo, New York, where he was a teacher and organist. In 1942 the Mexican Government had his body flown from Buffalo to Mexico City where it was reburied with all honor and ceremony.

France, where freedom is as necessary to the people as the air, was the home of a composer of humble origin who had the gift of stirring his fellow-men. L'INTERNATIONALE, song of the working man, was written in 1888 by Pierre Degeyter, a wood-carver. The original French words by Pottier have been translated into many languages by Socialists and Communists. Sung in Russian, it was for a time the national anthem of the Union of Soviet Socialist Republics. In 1944, however, the HYMN OF THE SOVIET UNION, with music by A. V. Alexandrov and words by Sergei Mikhailkov and El-Registan became the official Soviet anthem. Louis Untermeyer, the American poet, has translated the words into English.

The words of China's national anthem are taken from a speech made by Dr. Sun Yat-sen (1867-1925) at Whampoa Military Academy. The Kuomintang held a competition for the music in 1928, which was won by Ch'eng Mao-yün, the man in charge of the Bureau for the Advancement of Musical Education in Kiangsi Province. The Chinese combine their musical sounds in a different way from that of our music, but as we listen more and more to the songs of our Eastern neighbors we shall learn to hear the beauty in their music, as they will learn to hear beauty in ours.

Brown Brothers

Franz Schubert, Vienna's gift to song.

Two national songs are used by the people of Canada. One is GOD SAVE THE KING, and in singing this hymn Canadians pay homage to the sovereign who reigns in Canada as in other parts of the British Commonwealth of Nations. The other national hymn is O CANADA. The stirring music of this song was written by a famous Canadian com-

poser, Calixa Lavallee. There are two sets of words, one in French by Basile Routhier, first published in 1882, and the other in English, by R. Stanley Weir.

Another patriotic song of Canada is THE MAPLE LEAF FOREVER, written by a Toronto schoolmaster, Alexander Muir, in the autumn of 1867, the year in which Canada became a dominion. The maple leaf, as you know, is the national symbol of Canada.

an English playwright, John Gay (1685-1732), decided to give the people something they could enjoy. Gay wrote a lively libretto in English, making fun of the unreal opera stories. Doctor Pepusch set the songs to well-known English folk tunes or airs by Purcell or Handel. Only the accompaniments and overture were his own. The result was the delightful THE BEGGAR'S OPERA which London received with relief and en-

The gay BEGGAR'S OPERA, making fun of the heavy, artificial operas of the day, was a huge success in 1728. In this scene the hero sings the famous lines: "How happy could I be with either; Were t'other dear charmer away."

One of the most famous of modern Canadian composers is the organist and teacher Healey Willan. He was born in Surrey, England, in 1880. He has been the head of the theory department in Toronto Conservatory for many years. He is best known for his organ compositions and for hymn tunes, especially his settings of early plain-song melodies for the Episcopal Church service.

In 1728 the music lovers and theatergoers of England were tired of the entertainment which was being offered to them. German composers were writing Italian operas based on Greek myths. The music was poor, the language foreign, and the stories were tragedies. A Prussian composer, John Christopher Pepusch (1667-1752), and

thusiasm. It has been revived a few times.

Nearly 150 years later another team gained tremendous success in London by writing comic operas. Arthur Sullivan (1842-1900) was a recognized composer of serious music when he met William S. Gilbert (1836-1911), a poet of renown. Sullivan might still be remembered by his ONWARD CHRISTIAN SOLDIERS and THE LOST CHORD, and Gilbert for his BAB BALLADS, but only by a few. Together they created the most delightful operettas we have ever known.

Sullivan, the grandson of an Irish soldier and son of the bandmaster at the British Military Academy, was a choirboy in the famous Chapel Royal in London. His musical gift was so great, especially in composi-

William Gilbert, the writer of the Gilbert and Sullivan team, reads one of their works to Savoy Theater actors.

tion, that he won the Mendelssohn Scholarship when he was barely fourteen. From then on he was amazingly successful at everything that he touched. His gay and charming personality brought him many friends.

Gilbert's father was a naval surgeon who became a writer after he was retired. He was a man with a violent temper which was inherited by his son. Although the younger Gilbert trained for several careers, particularly that of the law, he belonged in the world of the theater and there he found his way after some years of experimenting with other means of livelihood.

Gilbert and Sullivan were brought together in 1875 by Richard D'Oyly Carte, a theatrical manager, who was farsighted enough to see what might happen if two men with a genius for making fun of the world were given the right opportunity. Sullivan was delighted by Gilbert's special kind of comedy, and Gilbert appreciated Sullivan's ability to write music that set off the words to perfection. D'Oyly Carte, who produced their work, became almost as famous as they did.

Culver Service

The Pirate King threatens Edith in mock seriousness, in Gilbert and Sullivan's PIRATES OF PENZANCE.

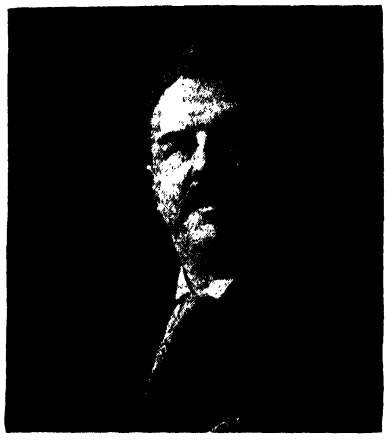
It is hard to choose their best-loved songs, there are so many. From TRIAL BY JURY we have WHEN I, GOOD FRIENDS, WAS CALLED TO THE BAR; from H. M. S. PINAFORE, a dozen or more, including I'M CALLED LITTLE BUTTERCUP; from THE PIRATES OF PENZANCE (the idea of which is said to go back to Gilbert's childhood when he was kidnaped), POOR WANDERING ONE and

A POLICEMAN'S LOT IS NOT A HAPPY ONE; and from IOLANTHE, WHEN I WENT TO THE BAR and WHEN YOU'RE LYING AWAKE. There are many people who love THE MIKADO most of all. In it are the delicate TIT-WILLOW and THREE LITTLE MAIDS FROM SCHOOL, and the beautiful THE MOON AND I. In the second act of THE MIKADO is a four-part song, BRIGHTLY DAWNS OUR WEDDING DAY, which is probably the finest musical work of Gilbert and Sullivan.

Johann Strauss, the younger. His lilting waltzes helped to make once-gay Vienna the very symbol of romantic charm.

Many a child's first taste of opera is HANSEL AND GRETHEL. Engelbert Humperdinck (1854-1921) and his sister Frau Adelheid Wette wrote it for the Wette children and their friends at Christmas time in 1893. Humperdinck had studied and taught in many cities of Europe. He and Richard Wagner were close friends, and Humperdinck helped to copy the score of the opera PARSIFAL.

The spirit of the German peasant runs through HANSEL AND GRETHEL. Frau Wette used a famous German fairy tale for her story, while her brother included SUSA, LITTLE SUSA and one or two other folk songs. He wove around them a score that sounds as if it could all be folk music; but Humperdinck actually wrote it. One of the loveliest songs is that of the angels guarding the children asleep in the woods—EVENSONG.



The Irish-American composer Victor Herbert. Songs from his tuneful comic operas remain ever popular.

VICTOR HERBERT (1859-1924) was born in Dublin, Ireland, but because of his great musical gift he was sent off to Germany when he was seven to study the violoncello, which was always his instrument, even though he is known as a composer of light operas. From that time on he lived in European music centers or in America. When he was twenty-seven he married Therese Foerster, prima donna of the Court Opera in Vienna. She was offered a position in the Metropolitan Opera in New York, and her husband, of course, went along. He started out as first 'cellist in the opera-house orchestra, but that was only the beginning of a career which included the writing of an opera, performed at the Metropolitan.

Now he is best known for many tuneful melodies from his comic operas. Since his death some of them have been made into moving pictures. The most popular songs are SWEET MYSTERY OF LIFE, KISS ME AGAIN and GYPSY LOVE SONG; his best-known operettas are NAUGHTY MARIETTA, SWEETHEARTS and BABES IN TOYLAND.

Even well into the 1900's young musicians in the United States were not recognized unless they had studied in Europe. Henry Louis Reginald DeKoven (1859-1920) was no exception. He left Middletown, Connecticut, where his father was a minister, before he reached high-school age, and had the rest of his study in England, or on the Continent. He was interested in light opera and studied it when he was working with Delibes in Paris. With Percy Mackaye, the poet, he wrote two grand operas, but his most famous songs, OH PROMISE ME and BROWN OCTOBER ALE are from ROBIN HOOD, the operetta which he made with Harry B. Smith.

Looking up a Strauss in a dictionary of music is a little like hunting a Smith in a telephone book. Johann Strauss Senior and Johann Strauss Junior are famous as composers of waltzes and conductors of dance orchestras in Vienna. The father decided that one musician in the family was enough, but the mother understood and arranged to have the son study music secretly while he was working in a bank to please his father. It is Johann Junior who wrote THE

BEAUTIFUL BLUE DANUBE and ARTIST'S LIFE waltzes. His most famous operetta is *Die Fledermaus* (THE BAT), which was called ROSALINDA when it was produced in the United States. There are many other Strausses who have written notable music.

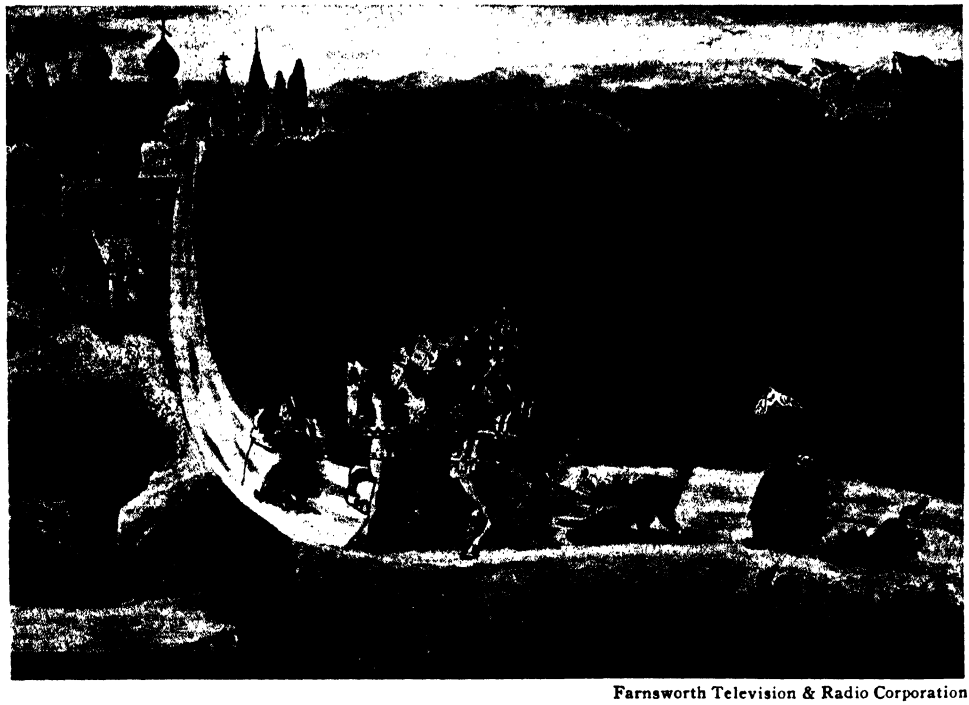
Central Europe is the birthplace of three other famous composers of light opera. Franz Lehar, born in Komorn, Austria, in 1870, composed his first song when he was six, and at twelve entered Prague Conservatory where he studied with Anton Dvořàk. His contribution is THE MERRY WIDOW. Sigmund Romberg came from the section that is now Yugoslavia. He crossed to New York with a letter of introduction from Lehar to the producer J. J. Schubert. BLOSSOM TIME (the life and music of Franz Schubert), NEW MOON and THE STUDENT PRINCE are among his twenty-six operettas and forty-eight musicals. In 1881 Charles Rudolf Friml was born in Prague, Czechoslovakia. He, too, studied in Prague Conservatory and distinguished himself as a pianist as well as composer. His comic operas, ROSE MARIE, HIGH JINKS and FIREFLY are probably his most successful works.

PETER AND THE WOLF is not a comic opera —it is a play in which the parts are taken by musical instruments. The composer, Sergei Prokofieff, born in Russia in 1891, calls it a symphonic tale for children. It was written for a children's concert in Moscow in 1936. The story is told by a man called a narrator, while the instruments act their parts. The flute acts the part of the bird; three horns, the wolf; a string quartet, Peter, and so on.

Prokofieff showed great musical ability even when he was tiny. He wrote his first composition when he was five. After he saw an opera when he was seven, he went to his uncle's house and wrote his own, The Giant. After World War I he left Russia by crossing Siberia. He stopped for a time in Japan and the United States before he went on to London and Paris. He returned later to Russia and became a citizen of the Soviet Union in 1935. He is recognized as one of the most gifted composers of our century. He has none of the sentimentality of nineteenth century music. His direct, crisp style is well shown in the gay little Peter tune that anyone can whistle or sing.

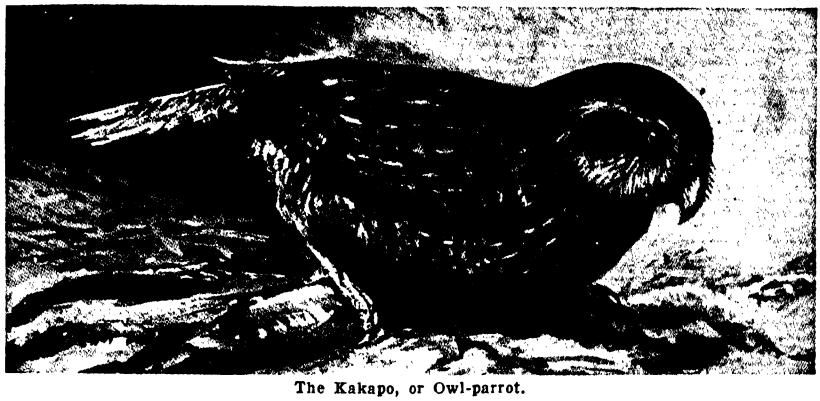
By URANA CLARKE.

THE NEXT STORY OF MEN AND WOMEN IS ON PAGE 3844.



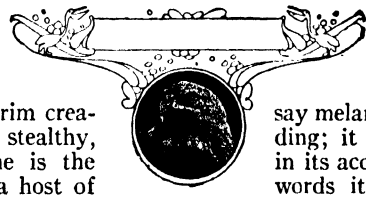
Farnsworth Television & Radio Corporation

This painting by Edward Buk Ulreich captures the witty gaiety of PETER AND THE WOLF, the "play" for musical instruments by Serge Prokofieff. The wolf's "howl" is three horns; and a string quartet is Peter's voice.



The Kakapo, or Owl-parrot.

THE PARROTS AND THE OWLS



TO most of us there would seem little in common between the gay parrot and that grim creature of the night, the stealthy, soft-flighted owl. One is the joyous chatterbox in a host of homes all over the world; the other, from ancient days to modern, has been the centre of sinister legend and tradition. The grouping of the animal family brings relationships to light which are startling in their unexpectedness. The parrot claims cousinship both with the cuckoo of the day and with the bird of night.

The one amuses us; the other labors in our interests, if at the cost of something of our cheerfulness. Let us welcome the parrot for his chuckling jollity, the owl as a scourge of our enemies. A study of their ways will increase our respect for both, and not wholly dispel a slight thrill of awe.

Who could better introduce the impertinent Parrot Family than that parrot which, escaping from its home, flew into the convalescent ward of a hospital one summer afternoon, hung himself upside down from the ceiling, surveyed the inmates in their beds, and greeted them with a cheerful "Hello"?

That is the sort of thing parrots do. They astonish us at times with borrowed speech which suggests intelligence. But a parrot will laugh and whistle at a funeral as readily as it will say melancholy things at a wedding; it has no sense of fitness in its accidental speeches. The words it utters have no more meaning for it than its mimicry of saws and steam whistles, and it is just as likely to pour forth one as the other.

We are bound to look at this side of Polly's place in the world. As a talker and echo of sounds it has made its fame and fortune in civilization. The gift of reproducing speech and a multitude of sounds is not restricted to parrots, but the parrot uses the gift most cleverly. In freedom the parrot has no apparent need of such a faculty. There is a definite parrot language—shrieks, squawks, occasional warblings, and sounds as of tearing calico. That serves the parrot all the purposes of communication in the wilds, and the vivid colors of the birds, nearly all tree-dwellers, are beacons which no keen bird eye can miss.

With this wasted gift of mimicry are associated the use of the foot as a hand, and structural features which claim attention. Essentially a climber, the parrot has feet in which one toe is always turned backward and can be joined by a second toe. That is to say, standing on the ground, the bird

has three toes pointing forward and one back; but when gripping a branch it has two toes forward and as many in the reverse position.

THE STRENGTH AND USEFULNESS OF THE PARROT'S BEAK

The beak, which is used to haul the bird about, is an implement of greater power than we suspect. The upper half can be raised like the lid of a box, and so we should not expect it to be richly endowed with strength; but there are nut-eating parrots whose power is so astounding that they can crack Brazil nuts. Birds in captivity have been seen to bend stout brass knobs with their beaks. Such strength is unique among birds. Falcons and owls tear things like miniature tigers, but some parrots have a force which may be compared with the bone-smashing jaws of the hyena.

The number of species in the Order is enormous. Some ornithologists count over six hundred. Most of them belong to the tropics, and few enter the temperate zones. South America has over a hundred and fifty species, but only one is found in North America.

The birds which occur first in the Order leave a painful impression on the minds of those who wish to think well of parrots. They are the Nestors, the unique group of New Zealand and its islands. There were four species within historical times, but the number is now reduced to two, the Kea and the Kaka.

THE TERRIBLE WAR OF THE KEA AGAINST THE SHEEP

Both are long-beaked and have fringed tongues, showing that Nature brought them up to make nectar and fruit juices a substantial part of their fare. The kea, strange, terrible bird, nesting high up in mountains where ice and snow abound, has gone mad in a fatal direction. It has become a sheep-killer! White men and their sheep are recent importations into New Zealand, where parrots have been from time beyond knowledge; yet within recent years the keas have become enemies of sheep.

How the evil practice started no one can tell. One suggestion is that the birds were accustomed to dig for insects with their beaks in a wool-like moss. A more likely theory is that the birds developed a taste for flesh, eating scraps of meat and sheepskins left about. They settle on a sheep's back, delve with their hooked beaks through the wool and deep into the flesh, working on till they expose vital organs and cause the poor sheep to die in misery. The evil has become serious and widespread. Out of four hundred sheep left by one farmer in pasturage for the winter, over two hundred had been slain by the keas when he went to count his flock in the spring.

It is a little singular that the next-of-kin to the nestors are the charming Lories and Loriquets. We do not find them in New Zealand, but in the Australasian and Polynesian region. They all have a brush-fringe to the tongue, and as they are handsome, gentle and amusing, they are loved in human homes. The lories are the larger, and the loriquets the small species, though Swainson's Loriquet measures a foot, including the five-inch tail. This Swainson beauty is the handsomest of all Australia's great parrot group.

Who shall tell a parrot from a cockatoo? Yet there need be no difficulty. Apart from the distinctive crest there is an unfailing clue in the beak. The lower part of the beak in the cockatoos is not smooth or marked by little transverse ridges as in the parrots; it is grooved, like a file.

HOW A QUAINT COCKATOO GETS ITS FOOD FROM A ROCK-LIKE PRISON

King of the cockatoos is the Great Black Cockatoo, or Ara, as big as a raven, but with a larger tail. It is a fantastic bird with a huge beak which holds a little worm-like tongue, pink and tipped with black; but there is a purpose in this beak. It masters the rock-like shell of the kanary-nut—the product of a huge forest tree—as easily as we should crack an almond. But we, to get at the kernel which forms this bird's food, must use a hammer. Most cockatoos, however, are white or whitish, though often tinged with red or orange. They do not talk well.

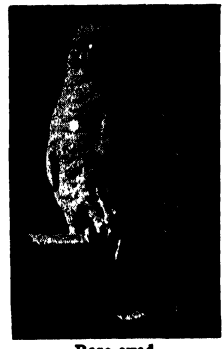
Cockatoos have prospered greatly in the Australian region, which gave them birth and is still their home. But we must leave them with this glance and come to the true parrots. It is a tremendous collection of birds. There are pigmies, natives of New Guinea, actually smaller than an English sparrow. They have tails, which must be of service to the birds in climbing and supporting themselves on the trunks of trees.

MEMBERS OF THE PARROT FAMILY

Sulphur-crested cockatoo.

Black-and-yellow macaw.

Hyacinthine macaw.



Bare-eyed cockatoo.

Love bird.

Leadbeater's cockatoo.

African gray parrot.

Hanging parrot.

Kea.

Rose-crested cockatoo.

Green parrakeet.

Budgerigar.

The Triton cockatoo.

In South America we find the macaws. They are the showiest of all the parrots. In general they are large, but their tails give them a suggestion of prodigious size. The Blue-and-Yellow Macaw is the commonest, the Red and Yellow the gaudiest, the Blue one of the rarest. It is notable for the fact that in place of the usual hole in a tree for a nest it mines a burrow in the bank of a river. The Severe, the Military, the Noble, the Hyacinthine and Spix's macaws are of the sorts coveted because they are harder to obtain.

THE BAT-LIKE HABITS OF THE CAROLINA PARRAKEET

All these macaws are great choppers-up of nuts. The great black cockatoo cuts his hard fare in slices—shell, kernel and all; but a blue macaw picks up a tough palm nut, which we could never penetrate without tools, and pulps it like a cherry-stone.

Next we have some thirty species of South American parrakeets, or paroquets, as they are sometimes called. They are slighter birds and smaller. The Carolina parrakeet is a foot long, gorgeous in green shading to yellow, with the head and cheeks a ruddy orange and the neck as yellow as a golden canary's. Their sociable habits resemble those of bats, but their homes are in great hollow trees, where they hang huddled up together, gripping the surface with claws and beak even when asleep.

This is the only North American parrot. Formerly it ranged as far north as Lake Erie, but now it is found only farther south, if found at all. It is almost extinct, if indeed any at all are left.

For some reason certain of the parrakeets have developed slender, narrow beaks, and branch off into a species by themselves. Of these the Gray-breasted Parrakeet is equally famous and distinct by making a true nest in trees, or rather many nests together. They even run great communal nests into one, with many entrances and exits in which a score of birds may incubate their eggs—a clumsy beehive of a nest.

REGIMENTS OF PARRAKEETS RAID THE CORN- AND RICE-FIELDS

Aviary-keepers welcome the Green Parrakeet because of its good health and spirits, and its tendency to increase its numbers. Where man has made his home in the region where they abound the bird is much dreaded. It is so prolific, it forages so boldly in regiments, that its visits to growing corn and rice fill the cultivator's heart with despair—as if locusts were dropping down in swarms from the unpitying skies.

We must note the resplendent Amazon parrots, and remember that the family has also an African representative. Some forty species are known, most of them denizens of the enormous valley of the river whose names they bear.

Guilding's Amazon, however, is a native of the island of St. Vincent, and is one of the survivors of a calamity which not many years ago shocked the entire world. The eruption of the volcano Mount Soufrière destroyed men, women and children, buildings, animals and birds, but a few of Guilding's Amazons fled to safety.

The Hawk-billed Parrot, with strange coloring and a unique ruff at the back of the neck, looks as if it were a ferocious specimen, but it is gentle and reliably affectionate in captivity, and also a good talker.

THE GRAY PARROTS WHICH KNOW THAT UNITY IS STRENGTH

The Gray Parrot is the prime favorite of all whose hearts go out to the parrot tribe, as they are the best talkers. They are at home in Africa and Madagascar, and New Guinea has one species. It is a pity that they must usually live alone when they are captured, for their nature is to live in flocks. They have single nests, but in case of an attack by an enemy too strong for a single pair, the whole clan unites in battle array, and woe to an intruder. At liberty they live entirely on fruits and palm nuts. It is the males which talk most, but the females which talk most distinctly.

They are often killed in their cages by misdirected kindness; given no water, denied the pieces of wood they love to nibble, fed on fats and table scraps which are fatal to their digestion, and with no sharp grit in their rations, they are doomed. Properly treated, however, they live in houses for threescore years and more, and are marvels of amusement and a sort of monkeyish sportiveness.

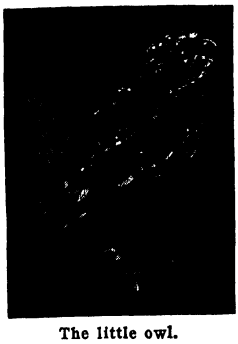
Madagascar has a curiosity in parrots, the Vasa, a bird whose black-and-sable raiment gives it the appearance of a crow at a distance. It looks too dignified to

SOME WISE OLD OWLS OF MANY LANDS

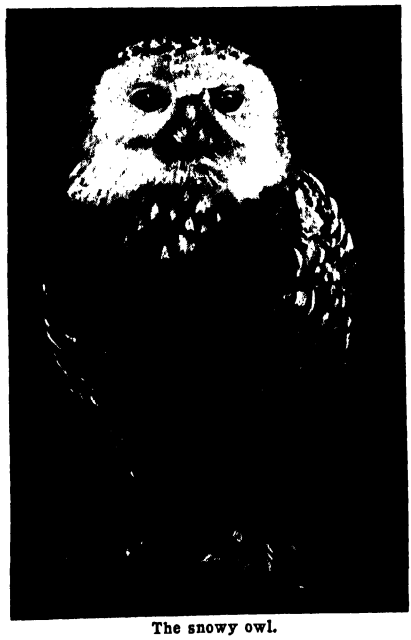
Great horned owl.

Fraser's Eagle owl.

Milky eagle owl.



The little owl.



The snowy owl.

Long-eared owl.

Mexican barn owl.

The tawny owl.

The burrowing owl.

African fish owl.

Australian barn owl.

The Ural owl.

talk, yet it talks like all the rest of the tribe, once liberty and shyness are forgotten. We know little of this bird's ways in nature, and still less of the black Papuan Parrot.

Among the jolliest small members of the family are the Love Birds. Several species from Africa, the East Indies or South America are called by this name. All are small parrots, stumpy in body and short of tail. They are common in all aviaries where parrots find a lodging. Their name is given them on account of their affection toward one another, and also from the fact that if one of a tame pair dies, the other generally declines and sinks into an early grave—dead of blighted affection we probably think. The truth is different, yet sad: the disease which has killed the first is generally implanted in the second also. His little lease of life beyond that of the mate is simply proof that the stronger of the two has survived.

THE LITTLE VISITORS FROM AUSTRALIA THAT NESTED IN OUR WINTER

Even greater favorites than the love birds are the Budgerigars, though they are sometimes called love birds also. Their long tails make them look quite big birds, but in reality they have bodies no bigger than that of an average canary. These are the parrots that you sometimes see "telling fortunes" on the street or at a fair.

They are Australian birds, accustomed to a summer which occurs when winter is with us. The consequence is startling when they first come over. They nested with the writer about Christmas, and brought off their first five young when snow lay three inches deep on the ground. Yet they throve, and were never sick or unhappy except on first nights out of the nest.

We pass to the Hanging Parrots, so named because when they rest they have the quaint habit of suspending themselves upside down and sleeping with their heads where we should expect their feet to be. Honey, flower-buds and tender shoots are their food, but they frequent pots set to catch palm-juice, and this has an intoxicating effect on the pilferers, so that they are often caught before they recover their senses. Even at the best of times they are sleepy little fellows, and we must view their practices with suspicion.

AN OWL-LIKE PARROT WHICH IS BECOMING EXTINCT

There are many other species in this Parrot Family, but we must leave them with the Kakapo, or Owl-parrot. Like the ostriches and the penguin, it has lost the power to fly. It has lived in a New Zealand paradise where no dangerous mammal was till man arrived with the dog, the rat and the cat.

Wings it still retains, but the great breastbone to which the huge muscles of flight must anchor is wasted to half its proper size, and the kakapo can never again be a true flier. In quiet glades it may show itself by day, but in the main it is driven to feed by night, to run up and down trees, to forage among the grass, never returning to anything nearer true flight than a flop downward from bough to bough or from tree to ground.

Unless man saves it, this errant bird will perish utterly within a generation. Pigs and dogs and other animals, to say nothing of human gourmands, have eaten the greater part of the myriads which once roamed in company with the giant moa.

THE MAJESTY OF THE OWL AS WE SEE IT IN THE NIGHT

We have worked our way along this living trail of birds till we have met in the kakapo an owl-like parrot, and now we reach the owls themselves, the shrieking night birds of prey, the subject of legends and fables which have made nations in all ages tremble with unreasoning horror. The fact can be explained on two grounds. Owls are mainly creatures of the night. They are silent as thought on the wing; they haunt old ruins, dark trees in deep woods and dim barns, where great rats scuttle and scream. So foolish man has woven the owl into grim tales of death and terror.

The large head, the cruel beak, the eyes brought forward for piercing vision, the disks of feathers in which the eyes are set, the tufts of feathers which sometimes crown the ears, the powerful legs and feet are all features to impress the timid. But we usually see owls by daylight when they are not at their best. It is at night when their majesty appears, when the great eyes collect the little light there is.

They are among the most widespread of all birds. Wherever there are plagues of shrews or field-mice there come the owls.

They flock in from all parts, drawn by we know not what natural telegraphy. They breed quickly on their unbounded diet. Not only do they produce more eggs at an abnormally rapid rate, but the eggs themselves are bigger, so that to

A Meeting of Parrots—From the painting by Henry Stacy Marks.

combat a plague of vermin they furnish more, larger and stronger owls for the fray. Owls swallow their prey whole and afterward throw up the parts they cannot digest.

Owls may attack us when we rob their nests—they would be poor-spirited creatures if they did not. They may attack us when we deprive them of the means to a meal, but when we are sleeping, and leaving our substance to the mercy of rats and mice, to shrews and rabbits, beetles, slugs and moths, it is the owl that is guarding our interest. A few of the larger owls sometimes eat poultry, and they do eat some birds, but the greatest part of their food is made up of our enemies. The wise farmer leaves spaces in the walls of his buildings for barn owls to enter and leave, and he could have no better guardian.

An immense sensation was created

some years ago by the report of "luminous owls" in England. The naturalist's explanation is that the birds were truly luminous, simply from rubbing against phosphorescent material in rotting wood.

The Tawny Owl is common over most of Europe and extends into Africa and Asia. It is a true wood owl, and its haunting note can be heard a long way. The nearest American relative is the Barred Owl, called also the Hoot Owl. This is also a woodland bird, and its strange call can be heard a mile.

The Long-eared and the Short-eared owls are found both in Europe and in America, and the same is true of the little Saw-whet, or Acadian Owl. All three species hunt mice vigorously. The common Barn Owl, or closely related species, may be found on both sides of the Equator. We tell you more of our owls in the chapters on the Birds of North America.

THE LITTLE OWL OF AMERICA THAT LIVES IN A HOLE

Wherever owls can live, there we find them, some everywhere, some restricted to jungles, some common to a continent, some chained by destiny to the desert, some peculiar to Indian regions. There are more than two hundred species. The largest is the Gray Owl, of the Arctic, with wings five feet from tip to tip. The smallest is the Elf Owl, of Mexico and Texas, about the size of a sparrow. The Snowy Owl of the Arctic regions is not much smaller than the gray owl. It dislikes settled countries, and comes southward only when forced by hunger.

There is a little owl in America which has followed the lead of many harried mammals, and taken to the ground for its home. This is the famous Burrowing Owl, a nine-inch specimen—not a Titan for the work, but burrowing owls are wise in their generation, and share the homes which other powers have made—the homes of burrowing rodents. They not only lodge with their hosts but board with them, *on them*, in fact, for they eat the young of their entertainers, and occasionally add a meal of rattlesnake when those deadly reptiles seek part in the underground community.

THE HAWK OWLS THAT ATTACK THE LEMMINGS ON THEIR MARCH

Turning again to birds of larger stature, we have the Hawk Owls, of which an Australian species dines on young koalas, the animals the Australians call the bear. The other representatives of the hawk-owl group range from Northern Europe, through Asia, to Northern America. They are bolder and hunt by daylight. The little birds circle round to mob them. It is the hawk owls of Northern Europe that generally head the attack on the moving myriads of lemmings.

If the Eagle Owls chose, they might be as active when the sun is up. Indeed, they do sometimes hunt by day, though commonly they are creatures of the night. Perhaps it is as well that we do not see too much of them in the day, for they are as fierce and bold as any bird that breathes. They are great ear-tufted creatures, sometimes twenty-eight or more inches long, so strong and daring that they include in their prey the fawns of deer, as well as full-grown hares and rabbits, birds of many kinds, with a reptile by way of variety. We also call our eagle owl the Great Horned Owl.

MAN'S MOST VALUABLE FRIEND AMONG THE BIRDS

The bird is superbly fitted for its work. All owls are. Think of the equipment of the Fish Owls of Africa and India. Their feet have horny spicules. The lion and the tiger have such things on their tongues to rasp flesh from the bones of their prey; the owl has them so that when he makes his plunge and grasps a fish in the water his slippery prey shall not escape.

Several hundred species of birds make up the families we have looked at quickly here, though it is probable that many of these species are not really distinct. They have their appointed work, serving us by seeking their own ends. If we interfere, an eye or a cheek may be torn; if we leave well alone and the owl to his business, life will be fairer for the owl and for ourselves, though uneasy and precarious for the enemies that consume our stores of food.

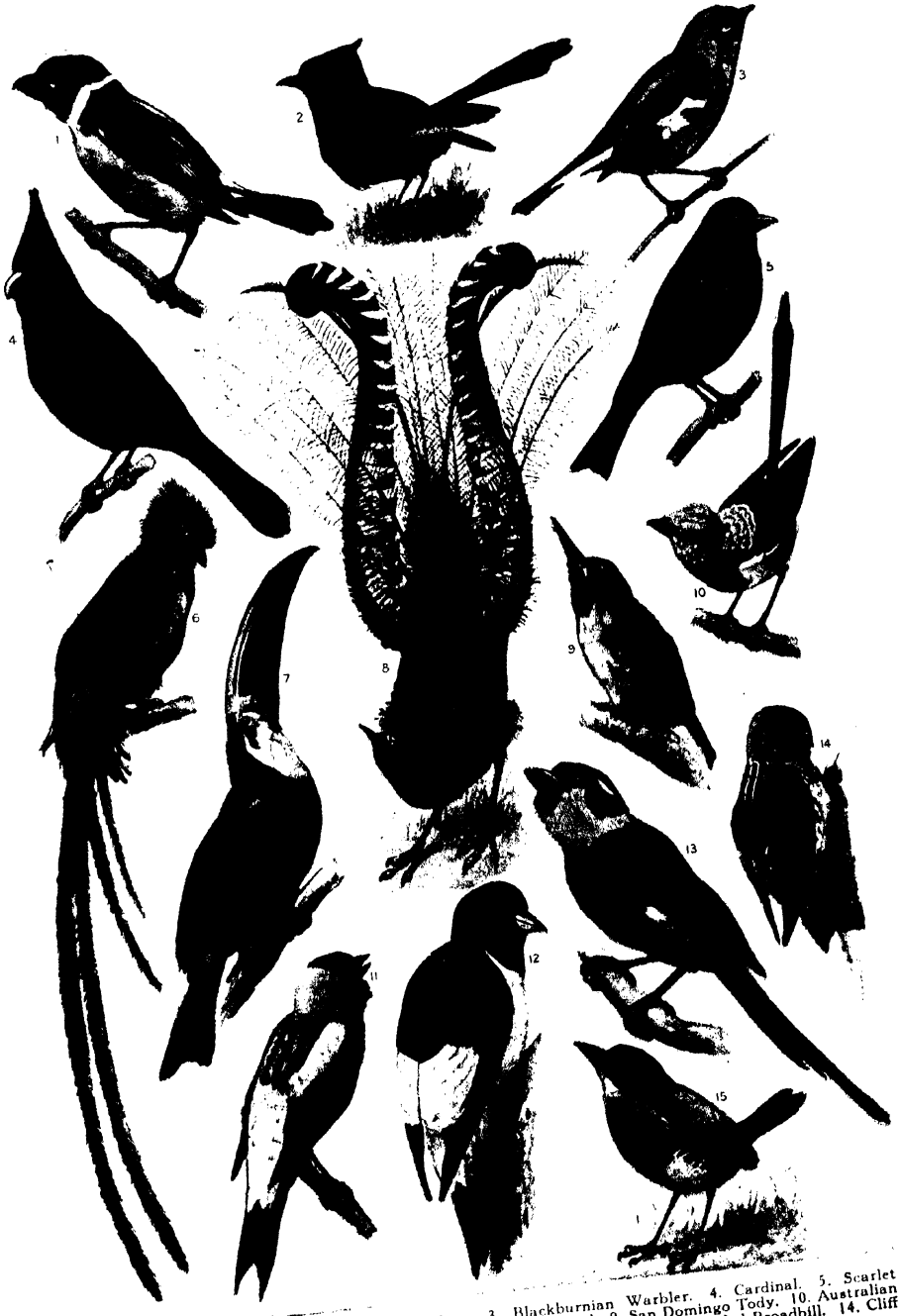
The owl is as carnivorous as a wolf, and, knowing that, and all the counts for and against it, a high authority finds that the owl is the most valuable to man of all birds. But the wise old owl takes no heed of the tribute. He is busy to-night with some mice, and to-morrow he will have an appointment with some rats. May his natural ventures ever prosper!

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 3753.

BEAUTIFUL BIRDS OF THE WORLD (I)

1. Superb Fruit Pigeon. 2. Pennant's Parrakeet. 3. Chestnut-backed Babbler. 4. Red-necked Tanager. 5. Bluebird. 6. Columbian Cock-of-the-Rock. 7. Orange-breasted Flower Pecker. 8. Blue Creeper. 9. Double-collared Aracari. 10. Pompadour Chatterer. 11. Horned Parrakeet. 12. Prairie Chicken 13. Yellow-fronted Manakin. 14. California Quail.

1. Blue-and-yellow Macaw. 2. Great Bird of Paradise. 3. Red-and-blue Macaw. 4. Beautiful Lorikeet 5. Splendid Grass Parrakeet. 6. Mocking-bird. 7. Swainson's Lorikeet. 8. King Bird. 9. African Shrike. 10. Baltimore Oriole. 11. Black-capped Lory. 12. Sultan Tit.



1. Black-and-yellow Broadbill. 2. Blue Wren. 3. Blackburnian Warbler. 4. Cardinal. 5. Scarlet Tanager. 6. Mexican Quezal. 7. Red-billed Toucan. 8. Lyre Bird. 9. San Domingo Tody. 10. Australian Wren. 11. Bobolink, or Rice Bird. 12. Red-headed Woodpecker. 13. Yellow-headed Broadbill. 14. Cliff Swallow. 15. Gurney's Pitta, or Ant-thrush.

1. Weaver-bird. 2. Red-shouldered Parrakeet. 3. Pink-crested Bee-eater. 4. Violet Gallinule. 5. Golden Conure. 6. New Guinea Broad-billed Flycatcher. 7. Puff Bird. 8. Sun Bittern. 9. Australian Jacana. 10. Central American Boatbill. 11. Blue-faced Barbet. 12. Lafresnaye's Bee-eater. 13. Regent Bower Bird. 14. Cinnamon Teal.

Dennison Manufacturing Company

Bottle doll door stops. Left to right: Mammy, Marie, Sonja, Hulda, Stephanie and Nina.

BOTTLE DOLL DOOR STOPS

THESE door stops are quaint and attractive and serve a useful purpose. They are quite easy to make and inexpensive. Mother will be delighted with them, for when you set one of them in position the door will just have to stay in place.

To begin with, you pick out a large bottle eight or ten inches tall. Ginger ale or soda water bottles will do very well. Fill the bottle with sand to weight it down and put in a tight cork stopper. You will find corks of all sizes and shapes at your five-and-ten cent store. The bottle will form the body.

For the head, crush and roll two sheets of white tissue paper into a very tight ball. Wrap an 18-inch by 7-inch strip of peach color crepe paper (black crepe for the Mammy doll) around the tissue ball about three times. Paste the edge and tie at the top with spool wire; cut off the surplus paper above the knot. Place the base of the ball around the neck of the bottle and tie with spool wire. Paste the surplus (about 4 inches) down on the bottle (figure 1).

The petticoat is made of a piece of white crepe paper 9 inches by 45 inches. Gather with needle and thread 2 inches from the edge along the 45-inch length. Fit around the bottle 1½ inches below the head. This will make a padding for the skirt, which will be put on later.

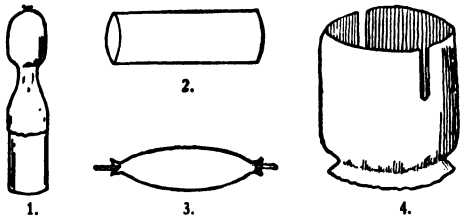
For the arms cut a piece of No. 15 wire 14 inches long. Turn the ends back ¾ of an inch in loops to form the hands. Wrap back and forth three or four times with a ½-inch strip of peach color crepe (black crepe for the Mammy doll).

Next fit the sleeves over the arms. For the sleeves cut a 14-inch square of crepe paper and paste the opposite sides together to form a tube (figure 2). Gather ½ inch from each end. Slip over the arms and tie, as shown in figure 3. Tie again in the middle and paste this section to the back of the bottle just below the neck line. Bend the arms into position.

The waist is made of a piece of crepe paper, 14 inches by 6 inches. The edges of

the two short sides are pasted together, forming a tube. Gather up the crepe at the bottom and tie around the doll's waist with spool wire. Cut slits down from the top to allow for the arms (figure 4). After the arms are in position in the slits, gather the waist again along the top edge and tie tightly around the neck with the spool wire.

Cut off a piece of crepe paper, 9 inches by 45 inches for the skirt. With needle and thread gather along the 45-inch length 1½ inches down from the edge. Place the skirt, wrong side out and with the gathered part at the bottom, around the doll in such a way that the gathered part will be at the doll's



Four preliminary steps in the process of making a bottle doll door stop.

waist. Tie the skirt in place. Now turn down the skirt, allowing the 1½ inches to form a padding under the top of the skirt to make it stand out.

The apron is cut from a piece of shelf paper or crepe paper 6 inches wide and 14 inches long. Gather along the 14-inch edge and draw up to a 5-inch length. Cut a piece of crepe 24 inches long 1½ inches wide, and fold in thirds lengthwise. Paste the three folds together to form a band 24 inches long by ½ inch wide. Paste this band to the back of the apron, along the top, allowing the protruding ends of the band to extend equally on both sides. These protruding ends are the apron strings; with these you are to tie the apron in place.

The hair is made of tightly twisted strips of crepe paper cut 1¼ inches wide. Paste in close rows to the head and make braids where indicated in the detailed directions given below. To make the features use a bit of rouge for the cheeks and gummed dots for the eyes and mouth. Use India ink for the eyelashes, eyebrows and nose. Use white ink or paint to make the Mammy doll's eyes and lips.

Following are the specific instructions for making the individual dolls.

Stephanie (Poland). Hair—yellow crepe. Waist, sleeves, petticoat, apron—white crepe. Skirt—blue and white strips of decorated crepe. Apron, sleeves and scarf trimming—peasant flower napkin or red check shelf paper.

Hulda (Holland). Hair—yellow crepe. Waist, sleeves, petticoat—white crepe. Bodice—black crepe. Skirt—blue crepe with jade green, red and yellow bands. Sleeve bands—red crepe. Apron—shelf paper.

Marie (Alsace). Hair—brown crepe. Waist, sleeves, petticoat—white crepe. Jacket, hair bow—black crepe. Apron—red crepe. Skirt and waist trim—shelf paper.

Nina (Gipsy). Hair—black crepe. Waist, sleeves, petticoat—white crepe. Skirt—vermilion crepe. Bolero—black crepe with jade green edging. Head scarf—jade green crepe. Apron—green and cream lace shelf paper. Earrings—No. 1 metal rings. Beads—gold gummed dots stuck back to back on threads.

Sonja (Sweden). Hair—yellow crepe. Waist, sleeves, petticoat—white crepe. Bodice, hat—black crepe. Skirt, sleeve trim—peasant flower decorated crepe. Hat trimming—1 spray each of pink, yellow and blue tiny flowers. Bodice ties, hat trimming—1½ yards narrow blue satin ribbon.

Mammy (South). Hair—black crepe. Waist, sleeves, neckerchief, cuffs, apron—white crepe. Bandana—white crepe with red polka dots. Skirt—black-and-white plaid pattern crepe. Waist buttons—white gummed dots.

All of the items listed above may be bought at your stationery store.

BUILDING A WORD

WE begin by taking the vowel used most frequently in the English language. Next we place another letter before this one, and we have the initials of a large manufacturer of electrical supplies. Putting another letter before the first two, we have a word that means period. Adding still another letter, we have a wise man. If we set a letter before the other four, we have a Kansas river. A letter before the rest gives us a measure in medicine. The answer is on the next page.

ANSWER TO PROBLEM ON PRECEDING PAGE

The vowel that is used most frequently in the English language is E. Putting a G before it, we have GE (General Electric). The addition of the letter A gives us AGE. If we put an S before AGE, we have the word SAGE, or wise man. Placing an O before SAGE, we have OSAGE, the name of a river in Kansas. Finally, if we set the letter D before all the other letters, we have DOSAGE, which is a measure in medicine.

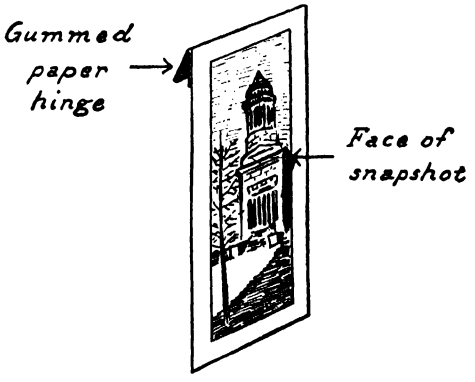
HOW TO KEEP A SNAPSHOT ALBUM

WHEN one puts snapshots in an album, the usual practice is to paste from three to six snapshots in one or two rows extending across the page; sometimes the subject of a given picture is indicated below the picture by means of a white pencil. This method is not very satisfactory. For one thing it is quite wasteful of space; and in these days when many boys and girls are constantly taking pictures, it is desirable to utilize as much album space as possible. Again, if you wish to find a given snapshot, you must thumb your way through the album until you happen to come upon the desired picture. In this article we are going to show you how to arrange your photographs neatly, save a good deal of space and be able to put your finger on any desired snapshot within a few seconds.

Any photographic album will do for your collection of snapshots. However, instead of pasting your snapshots across the page, mount them by means of hinges one below the other in a single column at the left of the page.

The mounting process is extremely simple. You must provide yourself with some heavy gummed paper of the type used to fasten packages. These come in rolls of different widths. Your grocer or druggist will probably be glad to give you a yard or two of this paper; a yard will mount about 36 snapshots. If you have a great many snapshots to be mounted, you may find it advisable to buy a roll of this paper at your stationer's.

Cut the paper into 1-inch lengths, so that you will have a number of pieces of gummed paper 1 inch by whatever the width of the roll is. Take one of these pieces and on the gummed side draw a line, parallel to the two longer edges, in such a way that it will divide the gummed surface in two.



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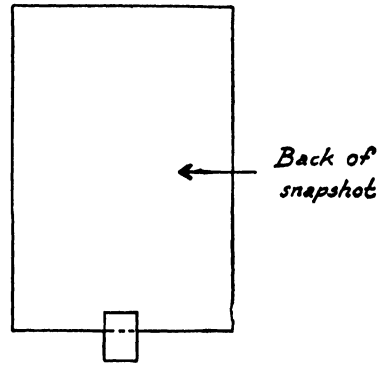
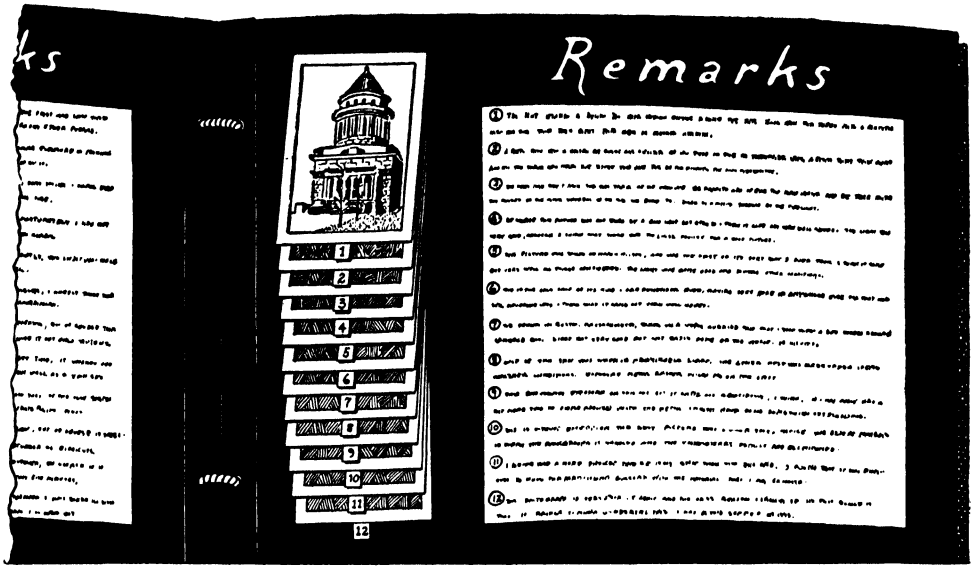


2.

You must now apply the gummed paper to the upper edge of the *back* of a snapshot so that the line you have just ruled on the gummed paper will be even with the edge of the snapshot; of course ½ inch of the gummed paper will protrude beyond this. Fold back this protruding section (figure 1). Next press this protruding gummed paper into position near the top of the album page, at the left-hand side. The next snapshot is mounted directly below the first so that the top edge of the second snapshot will be ¼ of an inch below the top edge of the first.



3. How the album will look when it is completed.

(See figure 3.) Mount others in the same way. You will be able to put from ten to fifteen snapshots on the album page, depending, of course, upon the length of the page.

The snapshots are numbered consecutively throughout the album. Prepare rectangles of white paper ½ an inch by ¾ of an inch. Paste one of these to the lower edge of the back of a snapshot, at the centre, so that a ½-inch square will protrude below the lower edge of the snapshot (figure 2). Write the number of the snapshot upon this little square, which will serve as a tab to make handling of the photograph easier.

When your photographs are all mounted, the right-hand side of the page will contain remarks about these snapshots (see figure 3). These remarks, written with white pencil, or on a separate sheet of paper pasted to the album, should include all the information necessary to identify the snapshot. If you wish you may add information about the lighting conditions at the time the picture was made, the length of exposure and so on.

The last few pages of the album are devoted to an index of the pictures it contains. This index is arranged by subjects, such as Friends, Dogs, Sports, Scenery and the like. To make this index, supply yourself with a package of 3-inch by 5-inch index cards.

First let us examine picture 1 of the album. Let us suppose that it is a family picture. Write the word Family at the upper left-hand corner of an index card and under it put the number of the picture. If picture 2 shows a dog, make a new card with the name Dogs on it and put the number 2 under the name. If number 3 is a picture of scenery, prepare a card with the word Scenery on it and underneath this word the number 3. These cards are arranged alphabetically. If number 4 is another family picture add number 4 to your Family card. Go through the entire snapshot album in the same way until the number of each picture has been entered upon the appropriate index card.

Then type or write all these entries in alphabetical order on one or more sheets of white paper. Each of these sheets should be a little smaller than the album page and may be cut to fit. Following are the first few entries in a specimen index:

Action Shots—23
Airplane—1, 6, 21
Airport—18, 40

These entries indicate that pictures 1, 6 and 21 show airplanes; pictures 18 and 40, an airport; picture 23, a spirited action shot—perhaps a race. Use as many sheets as are necessary to index all the pictures.

HOW TO STAIN, VARNISH AND POLISH

STAIN

WOODWORK is stained to improve its natural color. The difference between stain and paint is that stain sinks into the fibres of the wood and colors or dyes them, leaving the grain of the wood showing as plainly as before. Paint forms an opaque coat (one not allowing the light to pass through) on the surface which quite conceals the material beneath. Generally stain is used to make a cheap wood look like an expensive one. The colors used are chiefly imitations of walnut, mahogany, rosewood and other woods. Sometimes colors quite different from that of any wood (such as green or blue) are used as stains.

Sometimes fancy woods are darkened in appearance by stains resembling their natural color. Stain is used to darken lighter parts of the wood to the same shade as the rest. In all cases, stained wood should be darker than the natural color, for a dark surface will show through a lighter stain, and all one's work will have gone for naught.

Stains for wood are sold ready for use in bottles or cans at hardware shops, paint supply stores and even some five-and-ten-cent stores. Stains may be put on with a brush or rubbed in with a rag. The neater way is to use a brush. Generally two coats are given. With only one coat it is not easy to keep the same shade of color all over, because any overlap with the brush in applying the first coat shows darker than parts over which the brush has passed only once. In succeeding coats this becomes less and less noticeable. The best result may be obtained by using weak stain and applying a number of coats, never putting on the next coat until the previous one is quite dry. This is an important point.

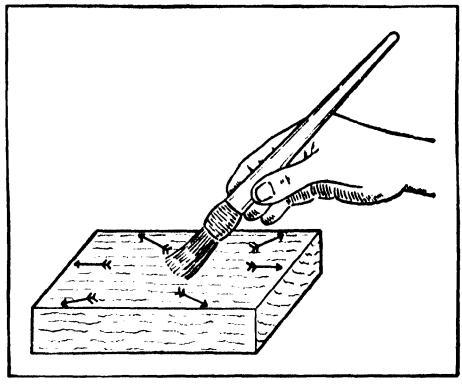
The surface must be smoothed with sandpaper before the first coat and after each coat has thoroughly dried. Otherwise the surface will look and feel rough. Varnish stains are often used instead of simple stains. These are varnish and stain combined, and they save the trouble of staining and varnishing separately. If varnishing and staining are done separately, the wood must be stained before it is varnished.

VARNISH

VARNISH does not conceal the character of the wood beneath it, for it is almost transparent unless something is added to color it. It simply produces, when dry, a hard, glossy film on the surface, which protects the wood from dampness and from becoming discolored by dirt.

Varnish is applied with a brush. Two or three coats are put on, each being allowed to dry and then being smoothed with sandpaper before the next coat is applied. For large surfaces a large brush should be used, so that the varnish may be spread quickly. For small surfaces a small brush is better.

The varnish should be put on uniformly, so that some parts will not be more thickly coated than others. Varnish should not be allowed to run over edges or corners of the article being varnished. The brush should be used so that it does not leave unsightly brush marks all over the work. The best



1.

way is to take one surface at a time and to cover it with varnish as quickly as possible —that is, if ordinary shellac varnish, which dries quickly, is being used.

The brush should be held as in figure 1, and it should move as far as possible in line with the grain of the wood. If the brush is used across the grain, its marks will show more distinctly. The brush should always move outward to the edges, as is indicated by the arrows in figure 1. In approaching the ends of the wood, the brush goes directly to the edges. In passing along the sides, its direction is only slightly diagonal toward the edges there, so that the movement of the brush will be as nearly as possible in line with the grain. As we have said, the surface should be well sandpapered after each coat has hardened. It will be best, however, not to apply the sandpaper after the last coat. Remember that sandpaper should always be rubbed in line with the grain of the wood. If rubbed across the grain, it scratches the surface.

POLISH

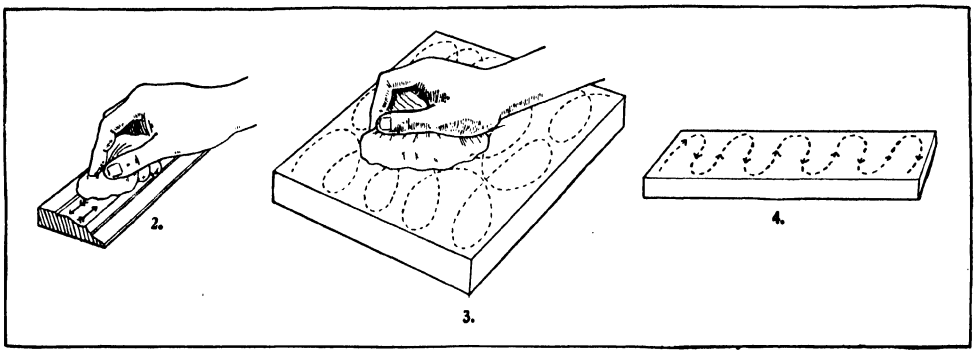
THE difference between polishing and varnishing is chiefly in the method of application, because shellac varnish and polish are very much alike. Varnishing is done with a brush and polishing with a rag. Polishing requires more skill and time, but it gives a smoother and glossier surface than varnishing. It is important in polishing that the pores of the wood should first be thoroughly filled so that the polish cannot sink in and lose its lustre. A number of applications of polish with long intervals for drying will produce this effect.

It is quicker to fill the pores with some other substance before beginning to polish. As the filler you may use whiting or plaster of Paris, dissolved in water, turpentine or oil, and colored to match the wood. The filler is rubbed in and allowed to dry, and then the surface is sandpapered as smoothly as possible. The wood is now ready to receive the first application of polish.

The rag used in polishing is called a "rubber." It should be a piece of soft white linen. This is used as an outer covering for a pad of cotton batting. The cotton batting is moistened with polish and the single thickness of rag encloses it. The rag is then drawn up at the top and grasped by the hand while it is used. Figure 2 shows a small rubber held in this way by the thumb and fingers only. Figure 3 shows a larger one.

The pressure on the rubber should not be too great. A few drops of linseed oil are put on the rag to make it move about freely. As we have seen, the polish is put on the cotton batting only; it gets squeezed through the rag in rubbing. In this way we avoid using an excess amount.

The method of rubbing depends to some extent on the shape and size of the work. First, it is necessary to cover the surface of the wood with polish as quickly as possible. This is done by moving the rubber in large sweeps, either with or across the grain, or both. The direction is not important as long as the polish is rubbed uniformly all over the surface. On a molding, as in figure 2, the movement should be entirely backward and forward lengthwise. On a large, flat surface, as in figure 3, the rubber may be moved in curves or spirals, as shown by the dotted lines. On a long surface of moderate width the first movements of the rubber might be directed up and down the long surface, as shown in figure 4. For getting into the corners of panels and similar parts the rubber must be squeezed into a pointed form that will reach these parts.



2-4. Various methods of polishing.

After the polish has been applied in this manner, the work should be laid aside for at least a day. Then a second application in given in the same way as the first. In the best work the process is repeated a third time and even a fourth.

As the polish sinks in and hardens, it generally loses some of its gloss. As long as this occurs the work can be improved by fresh applications of polish. This is called *bodying in*. The result of one's labors in polishing may depend upon the conscientious care with which one bodies in.

The final process in polishing is called *spiriting off*. In spiriting off, the rubber is moistened with wood alcohol instead of polish. It is rubbed lightly over the surface to remove smears caused by the rubber and also to take up any oil that might be present. The last movements of the rubber should follow the grain of the wood.

THE NEXT THINGS TO MAKE AND TO DO ARE ON PAGE 3765.

SCIENCES

SOUND IN EVERYDAY LIFE

WHEN a sound has an unpleasant, irregular or jarring effect on us we call it a noise; but if it is pleasant and has a certain regular pitch, we call it a tone, or even a musical note. As you can see, the difference between a note and a noise is not always very distinct.

Now if we listen to notes from various instruments we find that these various sounds can differ from one another in three ways: in pitch, in loudness and in the peculiar quality of each separate instrument.

1. We have explained in the chapter on Sound that the pitch of a note depends on the rate of vibrations of the source producing the sound. A rapidly moving violin string, for instance, sets the surrounding air in rapid vibrations so that each near-by air particle moves back and forth like the particles of the string itself, and at the same frequency. This vibration is passed on from one layer of air molecules to the next, and so the sound is transmitted to our ear. The more rapid the vibrations of the string, the higher is the pitch we hear. The pitch we hear depends, therefore, only on the frequency of the source, and not on the medium through which the sound travels.

2. The loudness of a sound we hear depends on how intense the vibrations of the sound-waves are at our eardrum—and that in turn depends on how far away the source is, how strongly it vibrates and whether there is any sound-absorbing material (like cotton wool) between the ear and the source. In other words, the loudness depends on how much sound-energy actually gets into our ear. The measurement of the loudness is interesting and important. You can read more about this on page 3634.

3. The quality, or timbre, of a note depends on the pitch and the loudness of the overtones, those additional, weaker notes that accompany most "fundamental" notes. The flute and the tuning fork are relatively free of such overtones, and therefore they have a very pure sound. But string instruments, like the piano, have long strings on purpose, in order to allow a lot of overtones to appear; in this way the instrument acquires its own special richness of sound.

Though you can not always make them

out clearly by themselves, these overtones are very important for the quality of a sound. The noticeable difference of timbre between a plucked string and the same string when bowed is due entirely to the fact that more and stronger overtones are excited on the bowed string, though the fundamental note is the same both times.

Now let us apply to instruments what we have learned about the various ways of producing and maintaining sounds. Usually, instruments have two main parts. One part produces the vibrations without which we could not have sound. That is the purpose of the string on the violin, the reed in the clarinet, the stream of air against the mouth of an organ pipe, or indeed, the vibrating lips against a trumpet. But here is an amazing thing! None of these instruments could be heard well if these generators of sound did not have another part attached to them, which amplifies the amount of sound they produce! The string by itself, or the reed by itself, do not act on enough surrounding air to launch sufficiently loud sounds. Therefore we have to have, on these instruments, the second part, the resonator.

The generator of sound transmits its vibrations to the resonator. The resonator, vibrating vigorously under the action of the generator, then sets into strong vibration the surrounding air.

In the case of string instruments this resonator is, of course, the sounding box or board; for wind instruments it is the air contained in the body of the instruments. Only the bell and the cymbal are common instruments that do not need resonators.

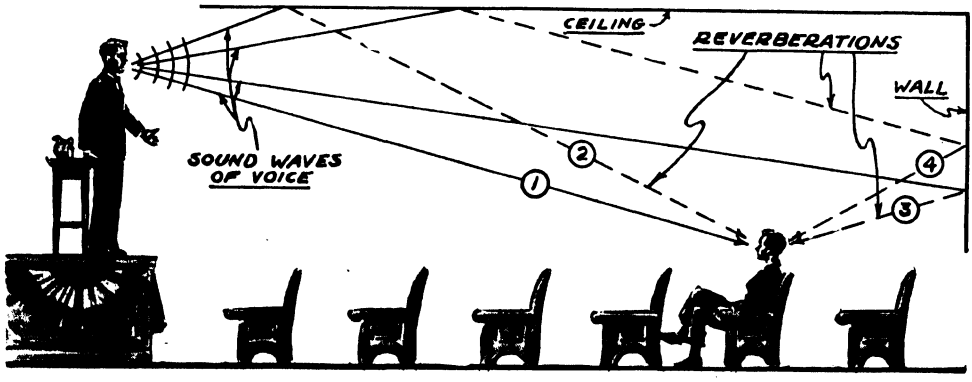
All instruments can be put into a few general groups according to the kind of generator of sound they have.

The String Instruments First there are the string instruments. In the piano, clavichord and dulcimer a little hammer is made to strike and rebound quickly from the strings. Other instruments have their strings plucked in order to set them into vibrations. Among those are the harp, guitar, mandolin, ukulele and banjo; the spinet and harpsichord; and the lyre of the ancients. Lastly comes the whole violin family, whose strings are usually bowed.

The Wind Instruments In the second great section are the wind instruments. Among those the brass instruments are the simplest to discuss. The lips of the player are stretched across the mouth of the instrument and serve as the generator of the vibrations. The trumpet, trombone, bugle, cornet, French horn and bass tuba—they all belong to this group. But even a conical roll of cardboard can be blown to sound like a kind of "brass" instrument.

A very curious member of this group is the long Alpine horn for which the Swiss are renowned. It takes quite a strong man to blow that! But even more powerful must have been old King Arthur who is said to have summoned his men by blowing into the twisted and hollow interior of a huge boulder that is still to be seen in England, not far from Oxford. When your author once tried to "blow" the stone with all his lung power, nothing but the faintest squeal came out!

Another group of wind instruments depends on the vibration of a thin sheet of streaming air blown across their mouth. Here belong the organ pipe, flute, whistle, pan-pipe —even the human mouth when whistling. The organ pipe is particularly interesting



Reverberating sounds are those that are bounced around and reflected from various surfaces before getting to the ear; they are delayed in arriving. Numbers 2, 3 and 4 are reverberations, while number 1 is heard directly.

because by changing its shape and material one can excite in it various overtones similar to those that other instruments have. With skill one can therefore make a pipe that, depending on the construction, sounds like a string instrument or a clarinet.

The last group of wind instruments uses a reed to generate the vibrations. The reed may be made of metal or of wood. This reed is kept in motion by letting it flutter in the breath of the player, like a flag in the wind. Such reeds make the sound in the mouth-organ, clarinet, oboe, English horn and saxophone—and also if you blow across a blade of grass stretched between your thumbs!

The Percussion Instruments Lastly, there is the third great section of instruments—the percussion instruments; they include the bell, cymbals, tuning fork, xylophone and all the various drums.

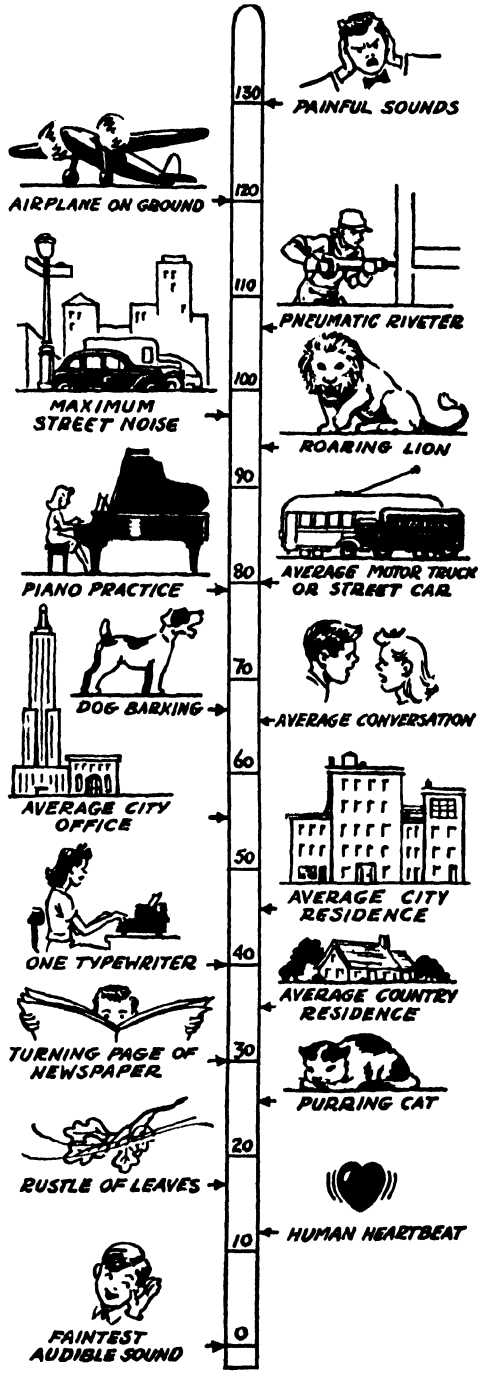
Architectural Acoustics Until not so very long ago, auditoriums and theaters were designed so that the buildings were convenient, safe and beautiful—but often they turned out to be very poor acoustically; either one could hear distinct echoes of what was said on the stage, or else the audience heard so many reflections close together from the various walls that each word or bar became a vague blur.

Through the intensive work of Professor Wallace Sabine of Harvard University the cause and prevention of these defects first became clearly known. He can truly be called the founder of the science of architectural acoustics.

To design a good auditorium we must prevent strong direct echoes from the walls; and we must also be careful that the hall does not reverberate too much. Reverberation is the prolongation of a sound by a number of reflections. These reflections tend to confuse the sounds that follow. One way to avoid these two defects is to put on the walls and ceiling some material, such as heavy cloth, that will absorb most of the sound that falls on it, and will reflect little. (Once it was thought that wires stretched across the room might also take up the sound and prevent reflection; but that idea was wrong.)

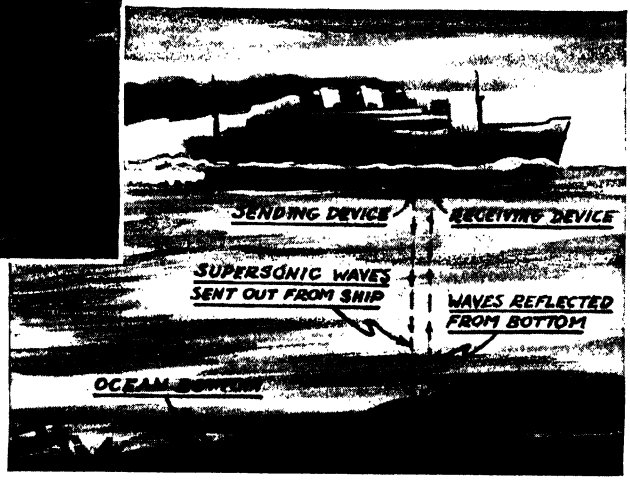
Now if we put absorbing material on all walls and then try to listen in the auditorium, we may find two surprises. Some materials absorb the low-frequency sounds better than the higher ones; and that will make strange listening!

Another thing that may happen is that



THE NOISE THERMOMETER

When a submarine is close enough, the sound of its propellers can be heard by the listening device in the ship above.



The fathometer is used to tell how deep the ocean is at any given moment. It uses high-frequency, or supersonic waves.

the room sounds "dead"—has not enough reverberation! For it turns out that a little reverberation is needed for good listening, and also to permit people in far corners of a large room to get enough sound. Professor Sabine found that trained musicians like to listen to music best in a room where a sound persists (by reflection around the room) for about one second after the player has stopped making it. The time it takes the sound to die out in a room is called reverberation time; in your living-room the reverberation time is probably a little less than one second.

Now a tricky question has to be solved by the architect. He could distribute all the absorbing material on the walls, and thus get the reverberation time of the empty hall down to one second. But if people fill the hall, they will absorb in their clothing some more sound, and reduce the reverberation time, depending on how many there are present. How can one design a theater whose reverberation time is the same no matter how many people are in it? The answer is surprisingly simple: put part of the absorbing material on the seats! Then the audience covers up about as much absorbing material as it adds.

Noise Meters and Decibels It is now possible to study noise scientifically by means of electrical instruments. Chief among these is the sound meter or noise meter, a device which converts sounds into electrical signals and then measures the signals. The unit of sound measurement is the decibel, which is about the smallest difference of sound intensity that the normal human ear can detect, though humans vary.

A man's heart-beat creates a sound of a little more than 10 decibels. The purring of a cat is about equal to a whisper—25 to 30 decibels. A single typewriter accounts for 40 decibels, while the average streetcar gives out 80 decibels of noise.

A few common noises are rated in decibels as follows: barking dog (65), piano practice (75), average motor truck (80), loud shouting (85), pneumatic riveter (105). All noises above 130 decibels are actually painful in our ears.

The noise of city streets ranges from 50 to 85 decibels. The country noise level is about half that of the city. It should be remembered, however, that a large volume of steady noise in the city actually seems less than a series of lesser country noises coming

at random after intervals of comparative silence. The cricket and katydid, the locust and bullfrog and the mournful whip-poor-will often strike the attention to a degree out of proportion to the noise they make. Just so the sudden slamming of a door and the unexpected ringing of a telephone bell are more of a menace to sleep or concentration than the continuous roar of traffic, loud as it may be.

Homer says that Stentor (source of our word stentorian), famous in the Greek army for his loud voice, could equal the combined voices of 50 men. His shout was probably on a decibel level of 100.

Experiments show that it requires more energy to do a given piece of mental work under noisy conditions than under quiet ones. A noisy office or school means increased weariness at the end of the day, lowered efficiency and more errors made in your work.

One method of noise reduction locates with testing apparatus the precise parts of typewriters or other business machines that are chiefly responsible for noise and eliminates the noise as far as possible. A second method undertakes to absorb noise that can not be directly removed. The walls, ceilings and floors of noisy rooms are soundproofed with materials that absorb sound.

Applications of Sound at Sea

Because in a fog the beam from a lighthouse penetrates only a few hundred yards, fog horns or fog sirens are used to guide ships. But the sound, though very strong, is sometimes not heard very far because it may be refracted up into the sky; therefore submerged bells are sometimes used instead. To hear their sound one needs a special undersea listening device, called a hydrophone. This can be either a water-sealed electric microphone dragged along by the ship and electrically connected to the inside; or it can be just a set of diaphragms connected to listening tubes and immersed in the water. If two such hydrophones are put at the ends of a long horizontal rod that can swivel around in the water, and one is connected to each ear, it is easy to find the precise direction from which the sound of the submarine bell comes by turning the hydrophone in the water, just as you find the direction of air-borne sounds by turning your head.

These hydrophones were used in the first World War to pick up the sound made by the rapidly turning propellers of enemy submarines. This use was not very successful because the propeller's noise is usually quite weak at any considerable distance, and is drowned out by the noise of the fast-moving ship itself.

Supersonic Devices

Another method of submarine detection was used in World War II and proved much more successful. Very high-frequency sound-waves were sent out from the ship through the water; and the submarine would give its presence away by reflecting these supersonic waves! (Supersonic waves are waves of such high pitch that one can not hear them.) The echo of the sound under water was picked up by a form of microphone; of course the echo could not be heard directly, but was registered electrically on a meter or on the screen of a cathode-ray tube. The direction from which the echo came could be discovered with two microphones, just as for the submerged bell.

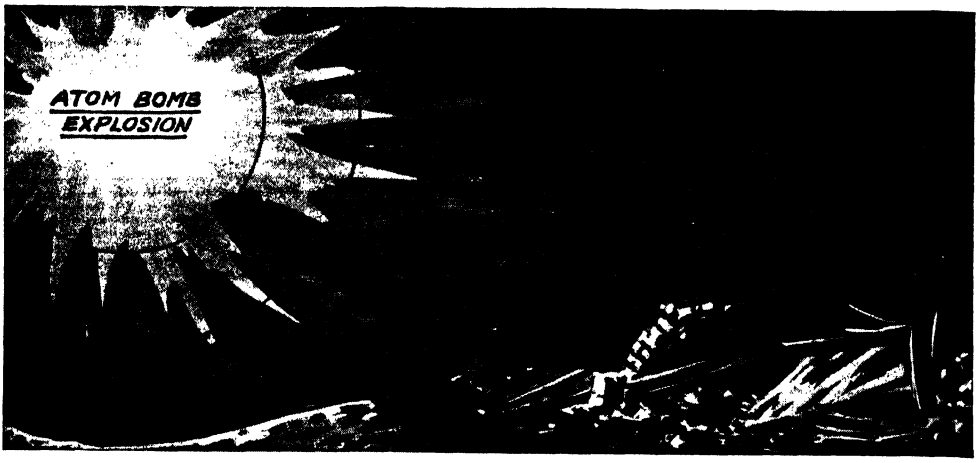
The echo of a supersonic beam of sound can also be used to find the distance to the bottom of the sea—and this is a much better way of "sounding" the ocean depths than the tedious measurement with a weighted string or cable. Without any need for stopping the ship, the depth may now be mapped automatically by the echo method continuously over the whole voyage. The sound-wave is sent out and is reflected from the bottom of the ocean back to the ship. Navigators can figure out the depth from the length of time required for the round trip of sound.

There are many other applications for supersonic sound. By the echo method one can discover in the water large schools of fish, or the presence of an iceberg during the night or in a fog.

But why not use low-frequency sound-waves instead of supersonics? For the same reason that the blind bat uses high-frequency cries for producing an echo—namely to prevent diffraction of the sound by the obstacle, instead of reflection from it. And also, because of less diffraction at high frequencies, the sound-waves sent out can be focused more easily into a sharp beam.

Applications of Sound in the Earth

Sir William Bragg, a great British scientist, told once of an interesting way in which sound was used in the first World War. By pressing against the ground and the sides of a mountain a geophone—an instrument like the stethoscope used by the doctor when he examines your lungs—British soldiers could listen to the sound of pickaxes of the enemy tunneling toward their lines! The direction of the tun-



Much of the damage done by great explosions is caused by compression waves. When an atomic bomb goes off, the explosion waves that result are violent back-and-forth motions of the air that can destroy buildings miles away.

neling operation was found by listening with two such geophones, one to each ear.

We have discussed in Sound how sound-waves are partly reflected at the boundary between different materials, and how the rest of the waves are refracted. This is put to good use by the geophysicist; he uses instruments that record the time it takes an explosion wave, started about a mile away, to reach him. First comes the wave that traveled toward him in the surface of the ground, then perhaps the air-borne explosion wave. After that, one by one, various reflections from different layers and materials in the earth. Since the geophysicist knows with what speed sound travels in different media, he can judge from his record what materials the earth might contain underneath him, and how deep down they are. Thus he can even predict where an oil deposit might be.

Applications of Sound in the Air In the first World War, when radar was not yet known, the position of enemy guns was detected by recording electrically on a strip of moving film the successive arrivals of the same explosion wave from one gun at six microphones in the field. Here is how this record was used:

If only two microphones had been used, about one mile apart from each other, and both recorded the arrival of the explosion at the same instant, it is clear that the gun would be between them, and the same distance from each microphone. That would give the direction in which to look for the gun.

Now suppose a third microphone, placed exactly between the other two, received the same explosion wave a second before the others; this means the wave traveled on for about 1,100 feet before hitting the two outside microphones. Now this gives, on a map that shows the position of the microphones, three points where the explosion wave was at the same time—namely at both outside microphones, and 1,100 feet beyond the one in the middle. But the wave front of this explosion wave, having expanded from the gun, is circular along the ground, and there is only *one* circle with one center (the gun itself) which can be constructed through these three points on the map. Thus the gun is found.

Even in more complicated cases, the whole problem is one of simple geometry. The other three of the six microphones are used to get great accuracy despite winds, and so on, which might have distorted the shape of the explosion wave.

Explosion waves are such violent back-and-forth motions of the air that they are the cause of most of the damage made by high-explosive projectiles. It is the explosion wave of a bazooka projectile that tears open the steel plate of a tank; and the tremendous compression wave created by the explosion of an atomic bomb of a few pounds can knock down walls miles away.

Our Voice Have you ever stopped to think what a marvelous thing our voice is? With it we can produce an infinite variety of sounds, from a soft whisper to a loud shout; we can express anger or

tenderness; with skill we can imitate many instruments over a large range of frequencies. Indeed, we can put into our speech so much meaning that even some animals can discover what we wish them to do, though of course animals can not understand the words we say. And also if you have listened to an opera, you will know that a beautiful song can move us very much, though it might be sung in a foreign language.

What is the "instrument" in our throat that allows us to express all these things? How does it work, Most of the sounds of speech and song originate in the upper part of the windpipe through which we breathe. This region is called the larynx, or "voice-box" (in the neighborhood of the Adam's apple). Like lips across our mouth, two muscles lie across the diameter of the larynx; these are the all-important vocal folds, or vocal "cords," which, by tightening, or rhythmically closing and opening, can control the air flow from our lungs. However, the vocal cords by themselves do not produce the sounds of speech and song; they furnish only the raw material which is modulated and shaped in the cavities of throat, nose and particularly in the mouth.

How, for instance, can we sing a high note? By stretching the vocal cords more tightly we can produce more high-frequency components in the sound coming from them, and by putting our tongue, cheeks and jaw into the correct position, we select, by resonance, from the "unfinished" sound those frequency components we want. In speaking we therefore change the tightness and position of the vocal cords and rearrange the mouth cavity constantly to make the various sounds of speech! Another factor over which we have control is the amount of air issuing from our lungs; but it will surprise you to learn that a good singer needs much less air for a loud note than for a delicate, soft tone.

Stop to think for a moment how much more complex the "instrument" in our throat is than man-made instruments. In a violin, for instance, we change the pitch of the note we play by changing with the finger position the effective length of the string that can vibrate under the bow; you remember that the vibrations of the string determine the pitch we hear, and that a short piece of string vibrates faster than a long one. In a piano we use strings of various lengths for the various notes—different strings for each different note. And in a clarinet it is the length of the air column trapped in the pipe between the mouth piece and the stops that determines the pitch. But each instrument has a quality of its own which even the best player can not change much. Our own voice-instrument, however, is smaller than many of these, and yet capable of a much larger variety of tones.

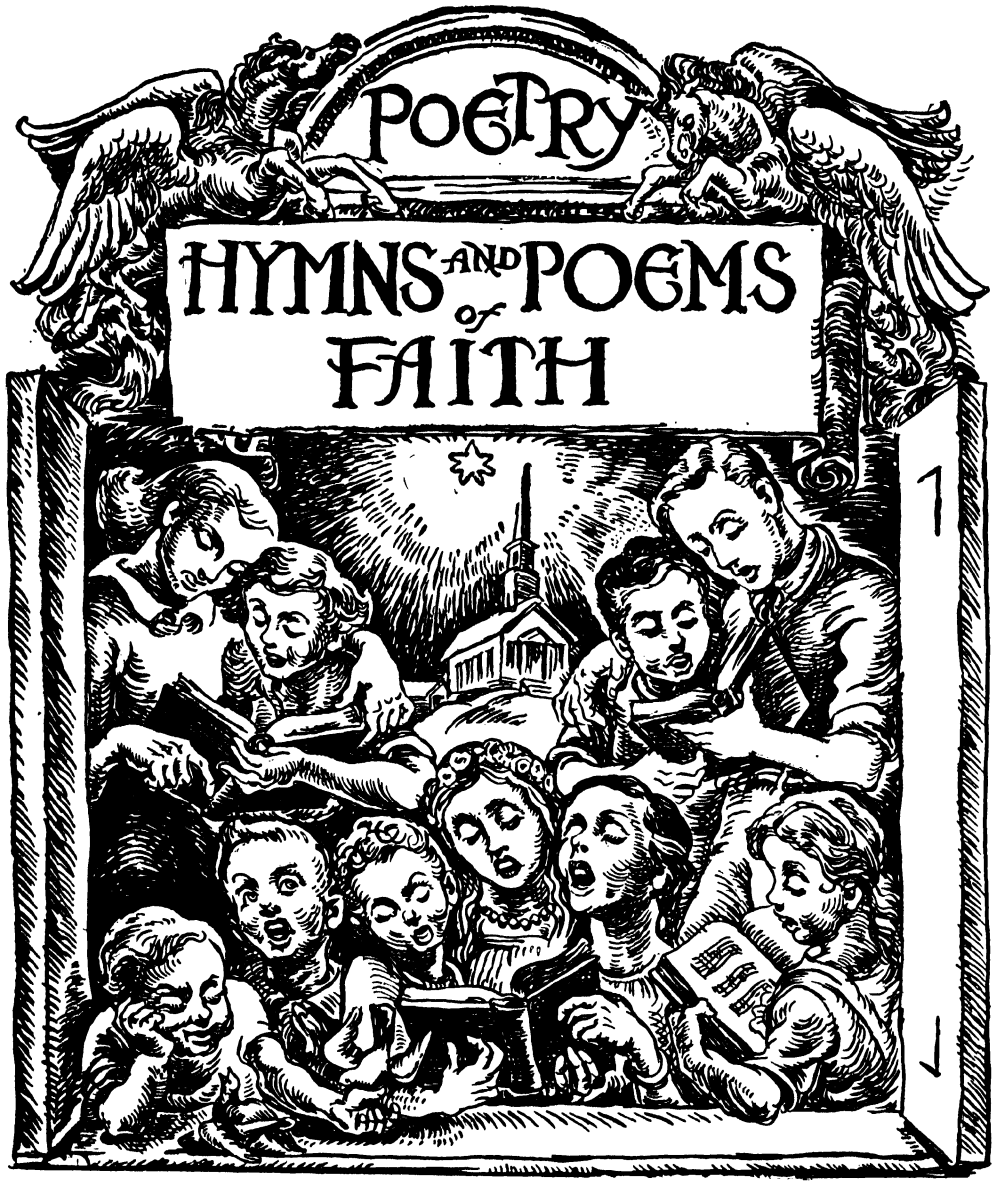
In quality and flexibility our voice can still best be compared with a large organ. And in fact, there have been many attempts to build an artificial voice out of organ pipes. Yet even the best and bulkiest of these instruments could do no more than "say" a few simple words.

However, there is one thing that almost all instruments have, and which our voice lacks: that is a wide range of frequencies. A piano can have a range of more than seven octaves, but the average person can not sing well over more than two octaves (though one famous singer is said to have had over twice that range!). Also, men have usually a deeper voice than do women and boys, because men's vocal folds are larger and heavier, and therefore can not vibrate rapidly enough to produce the higher frequencies.

This article is best read along with the chapter on Sound, page 3192. You may wish to read also The Violin and the Piano, page 1794.

By GERALD J. HOLTON.

THE NEXT STORY OF SCIENCE IS ON PAGE 3687.



Designs by James Daugherty

Rock of Ages

By AUGUSTUS MONTAGUE TOPLADY
(1740-1778)

ROCK of Ages, cleft for me,
Let me hide myself in Thee!
Let the water and the blood,
From Thy riven side which flowed,
Be of sin the double cure—
Cleanse me from its guilt and power.

Not the labors of my hands
Can fulfil Thy law's demands;
Could my zeal no respite know,
Could my tears for ever flow,
All for sin could not atone—
Thou must save, and Thou alone.

Nothing in my hand I bring—
Simply to Thy Cross I cling;
Naked come to Thee for dress—

Helpless look to Thee for grace;
Foul, I to the Fountain fly—
Wash me, Savior, or I die!

While I draw this fleeting breath,
When my eye-strings break in death,
When I soar to worlds unknown,
See Thee on Thy judgment-throne,
Rock of Ages, cleft for me,
Let me hide myself in Thee!

Blest Be the Tie that Binds

By JOHN FAWCETT (1740-1817)

BLEST be the tie that binds
Our hearts in Jesus' love;
The fellowship of Christian minds
Is like to that above.

Before our Father's throne
We pour united prayers;
Our fears, our hopes, our aims, are one,
Our comforts, and our cares.

We share our mutual woes,
Our mutual burdens bear,
And often for each other flows
The sympathizing tear.

When we at death must part,
Not like the world's our pain;
But one in Christ, and one in heart,
We part to meet again.

From sorrow, toil, and pain,
And sin, we shall be free;
And perfect love and friendship reign
Throughout eternity.

Onward, Christian Soldiers!

By SABINE BARING-GOULD (1834-1924)

ONWARD, Christian soldiers!
Marching as to war,
With the Cross of Jesus
Going on before.
Christ the Royal Master
Leads against the foe;
Forward into battle,
See, His banners go!
Onward, Christian soldiers!
Marching as to war,
With the Cross of Jesus
Going on before.

At the sign of triumph
Satan's host doth flee;
On, then Christian soldiers,
On to victory!

Hell's foundations quiver
At the shout of praise;
Brothers, lift your voices,
Loud your anthems raise!

Like a mighty army
Moves the Church of God;
Brothers, we are treading
Where the Saints have trod;
We are not divided
All one body we,
One in hope and doctrine,
One in charity.

Crowns and thrones may perish,
Kingdoms rise and wane,
But the Church of Jesus
Constant will remain·
Gates of hell can never
'Gainst that Church prevail;
We have Christ's own promise,
And that cannot fail.

Onward, then, ye people!
Join our happy throng,
Blend with ours your voices
In the triumph song;
Glory, laud, and honor
Unto Christ the King,
This through countless ages
Men and angels sing.
Onward, Christian soldiers!
Marching as to war,
With the Cross of Jesus
Going on before.

Now the Day Is Over

By SABINE BARING-GOULD
(1834-1924)

NOW the day is over,
Night is drawing nigh,
Shadows of the evening
Steal across the sky.

Now the darkness gathers,
Stars begin to peep,
Birds and beasts and flowers
Soon will be asleep.

Jesus, give the weary
Calm and sweet repose;
With Thy tenderest blessing
May mine eyelids close.

Grant to little children
Visions bright of Thee;
Guard the sailors tossing
On the deep blue sea.

Comfort every sufferer
Watching late in pain;
Those who plan some evil
From their sin restrain.

Through the long night watches
May Thine angels spread
Their white wings above me,
Watching round my bed.

When the morning wakens,
Then may I arise
Pure and fresh and sinless
In Thy holy eyes.

Glory to the Father,
Glory to the Son,
And to Thee, blest Spirit,
Whilst all ages run.

Nearer, My God, to Thee

By SARAH FLOWER ADAMS
(1805-1848)

NEARER, my God, to Thee,
Nearer to Thee!
E'en though it be a cross
That raiseth me;
Still all my song shall be,
Nearer, my God, to Thee,
Nearer to Thee!

Though like the wanderer,
The sun gone down,
Darkness be over me,
My rest a stone;
Yet in my dreams I'd be
Nearer, my God, to Thee,
Nearer to Thee!

There let the way appear
Steps unto heaven;
All that thou send'st to me
In mercy given;
Angels to beckon me
Nearer, my God, to Thee,
Nearer to Thee!

Then, with my waking thoughts
Bright with Thy praise,
Out of my stony griefs
Bethel I'll raise;
So by my woes to be
Nearer, my God, to Thee,
Nearer to Thee!

Or if on joyful wing
Cleaving the sky,
Sun, moon, and stars forgot,
Upward I fly,
Still all my song shall be,
Nearer, my God, to Thee,
Nearer to Thee!

A Mighty Fortress Is Our God

By MARTIN LUTHER

Translated from the German by F. H. Hedge.

A MIGHTY fortress is our God,
A bulwark never failing;
Our helper He amid the flood
Of mortal ills prevailing.
For still our ancient foe
Doth seek to work us woe;
His craft and power are great,
And, armed with cruel hate,
On earth is not his equal.

Did we in our own strength confide,
Our striving would be losing,—
Were not the right man on our side,
The man of God's own choosing.
Dost ask who that may be?
Christ Jesus, it is He,
Lord Sabaoth His name,
From age to age the same,
And He must win the battle.

And though this world, with devils filled,
Should threaten to undo us,
We will not fear, for God hath willed
His truth to triumph through us.
The Prince of Darkness grim,—
We tremble not for him;
His rage we can endure,
For lo! his doom is sure:
One little word shall fell him.

That word above all earthly powers,
No thanks to them, abideth;
The spirit and the gifts are ours
Through Him who with us sideth.
Let goods and kindred go,
This mortal life also;
The body they may kill,
God's truth abideth still,
His Kingdom is forever.

O Mother Dear, Jerusalem

From a Latin hymn written in the sixteenth century.

O MOTHER dear, Jerusalem!
When shall I come to thee?
When shall my sorrows have an end?
Thy joys when shall I see?

O happy harbor of God's saints!
O sweet and pleasant soil!
In thee no sorrow can be found,
Nor grief, nor care, nor toil.

No murky cloud o'ershadows thee,
Nor gloom, nor darksome night;
But every soul shines as the sun;
For God himself gives light.

O my sweet home, Jerusalem,
Thy joys when shall I see?
The King that sitteth on thy throne
In His felicity?

Thy gardens and thy gallant walks
Continually are green,
Where grow such sweet and pleasant flowers
As nowhere else are seen.

Right through thy streets, with silver sound,
The living waters flow,
And on the banks, on either side,
The tree of life doth grow.

There trees for evermore bear fruit,
And evermore do spring:
There evermore the angels are,
And evermore do sing.

Jerusalem, my happy home,
Would God I were in thee!
Would God my woes were at an end,
Thy joys that I might see!

The Son of God Goes Forth to War

By REGINALD HEBER (1783-1826)

THE Son of God goes forth to war,
A kingly crown to gain;
His blood-red banner streams afar!
Who follows in His train?

Who best can drink his cup of woe,
Triumphant over pain,
Who patient bears his cross below,
He follows in His train!

The martyr first, whose eagle eye
Could pierce beyond the grave;
Who saw his Master in the sky,
And called on Him to save:
Like Him, with pardon on his tongue,
In midst of mortal pain,
He prayed for them that did the wrong!
Who follows in His train?

A glorious band, the chosen few,
On whom the Spirit came;
Twelve valiant saints, their hope they knew,
And mocked the cross and flame!
They met the tyrant's brandished steel
The lion's gory mane:
They bowed their necks, the death to feel!
Who follows in their train?

A noble army—men and boys,
The matron and the maid,—
Around the Savior's throne rejoice
In robes of light arrayed.
They climbed the steep ascent of
Heaven,
Through peril, toil, and pain!
O God! to us may grace be given
To follow in their train!

Holy, Holy, Holy

By REGINALD HEBER (1783-1826)

HOLY, holy, holy, Lord God Almighty!
Early in the morning our songs shall rise to Thee;
Holy, holy, holy! merciful and mighty!
God in Three Persons, Blessed Trinity!

Holy, holy, holy! all the saints adore Thee,
Casting down their golden crowns around the glassy sea,
Cherubim and seraphim falling down before Thee,
Who wert, and art, and evermore shalt be!

Holy, holy, holy! though the darkness hide Thee,
Though the eye of sinful man Thy glory may not see,
Only Thou art holy, there is none beside Thee,
Perfect in power, in love, and purity!

Holy, holy, holy, Lord God Almighty!
All Thy works shall praise Thy name in earth and sky and sea;
Holy, holy, holy! merciful and mighty!
God in Three Persons, Blessed Trinity!

Abide with Me

By HENRY FRANCIS LYTE (1793-1847)

ABIDE with me! Fast falls the eventide;
The darkness deepens: Lord, with me abide!
When other helpers fail, and comforts flee,
Help of the helpless, O abide with me!

Swift to its close ebbs out life's little day;
Earth's joys grow dim; its glories pass away,
Change and decay in all around I see;
O Thou, who changest not, abide with me!

Not a brief glance, I beg, a passing word,
But, as Thou dwell'st with Thy disciples, Lord,
Familiar, condescending, patient, free,—
Come, not to sojourn, but abide, with me!

I need Thy presence every passing hour.
What but Thy grace can foil the tempter's power?
Who like Thyself my guide and stay can be?
Through cloud and sunshine, O abide with me!

I fear no foe with Thee at hand to bless:
Ills have no weight, and tears no bitterness.
Where is death's sting, where, grave, thy victory?
I triumph still, if Thou abide with me.

Hold then Thy cross before my closing eyes;
Shine through the gloom, and point me to the skies:
Heaven's morning breaks, and earth's vain shadows flee:
In life and death, O Lord, abide with me!

The Hound of Heaven

By FRANCIS THOMPSON (1859-1907)

I FLED Him, down the nights and down the days;
I fled Him, down the arches of the years;
I fled Him, down the labyrinthine ways
Of my own mind; and in the mist of tears
I hid from Him, and under running laughter.
Up vistaed hopes I sped;
And shot, precipitated
Adown Titanic glooms of chasmed fears,
From those strong Feet that followed, followed after.
But with unhurrying chase,
And unperturbèd pace,
Deliberate speed, majestic instancy,
They beat—and a Voice beat
More instant than the Feet—
"All things betray thee, who betrayest Me."

I pleaded, outlaw-wise,
By many a hearted casement, curtained red,
Trellised with intertwining charities;
(For, though I knew His love Who followèd,
Yet was I sore adread
Lest, having Him, I must have naught beside);
But, if one little casement parted wide,
The gust of His approach would clash it to.
Fear wist not to evade, as Love wist to pursue.
Across the margent of the world I fled,
And troubled the gold gateways of the stars,
Smiting for shelter on their clangèd bars;
Fretted to dulcet jars
And silvern chatter the pale ports o' the moon.
I said to dawn, Be sudden; to eve, Be soon;
With thy young skiey blossoms heap me over
From this tremendous Lover!
Float thy vague veil about me, lest He see!
I tempted all His servitors, but to find
My own betrayal in their constancy,
In faith to Him their fickleness to me,
Their traitorous trueness, and their loyal deceit.
To all swift things for swiftness did I sue;
Clung to the whistling mane of every wind.
But whether they swept, smoothly fleet,
The long savannahs of the blue;
Or whether, Thunder-driven,
They clanged his chariot 'thwart a heaven
Plashy with flying lightnings round the spurn o' their feet:—
Fear wist not to evade, as Love wist to pursue.
Still with unhurrying chase,
And unperturbèd pace,
Deliberate speed, majestic instancy,
Came on the following Feet,
And a Voice above their beat—
"Naught shelters thee, who wilt not shelter Me."

I sought no more that after which I strayed
In face of man or maid;
But still within the little children's eyes
Seems something, something that replies;
They at least are for me, surely for me!
I turned me to them very wistfully;
But, just as their young eyes grew sudden fair
With dawning answers there,
Their angel plucked them from me by the hair.

. . . . . .

Naked I wait Thy love's uplifted stroke!
My harness piece by piece Thou hast hewn from me,
And smitten me to my knee;
I am defenseless utterly.
I slept, methinks, and woke,
And, slowly gazing, find me stripped in sleep.
In the rash lustihood of my young powers,
I shook the pillaring hours
And pulled my life upon me; grimed with smears
I stand amid the dust o' the mounded years—
My mangled youth lies dead beneath the heap.
My days have crackled and gone up in smoke,
Have puffed and burst as sun-starts on a stream.
Yea, faileth now even dream
The dreamer, and the lute the lutanist;
Even the linked fantasies, in whose blossomy twist
I swung the earth a trinket at my wrist,
Are yielding; cords of all too weak account
For earth with heavy griefs so overplussed.

Ah! is Thy love indeed
A weed, albeit an amaranthine weed,
Suffering no flowers except its own to mount?
Ah! must—
Designer infinite!—
Ah! must Thou char the wood ere Thou canst limn with it?
My freshness spent its wavering shower i' the dust:
And now my heart is as a broken fount,
Wherein tear-drippings stagnate, spilt down ever
From the dank thoughts that shiver
Upon the sighful branches of my mind.
Such is; what is to be?

The pulp so bitter, how shall taste the rind?
I dimly guess what Time in mists confounds:
Yet ever and anon a trumpet sounds
From the hid battlements of Eternity;
Those shaken mists a space unsettle, then
Round-the half-glimpsèd turrets slowly wash again.
But not ere him who summoneth
I first have seen, enwound
With glooming robes purpureal, cypress-crowned;
His name I know, and what his trumpet saith.
Whether man's heart or life it be which yields
Thee harvest, must Thy harvest fields
Be dunged with rotten death?

Now of that long pursuit
Comes on at hand the bruit;
That Voice is round me like a bursting sea:
"And is thy earth so marred,
Shattered in shard on shard?
Lo, all things fly thee, for thou flyest Me!
Strange, piteous, futile thing,
Wherefore should any set thee love apart?
Seeing none but I makes much of naught"
(He said),
"And human love needs human meriting:
How hast thou merited—
Of all man's clay the dingiest clot?
Alack, thou knowest not
How little worthy of any love thou art!
Whom wilt thou find to love ignoble thee
Save Me, save only Me?
All which I took from thee, I did but take,
Not for thy harms,
But just that thou might'st seek it in My arms.
All which thy child's mistake
Fancies as lost, I have stored for thee at home:
Rise, clasp My hand, and come!"
Halts by me that footfall:
Is my gloom, after all,
Shade of His hand, outstretched caressingly?
"Ah, fondest, blindest, weakest,
I am He Whom thou seekest!
Thou dravest love from thee, who dravest Me."

Judas Iscariot

By ROBERT BUCHANAN (1841-1901)

We print here the second half of this long ballad. The first part tells how the soul of Judas wandered over the face of the earth looking for a place to bury his body, and finding none.

'TWAS the soul of Judas Iscariot,
Strange, and sad, and tall,
Stood all alone at dead of night
Before a lighted hall.

And the wold was white with snow,
And his foot-marks black and damp,
And the ghost of the silvern Moon arose,
Holding her yellow lamp.

And the icicles were on the eaves,
And the walls were deep with white,
And the shadows of the guests within
Passed on the window light.

The shadows of the wedding guests
Did strangely come and go,
And the body of Judas Iscariot
Lay stretched along the snow.

The body of Judas Iscariot
Lay stretched along the snow;
'Twas the soul of Judas Iscariot
Ran swiftly to and fro.

To and fro, and up and down,
He ran so swiftly there,
As round and round the frozen Pole
Glideth the lean white bear.

'Twas the Bridegroom sat at the table-head,
And the lights burned bright and clear:
"Oh, who is that," the Bridegroom said,
"Whose weary feet I hear?"

'Twas one looked from the lighted hall
And answered soft and slow,
"It is a wolf runs up and down
With a black track in the snow."

The Bridegroom in His robe of white
Sat at the table-head—
"Oh, who is that who moans without?"
The blessèd Bridegroom said.

'Twas one looked from the lighted hall,
And answered fierce and low,
" 'Tis the soul of Judas Iscariot
Gliding to and fro."

'Twas the soul of Judas Iscariot
Did hush itself and stand,
And saw the Bridegroom at the door,
With a light in his hand.
The Bridegroom stood in the open door,
And he was clad in white,
And far within the Lord's Supper
Was spread so long and bright.

The Bridegroom shaded his eyes and looked,
And his face was bright to see—
"What dost thou here at the Lord's Supper
With thy body's sins?" said he.

'Twas the soul of Judas Iscariot
Stood black, and sad, and bare—
"I have wandered many nights and days;
There is no light elsewhere."

'Twas the wedding guests cried out within,
And their eyes were fierce and bright—
"Scourge the soul of Judas Iscariot
Away into the night!"

The Bridegroom stood in the open door,
And he waved hands still and slow,
And the third time that he waved his hands
The air was thick with snow.

And of every flake of falling snow,
Before it touched the ground,
There came a dove, and a thousand doves
Made sweet sound.

'Twas the body of Judas Iscariot
Floated away full fleet,
And the wings of the doves that bare it off
Were like its winding-sheet.

'Twas the Bridegroom stood at the open door,
And beckoned, smiling sweet;
'Twas the soul of Judas Iscariot
Stole in, and fell at his feet.

"The Holy Supper is spread within,
And the many candles shine,
And I have waited long for thee
Before I poured the wine!"

The supper wine is poured at last,
The lights burn bright and fair,
Iscariot washes the Bridegroom's feet,
And dries them with his hair.

The Pillar of the Cloud

By JOHN HENRY NEWMAN (1801-1890)

LEAD, kindly Light, amid the encircling gloom,
Lead Thou me on!
The night is dark, and I am far from home—
Lead Thou me on!
Keep Thou my feet; I do not ask to see
The distant scene,—one step enough for me.

I was not ever thus, nor prayed that Thou
Shouldst lead me on.
I loved to choose and see my path; but now
Lead Thou me on!
I loved the garish day, and, spite of fears,
Pride ruled my will: remember not past years.

So long Thy power hath blessed me, sure it still
Will lead me on,
O'er moor and fen, o'er crag and torrent, till
The night is gone;
And with the morn those angel faces smile
Which I have loved long since, and lost awhile.

THE NEXT POEMS ARE ON PAGE 3735.

The grass waves in the wind.

THE SPLENDOR OF THE GRASS

THE great Grass Family includes nearly five thousand different species. Some grow to be hardly more than an inch in height, while some of the bamboos (which are true grasses) may reach a height of a hundred feet or more.

Grasses are to be found in the tropics, and they reach both north and south toward the region of perpetual snows. Some of them grow only in dry and hot portions of the earth, while others like to have their feet in water all the time.

Upon them our life depends. The bread we eat, whether it be made from wheat, oats, rye or corn, comes from a grass. Rice is a grass, and so is sugar-cane. The meat we eat is made principally from grass, no matter what animal furnishes it. The horses which pull the plow or draw the loads depend upon grass or its seeds for their food. So you see when the Hebrew prophet of old said that "all flesh is grass" he was speaking the literal truth, though he was really comparing the short life of man to the grass which springs up, lives for a short time and then withers away.

There is no part of the world in which there are not many species of grasses. Some particular kinds are widely scattered over the earth, as, for example, the common reed grass. Some are confined to a narrow area, such as high mountain-tops, or certain parts of the tropics. In the temperate regions man finds grasses wherever he goes, and others have followed in his footsteps.

Though there are several hundred grasses native to North America, some of the commonest kinds now found here were brought from other continents, sometimes intentionally, but very often accidentally.

The seeds of many species are very small. Dozens of them made the trip across the ocean in the little patches of soil which had stuck to the spade a colonist brought with him. Even the bit of clay which clung to his working shoes when he was taking his last walk through the fields in his old home might serve to transport the seeds of several species of grass to the new land.

The hay carried on shipboard to feed the animals which the early colonists soon brought over was often of species not found here. When the ship was cleaned, or the surplus brought on shore, some of the seeds may have reached favorable ground. Some grasses have seeds with sharp hooks that cling to clothing and came across in this way. If the conditions of soil and temperature were suitable, these

grasses flourished, and now we never think of them as being immigrants.

For example, we are so familiar with orchard grass, timothy, rye-grass and meadow foxtail that we take it for granted that they have always been here. On the contrary, all of these we have named and many others came from Europe. Just as men and women born in Europe become citizens of our country by naturalization, so we may say that these grasses have been naturalized, and are now a part of our flora, as we call our plant life.

The sugar-cane and the sorghums were brought from the Old World. Probably the original home of the sugar-cane was in Asia, and of the sorghums in Africa. Fields of these are beautiful, but there are few sights more attractive than a great field of our own corn, which belongs to America.

How grass makes the world more beautiful

So much for the usefulness of grass. Let us now speak of the beauty of the grass. What a difference in the appearance of the world the grass makes. Have you ever seen a house just completed standing on a bare lot? How cheerless and unkempt it seemed! But given time, the grass comes and covers the lot with a mantle of green. What was only a house begins to look like a home. Perhaps the grasses which appear are not the most beautiful. Very likely the soil is poor, and the surface uneven, but at least the ugliness is hidden.

What a joy it is to rest the eyes by looking at a well-kept lawn where the grass forms a living carpet! What a satisfaction it is to strike out over the hills! The springy turf is under our feet instead of hard pavements. The rolling hills, softened by the green covering, rise before us. When the grass is high the wind ripples over the fields, and you stop to see the progress of the wave.

The tiny flowers of some grasses are exquisite

Most of the grass flowers are small, and the careless hardly know that they exist. We have already shown you some magnificent pictures in color on pages 3521 to 3524, and you will agree that they are beautiful. There are dozens of others which are just as attractive if you will take the trouble to look. A simple magnifying glass will be a great help in studying some of the tiny flowers.

We speak of the grass as green, and yet many of the grasses show other colors. Purples, blues, yellows, reds, oranges are also to be found in profusion. In fact, some of the grasses are hardly green at all except when they are very young. As they mature other colors appear on blade, stalk and flower. They combine to make every clump a thing of beauty if we have the seeing eye.

The delicate odors of some of the grasses

The senses of touch and sight are not the only ones gratified by the grass. Unless our noses have been spoiled by strong odors, a field of grass may be like a flower garden if we will only come down to the earth, and lie among the fragrance. Some of the tiny flowers have the most exquisite smell. In others the blades themselves are filled with the delicate perfumes, and a little pressure will bring them out. You have seen baskets made of some of these sweet grasses.

When the hay is cut and the grass is lying on the ground, giving up its moisture, the odor is sweet beyond words. No wonder the perfumer tries to capture the secret and labels it "new-mown hay," but one who really knows the hay-fields will not be deceived. This is a scent which the chemist may imitate, but there is something in it that he cannot catch. The writer never feels so much at peace with the world as in the hay-field when the sun is shining, his ears are soothed by the drowsy hum of bees, and the waves of scent from the drying grass are all around.

We are showing you pictures of thirty-two important grasses. Some are valuable for hay, and you may see them either alone or mixed in the fields the farmer cuts. You will recognize the sweet vernal grass by smell if not by sight. It is the principal grass which gives the odor to the hay drying in the fields. It is found in nearly every field of mixed grass.

Some of these grasses are not of much use for hay, but they grow on the sandy shores, and prevent the sand from shifting. This is very important, for the wind and the sand may bury cultivated fields or kill trees. The fibrous roots of these grasses hold the sand in position and prevent it from moving so rapidly. Others are valued for their beauty. They make the world a more pleasant place.

THE NEXT STORY OF PLANT LIFE IS ON PAGE 3721.

THE MOST FAMILIAR WILD GRASSES

FIBROUS-ROOTED WHEAT—COUCH GRASS
Growing in woods, in July.

CREEPING WHEAT—COUCH GRASS
Growing in waste places, in June and July.

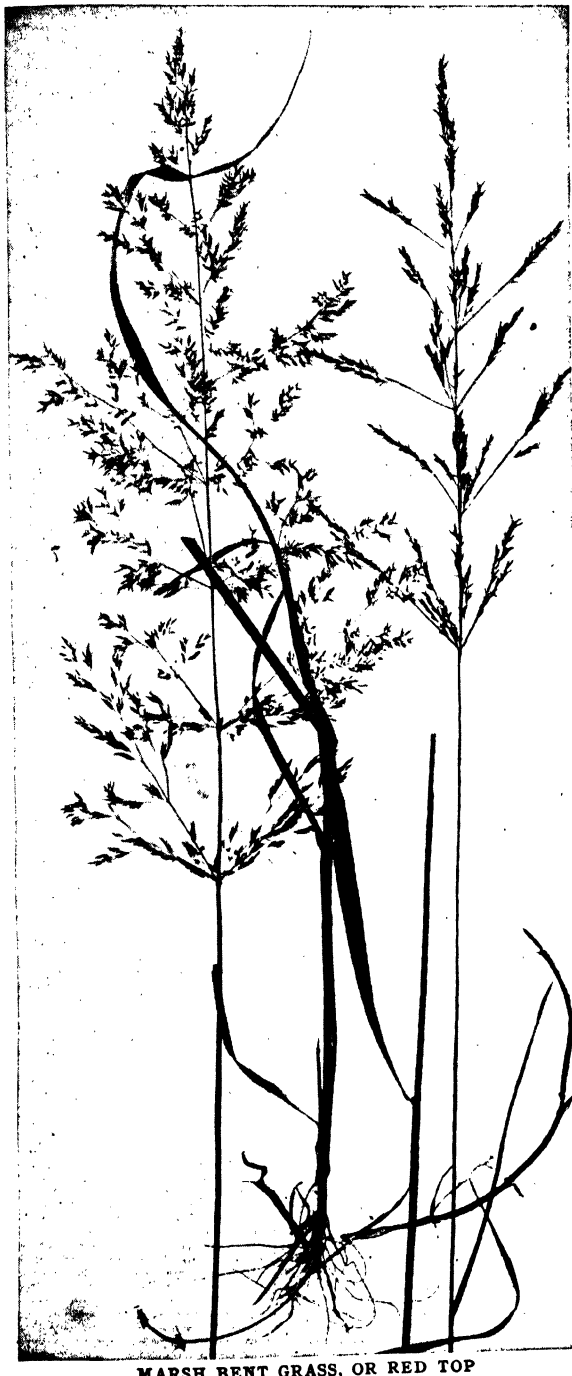
Though we may find couch grass in the woods, it is no use to look for it in the same place year after year, for, if left to itself, it soon dies down. Sometimes it is called "spear grass." The picture shows why.

PERENNIAL RYE GRASS

ORCHARD GRASS

Growing in meadows and pastures, from June onward.

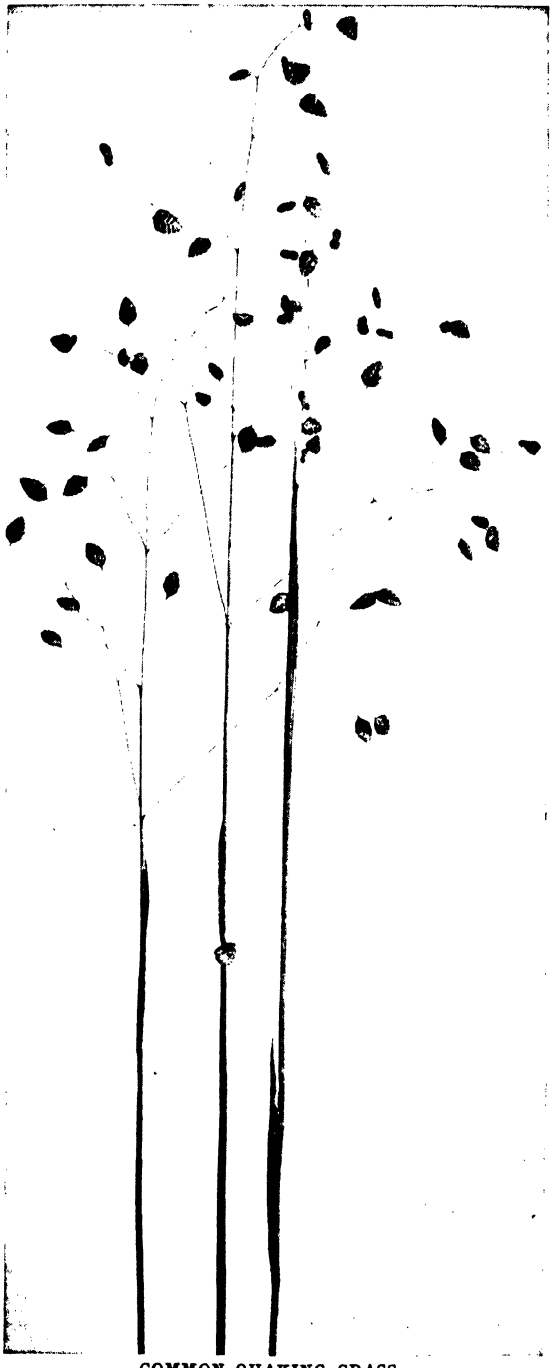
Rye grass is frequently to be met with in this country. It was the first grass to be gathered and cultivated in England. Orchard grass is very tall-growing. That is why hares and rabbits are so fond of it, as it is high enough for them to hide in and escape detection. Both of these grasses were brought from Europe.



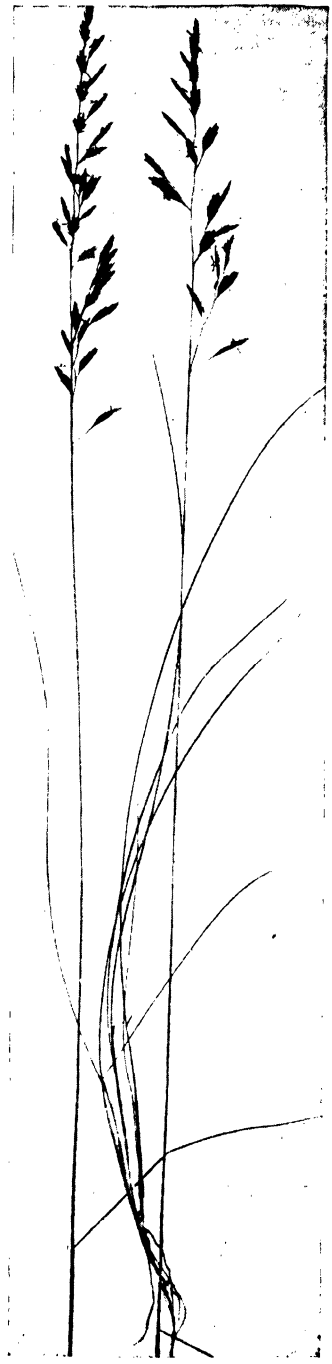
MARSH BENT GRASS, OR RED TOP
Growing in damp places, from July onward.

BROWN BENT GRASS
Found in meadows, July.

Bent grass is a very hardy grass—that is to say, it is difficult to kill. For this reason we find that the grass which grows by the roadside, or where there is much traffic, is largely bent grass. It is also a useful grass to plant on sandy hill slopes where otherwise water is likely to wash the earth away.



COMMON QUAKING GRASS
Found on downs and poor pastures, in June and July.



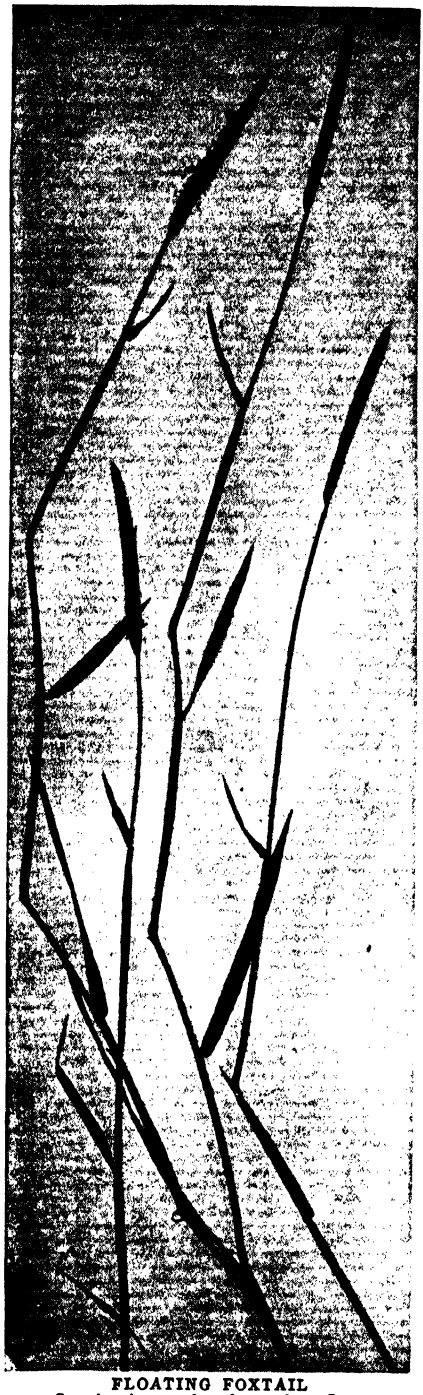
SHEEP'S FESCUE
Found on downs and moors, in June.

Quaking grass has this curious name because it quakes, or trembles, in the slightest breath of air, when all other grasses are standing still. As we may judge by its name, sheep's fescue is a favorite with sheep. It grows in rough places which would otherwise afford no food for flocks. Fescue means "stalk."

COMMON REED
Growing by ponds and marshes, in September.

TIMOTHY OR CATTAIL GRASS
Growing in meadows, July and August.

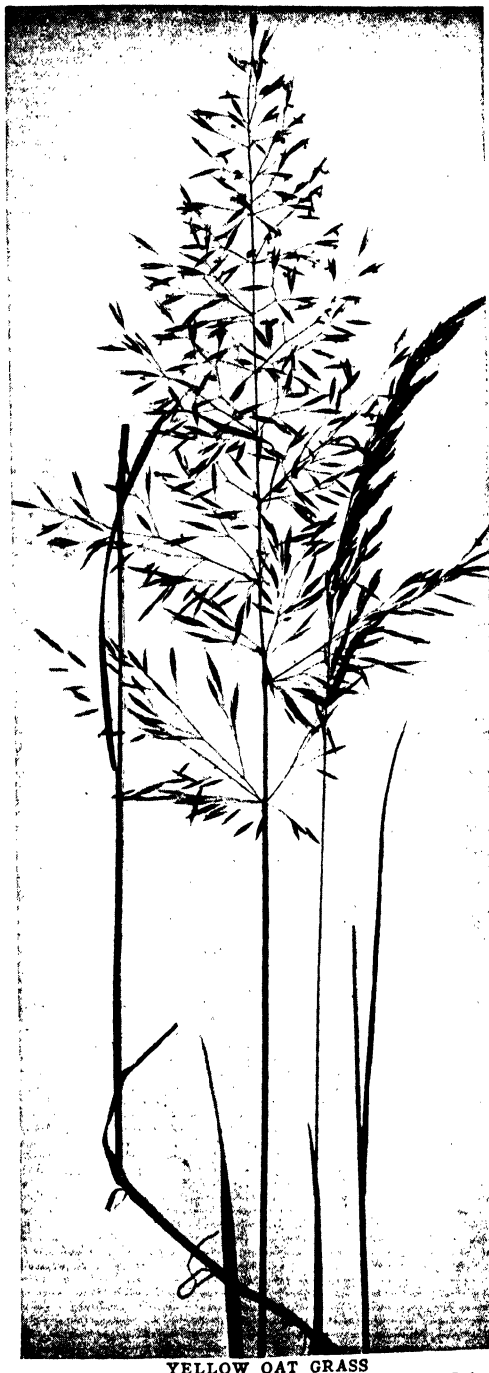
It is easy to tell reed grass from others, because it is much later in flowering than the other waterside-loving grasses. When we look at timothy we can see that there is no other grass quite like it. Though it is a native of England, it was first cultivated in the United States and then reintroduced to Europe.



FLOATING FOXTAIL
Growing in marshy places, from June.

COMMON SEA-REED, OR BEACH GRASS
Growing in loose sand by the sea about July.

Floating foxtail is a kind of brother of meadow foxtail; but it is not useful, merely curious, because it grows wild in such very wet places. The sea-reed is very useful because it prevents the storms from washing away the sands in which it grows and thus prevents the sea from encroaching upon the land.



YELLOW OAT GRASS
Growing in pastures and meadows, in June and July.

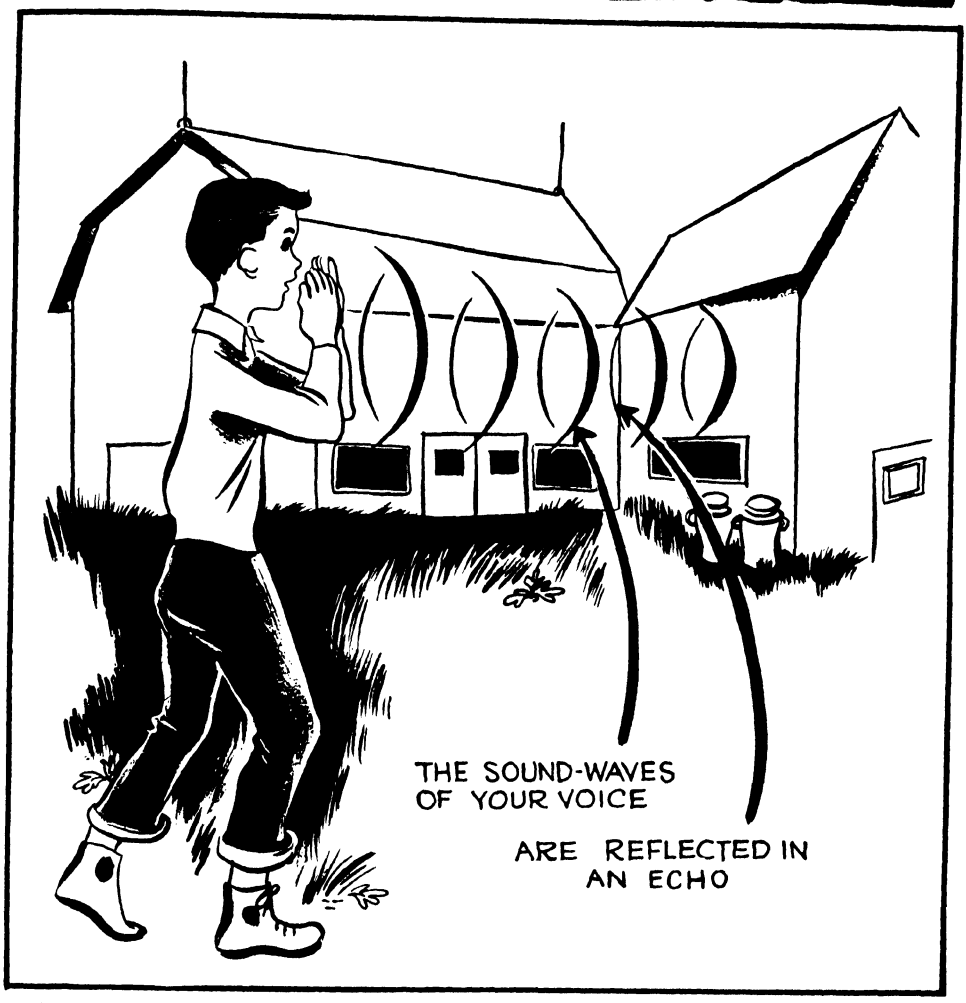
CRESTED DOG'S-TAIL
Growing in meadows, from June onward.

Yellow oat grass is so called on account of its bright yellow flowers. It is cultivated in France, but rarely found in America. It is a great favorite with sheep and cattle. Crested dog's-tail is nearly always found where chalk abounds. That is why it grows in abundance, for example, in England, on the downs of Kent.

SOFT BROME
Growing in meadows and pastures, from May to August.

SEA-LYME GRASS
Growing by the sea, in July.

Soft brome is a very greedy grass. That is to say, it devours all the nourishment there is in the soil, and leaves any other grasses near to starve and die. Sea-lyme grass is very much like sea-reed, shown two pages back. Even grown-up people, who should know better, frequently mistake one for the other.

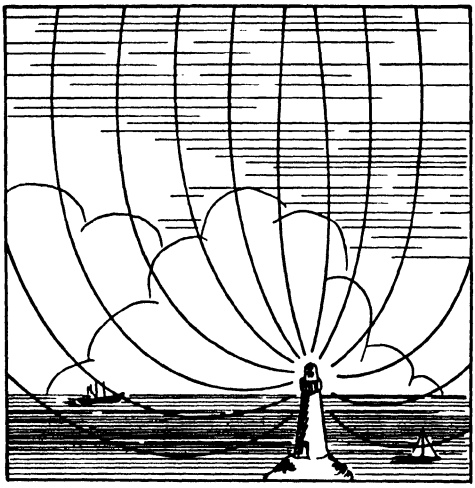


As this lad calls—probably for the hogs—his voice is reflected from the flat walls of the farm buildings.

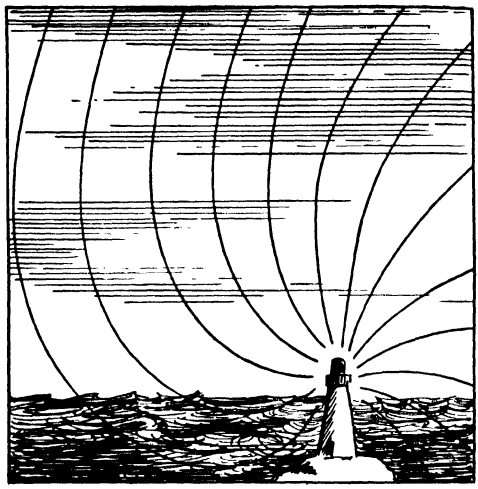
WHAT MAKES AN ECHO?

YOU have probably had the experience of hearing the echo of your own voice. When you spoke, the sound of your voice answered you, or was reflected back to you, from some object—a wall, a mountain or perhaps a canyon. Sound comes to your ears in the form of waves passing through the air. Anything that will stop the sound-waves and reflect them without changing the shape of the sound produces an echo. Certain irregular surfaces, however, so distort and break up the sound that it is hardly recognizable as your own voice when it comes back to you.

To produce an echo of your own voice, you must be standing far enough away from the wall, or whatever will throw the sound-waves back, to give a distinct interval between the time when we hear the voice and the time the echo is formed. This distance is usually somewhere between at least twenty and twenty-five feet. Any distance shorter than this is much too close.



On a day with little wind, the sound of the lighthouse signal goes out equally in all directions.



A wind has risen and, as the lines show, it has changed the direction of the sound-waves.

DOES SOUND TRAVEL IN STRAIGHT LINES?

Sometimes sound travels in straight lines and sometimes it does not. There are many things that affect the speed and direction of sound. Wind, fog and temperature all play their part.

In the first picture on this page, where there is little wind and little variation in temperature, the sound-waves are traveling along very definite paths from the source of sound. In the second picture, you can see how the direction of the sound-waves is changed by the wind. In fogs, particularly at sea—as shown in the third picture—sounds may be heard at great distances and yet not be heard close by. It is also true that sounds appearing to come from a certain direction may actually come from an entirely different quarter. Fog, in fact, has more effect on sound than any other state of the atmosphere. This is because in a fog there are such great variations of heat and cold. The outside layer is often quite hot and the interior, cold. This causes the direction of a sound to bend where the layers meet.

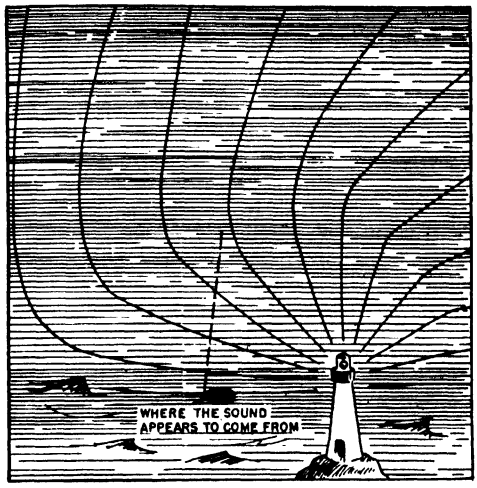
WHY DO WE HEAR BETTER ON WATER THAN ON LAND?

Sound is composed of waves that pass through the air. These waves are broken up and interrupted when they strike against solid obstacles. On land, sound-waves usually can not travel very far without striking against houses, or trees, or mountains or some other objects that stand in their path. These obstacles prevent the sound from traveling to great distances. On the sea, however, or on a big lake, where there are no obstacles in the way, it is possible to hear for a very long distance because there is nothing to stop the sound-waves.

WHY DO WE SEE THE FLASH FROM A GUN BEFORE WE HEAR THE NOISE?

When a gun goes off, the flash and the report of the gun occur at the same moment. If we are very near the gun, we see the flash and hear the noise at the same time. If we are some distance away, however, we see the flash before we hear the report. The length of time before you hear the report will be determined by your distance from the gun.

The sound of the gun, as you know, is carried to your ears by sound-waves that pass through the air. Light, too, is probably composed of waves. Both kinds of waves—those of sound and those of light—take time to travel from one place to another. The speed of sound-waves is very much slower than the speed of light-waves. Light travels more than 186,000 miles in one second! Sound, on the other hand, travels only about a thousand feet in a second. It is easy to see, then, that the light-waves will far outdistance the sound-waves. We always see the flash of light, no matter how far away we may be, within a tiny fraction of a second after it has happened. But if you are, for instance, about five miles from the gun when it is fired, you will not hear the sound for nearly half a minute.



Fog has formed, the paths of the waves are angular, and the sound seems to come from a different place.

You have probably noticed, too, when you have watched a game of baseball from a distance, that you see the bat hit the ball before you hear it. This, too, is because light, by which you see, travels so much faster than sound.

WHY DOES THE WHISTLE CHANGE AS THE TRAIN COMES NEARER?

If we are standing in a railroad station, and an engine approaches, blowing its whistle, the pitch of the sound rises as the train approaches us. As the train leaves us, the pitch of the sound falls. The effect is like a shriek, first rising in shrillness and then falling again to a lower level.

The pitch of a sound varies with the number of waves that beat on our eardrums in a given time. We call this number of waves the frequency. For example, the tone of middle C on a properly tuned ordinary piano has about 256 vibrations to the second. Sounds that are higher in pitch than middle C have a higher frequency, or more vibrations to the second. Sounds lower than middle C have fewer vibrations per second.

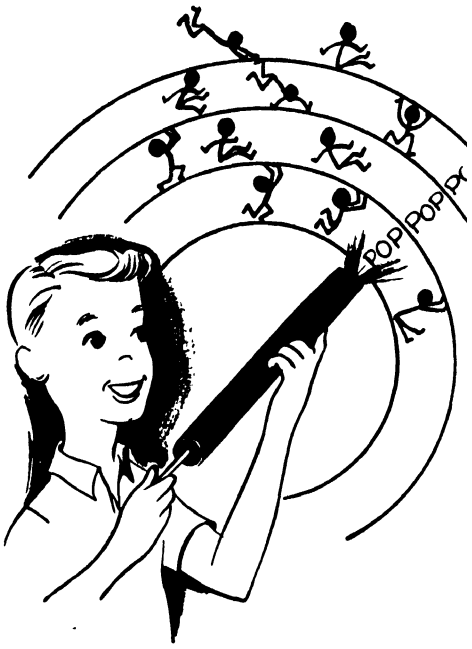
Now we can understand what happens to the whistle on the approaching train. Actually, it is giving out a certain steady tone. As the locomotive rushes toward us, however, we receive more vibrations in one second than the whistle is actually giving out in one second. Fresh vibrations come to our ears before others have died away. So, although to the engineer of the train the pitch of the whistle remains the same, to our ears the tone seems to rise as the train rushes towards us. As the locomotive leaves us behind, the number of vibrations per second that reach our ears from its whistle is smaller than the number of vibrations that actually leave the whistle. Therefore the pitch of the sound falls.

WHY CAN WE HEAR A NOISE LIKE WAVES IN A SEASHELL?

The sounds we hear when we hold a seashell close to our ears are not actually the noise of the waves or the roaring of the sea. This is a pretty idea, but it is really just a poet's fancy. We only imagine a likeness between the sounds that seem to come from the shell and the sound of the sea. The body of a shell, like the body of a violin, is a resonator—something that makes noises resound or echo back and forth. This is largely because it is shaped the way it is, and because its inner surfaces are very smooth.

The shell picks up the very slight noises that are always going on around us. It is never really quiet, and the shell picks up sounds so faint that we do not hear them at all without the shell.

No, that murmuring sound is not the sea!



With every pop of a popgun, the compressed air in the barrel rushes out, pushing hard to escape.

Scientists tried an experiment once with a seashell. They built a soundproof room from which were cut off all the tiny sounds which a seashell usually picks up. When a seashell was held to the ear in this room, no sound could be heard at all. If no sounds come to the seashell from its surroundings, it can give nothing out.

WHY DOES A POPGUN GO POP?

Inside the barrel of a popgun there is air. When you pull the gun's trigger, you release a ramrod or plunger that forces the air into a smaller space, that is, compresses it. As the plunger slides forward through the barrel, the air is pushed into such a small space that it exerts great pressure, not only on the sides of the barrel, but also upon the cork inserted in the opening of the gun. This pressure forces the cork out of the popgun. The quick push of the air against the cork is accompanied by an explosion made by the release of the compressed air. This explosion we hear as a pop; and so the pleasantly noisy toy is well named.

"Pop" is one of the many words that were invented in imitation of sounds. When you say the letter p, with your lips, you will find that you are making a little explosion with your mouth. This is exactly the same kind of explosion that is made when you fire a popgun. You squeeze or compress the air in your mouth and then force it out between your lips. The compressed air in your mouth escapes with a little explosion, just as the air in a popgun does when the cork flies out. The word "pop," beginning and ending with little explosions, is a very good word, then, to express the explosion the popgun makes.

You may be wondering where the gas comes from that makes the noise when you shoot a real gun. The cartridge with which you load the gun contains powder. When you pull the trigger, a firing pin strikes a percussion cap at one end of the cartridge and the powder burns. This burning of the powder produces a large amount of hot gas very suddenly, and hot gas occupies much more space than cold gas. The space within the barrel of the gun is not large enough to hold all this hot gas, and, as the gas expands with a rush, it forces the bullet out of the front end or muzzle of the gun. The release of bullet and compressed gases causes a loud noise that we call an explosion. It is similar to the popgun's pop, but much more forceful.

WHY DO OUR VOICES SOUND HOLLOW IN AN EMPTY HALL?

To answer this question, we might begin by asking ourselves why we use the word "hollow" to describe the sound of our voices. This kind of sound is always produced within any hollow or more or less rounded empty space. By a peculiar use of language, we have come to call the kind of sound produced in a hollow space a hollow sound. The sound seems hollow to our ears because it is reflected and echoed back to our ears from the walls of the space.

Furniture and people and hangings help to deaden sound in a room or a hall. These objects have irregular surfaces that may break up the sound-waves and do not reflect them truly. Hangings and clothes may also be made of materials that absorb the sound-waves set into motion by our voices.

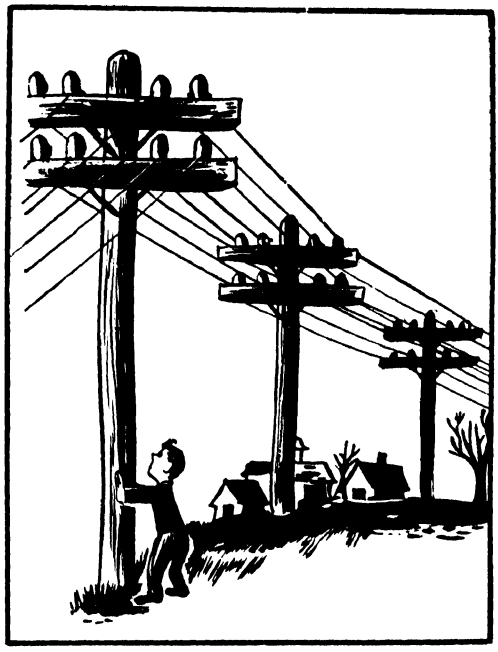
WHY DOES MY VOICE SEEM LOUDER IF I PUT MY HANDS OVER MY EARS?

When you put your hands over your ears, all the noises around you sound much fainter. As the sound-waves pass through your hands to your ear, they are greatly weakened. Your

voice, however, which comes from within your own head, sounds louder. This is because its sound echoes and vibrates against and through the bones of your head, and this increases the force of the sound. You have probably noticed, too, that when you hold your hands over your ears, your voice has a hollow sound that it does not have ordinarily. Your voice sounds strange to you when your ears are covered up because you are hearing it only from inside your own head. Usually you hear it partly through the airwaves that carry your voice around beside your head to your ears.

WHY DO THE TELEGRAPH WIRES HUM?

Because telegraph and telephone wires are stretched from pole to pole, they often vibrate or tremble when the air is in motion. If the wires vibrate rapidly in the breeze or the wind, they produce sounds that our ears can hear, just as we can hear the humming of the bee's wings. Sometimes, when we put our hands on the telegraph poles, we can feel the whole pole vibrating, too, from the movement of the wires.

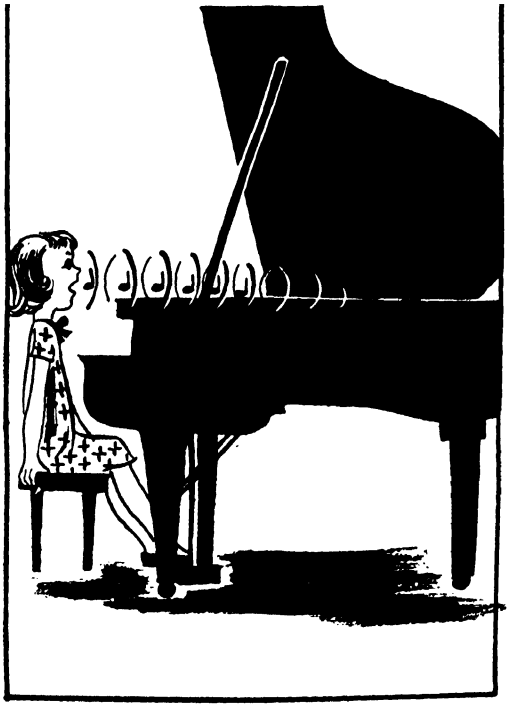


As the wires hum, the whole pole may vibrate too.

We ourselves are able to hum because the column of air in our throats vibrates our tightly stretched vocal cords. In each case, something that is stretched from one support to another is set in vibration by air currents.

A duet on the same tone, a piano and you.

THE TONE YOU SING STARTS THE SAME TONE VIBRATING IN THE PIANO



WHEN WE SING A TONE TO THE PIANO, WHY DOES IT ANSWER?

If you hold your foot on the loud pedal of the piano and then sing a steady tone, you will find that the piano also begins to sing. With your own singing, you have set waves of sound moving through the air. There is one particular string of the piano that is of the right length to correspond with the tone you are singing. This string begins to vibrate and give out sound. Only the tones you sing will answer you; all the other strings remain silent. To answer you, the piano string must vibrate exactly the same number of times a second as the tone you sing—it must have the same frequency. A physicist would tell you that this answering of the piano to your voice is called sympathetic vibration. Sometimes glass ornaments on the piano, or in the same room with the instrument, will give out sympathetic vibrations in response to a tone played.

WHY DOES FURNITURE MAKE A NOISE AT NIGHT?

When furniture creaks and cracks and groans, it is probably because of changes in the temperature. It is generally true that wood, and most other substances, expand as they are heated and shrink as they are cooled. During the day, the air has been warmed up by the heat of the sun, or by the warmth given out by the furnace in the house. At night it is usually much colder both in the house and out-of-doors. Furniture is likely to shrink more or less at night, as it cools, and to expand with the greater heat of daytime. A part of a chair or a table may suddenly slip a little and make a creaking noise. As the furniture shrinks a little, the joints do not fit as tightly as they did before. The amount of moisture in the air may also have something to do with this.

We notice the creaking of furniture, or of an old house, more at night than we do in the daytime because it is usually much more quiet then. However, furniture and houses do creak in the daytime as well.

IS IT TRUE THAT SOUND GOES ON FOREVER?

No sound lasts forever *as a sound.* The waves that carry the sound become weaker and weaker, and finally our human ears can hear them no longer. Nor is there any scientific instrument, no matter how delicate, that can record sounds after a certain length of time has passed. The waves that carried the sound to our ears have finally ceased to be waves.

Sound-waves contain energy, however, and no energy is ever lost. If we had more delicate instruments for the measuring of sound, we might find traces of the sound-waves in the movement of air particles long after the sound had ceased. Although the sound has ceased as a sound, the energy of its waves must go on in some way forever.

WHY DOES A VIOLIN STRING CHANGE ITS TONE WHEN HELD DOWN?

The shorter a violin string is, the more quickly it vibrates when it is plucked or when a bow is rubbed across it. When you put your finger on a string, and hold it down, it has the same effect as making the string shorter. Then, when the string is set vibrating as the bow is pulled across it, it must vibrate more quickly. One tone is higher than another just because the quicker vibrations of the string make the air tremble more rapidly.

If you hold the string down just halfway along its length, it will give out a tone exactly an octave higher than before—a high G instead of a low G, for instance. This is because the string now vibrates twice as fast as it did before. The tone made when the air vibrates twice as fast is exactly an octave higher. If you now halve the string again, you will get the G an octave higher still.

You can see roughly how this works by using a rubber band. Tie one end of the band around a doorknob or the arm of a chair. Hold the other end in one of your hands and stretch the band as far as you can comfortably without breaking it. Then pluck the band with the fingers of your other hand, and notice the tone it gives out. Move your hand that is holding the band halfway along its length, pull the band tight, and pluck it again. You will find that the second tone is much higher than the first.

A violinist places his fingers exactly where they must go to produce the tones he wants.

HOW CAN SOUND COME INTO A ROOM THROUGH A WALL?

When sound travels through the air, it travels in waves, somewhat like the waves you see circling outward when you throw a pebble into a pool of water. These waves travel outward from the source of the sound, in all directions. The wave motion of the sound passes from one molecule of air to the next, each particle passing the motion on to the next one to it. When a sound-wave, let us say from outdoors, reaches the wall of your house, the waves of sound do not stop at the wall. They continue to move through the molecules of the material of which the wall is made. Each molecule of the wall passes the wave on to the molecule next to it. A good deal of power or intensity of sound is lost as the waves travel, and especially as they pass through certain kinds of materials. Inside the house you do not hear the outdoor sound as plainly as you would outside, for the sound-waves have been weakened as they passed through the wall. Of course, the extent to which they are weakened depends upon the thickness of the wall and upon the material of which it is made. Materials that do not vibrate easily, such as heavy curtains or certain building materials, absorb most of the sound-waves.

We sometimes think of air as being the only medium through which sound will pass. If we stop to think, however, we know that sound passes through solids and liquids as well. We still hear, swimming under water.

Why Does a Stick Make a Noise When Swung in the Air?

When a stick is swung rapidly through the air, vibrations are set up among the particles of air through which the stick moves. We have seen that all sound is caused by vibrations of one kind or another. As the humming of a bee is caused by the vibration of air particles disturbed by the movement of the bee's wings, so the noise of the stick swung through the air is caused by the vibration of air particles. Countless millions of air particles are quickly moved aside to make room for the swinging stick. These particles strike the particles next to them, and then rebound. For a little while all the molecules of the air in the neighborhood of the swinging stick are swinging backward and forward. That motion or vibration makes the sound-waves that we hear as a humming or whistling noise, as the stick swishes through the air.

DOES SOUND ALWAYS TRAVEL AT THE SAME RATE?

No. Sound travels four and a half times more quickly in water than in air. Through steel, it travels faster than through any other substance—about sixteen times more quickly than in air. Perhaps you have noticed, too, that sound travels more quickly in warm air than it does in cold air, as temperature also affects the rate.

Sound does not travel at the same speed even through different kinds of gases. The lighter the gas, the faster the sound travels through it, if the pressure and the temperature of all the gases are the same. If the air we breathe were hydrogen, instead of being a mixture of nitrogen and oxygen, we should hear a clap of thunder much more quickly than we do. On an average, sound takes about five seconds to travel one mile through air. If a storm is four miles away from us, we hear the thunder about twenty seconds after we see the lightning. If the air were composed of hydrogen, we should hear the thunder about five seconds after the flash.

In a thunderstorm it is sometimes fun to figure out how far away the lightning is. For every five seconds that you can count from the moment you see the lightning flash, you must add one mile to the distance between the lightning and you.

Here are the speeds at which sound travels in different gases when the temperature is at zero degrees Centigrade (32 degrees Fahrenheit), and when the pressure is the same as that of the atmosphere at normal times: hydrogen, 4,163 feet a second; air, 1,090 feet a second; oxygen, 1,041 feet a second; carbon dioxide, 856 feet a second.

WHY DOES A BEE MAKE A HUMMING SOUND?

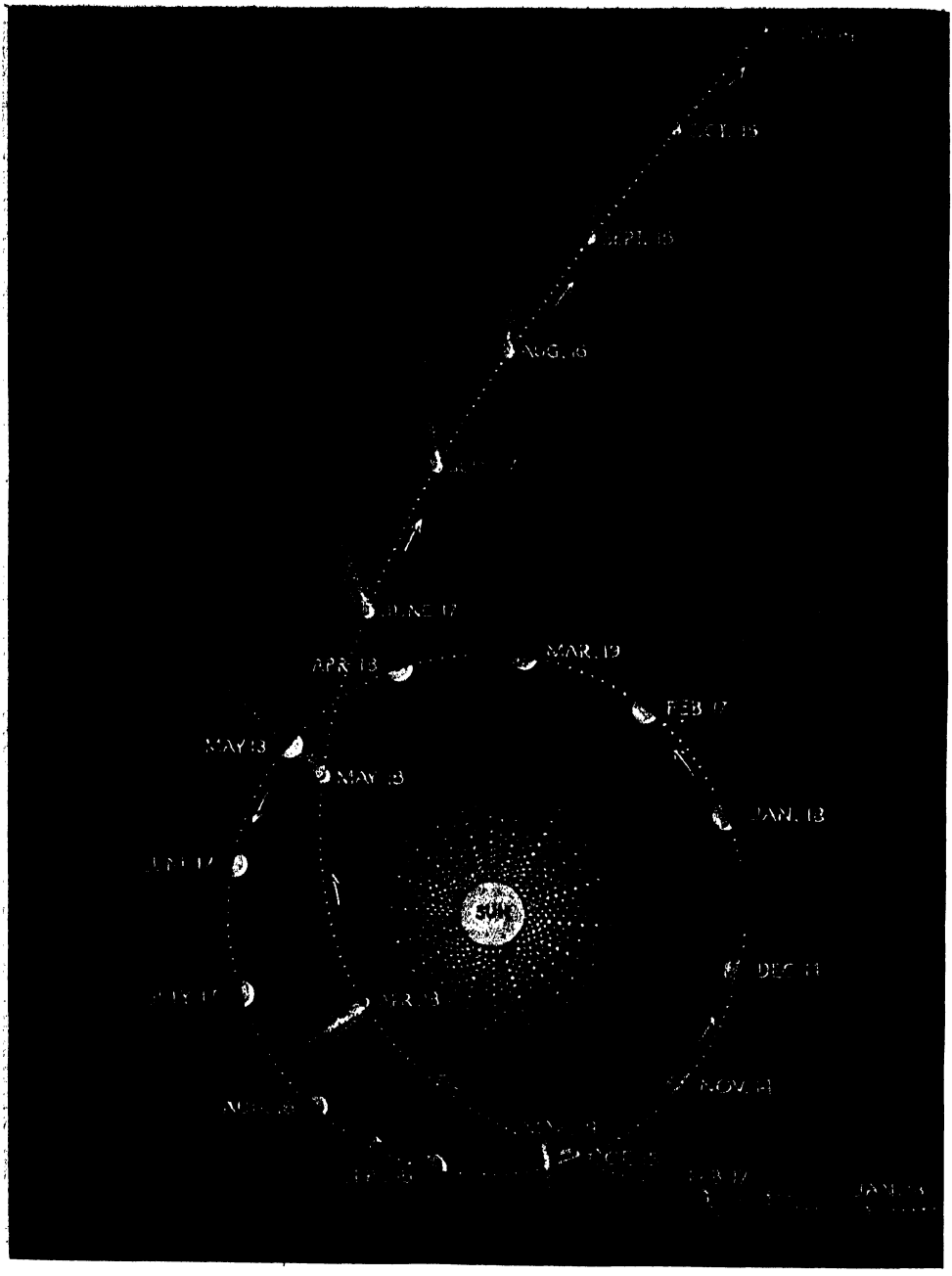
The bee's humming is made by the movement of its wings. The wings vibrate very rapidly, as they move to and fro, and these vibrations set up waves in the air that carry the sound to our ears.

Birds flap their wings as they fly, also, moving them up and down. The movement of their wings, however, is so much slower than that of the bee's wings that they create very little sound. The honey-bee moves its wings back and forth more than 400 times a second, sometimes more than 26,000 times a minute. Because these movements are so rapid, we can not sort out the individual sounds, but hear the constant humming. The word "humming," like the word "pop," imitates the sound it describes. There are many such words in most languages.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3729.

When most of nature seems to be drowsing on a warm day, the industrious humming of the bees still fills the air. The fragile-looking wings that produce the sound vibrate so rapidly that one can scarcely see them.

A COMET'S PATH ROUND THE SUN



The drawing shows how it is that people on earth may see a certain comet only once in fifty or a hundred or two hundred years. A comet travels in a long, oval orbit, or ellipse; the orbit extends far out in space, so that it may take years for the comet to make a complete round trip. In this picture a comet is seen approaching the sun (January 18 to April 18) and then receding, or going away. As it nears the sun its tail grows longer and the direction of the tail changes; the tail always points away from the sun. During much of the journey the tail streams in front of the head. While near the sun the comet's velocity is greatly increased; for instance, it travels a much greater distance between March 19 and May 18 than between any other two months. The sun lights up the comet; as the comet moves away, it loses its glow, and brightens when it nears the sun again.

FACING PAGE 3668

Courtesy, Lowell Observatory

The Finsler Comet, August 8, 1937. Were it not for their tails, we would find it difficult to see comets at all.

FRAGMENTS *of the* SOLAR SYSTEM

COMETS, METEORS AND METEORITES

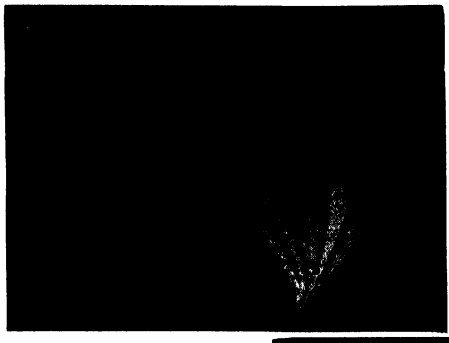
DUST there is in the air, we know. At the top of the highest mountains ever climbed there are three thousand specks of dust in every cubic inch of air, and in the highest clouds dust floats. But does it float in the great emptiness between the sun and the planets? Does it collect in the greater gulfs of space between the stars?

It does; but this is dust of such a fineness that one almost despairs of conveying an idea of it. You may think of a fog as dust of a kind, but a fog will cut down the light of a lamp by one half a few yards away; the dust-fog in outer space is so thin, the specks are so small, so far apart, that a thousand billion miles of such a fog would cut off only part of a distant star's brightness.

That is the finest kind of dust that has been imagined. It may be that some of it comes into the solar system as the sun, with its train of planets, makes its majestic way through space; it may also be that the sun leaves dust behind on that immeasurable journey. Remember that a speck of dust, like every other material thing, is subject to that law of attraction we call gravity. A speck of dust above our own globe is pulled down to the earth, though the winds may bear it up for a time. If the speck were placed within a measurable distance of the sun, the sun would pull it in. But there is something else the sun is doing besides pulling things to it. It is pouring out energy, radiating light. Now, only a two-thousand-millionth of this great outrush of energy falls on the earth, but even so the pressure of the sun's light on the earth is equal to 75,000 tons.

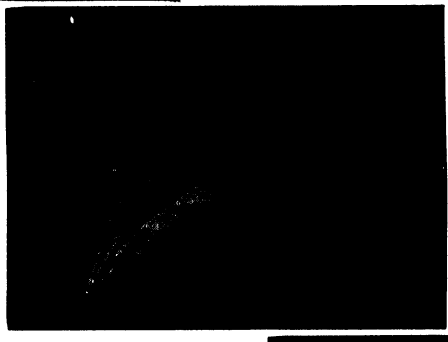
The sun is pushing the earth away with

that force, though the effect is swamped in the billions of tons with which it is pulling the earth to itself by the force of gravitation. But suppose the pressure of the sun's light is falling on something very much smaller than the earth, a speck of dust smaller than we can imagine. On dust of that size and kind



the light pressure may be greater than the gravitational pull.

A particle of that kind might have almost any kind of career in space. Anything might happen to it. But in the solar system such dust specks, which are something like the size of molecules of matter, have a peculiar interest, for they are the stuff that a comet's tail is made of.

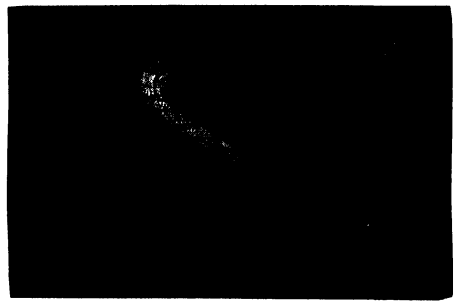


We have begun our story of the comet at its tail because comets are such very, very small members of the sun's great family that if it were not for their tails, they would be hard to see at all. Actually a comet has three parts—the nucleus, the coma and the tail. The nucleus is made up of a cluster of meteors. The coma, a veil surrounding the nucleus, consists of thin gas and particles of star dust. The nucleus and coma make up the head of the comet. Finally, the long flaming tail consists of a cloud of particles repelled by the sun's light.

There are about 400 comets whose paths we know, belonging as certainly to the sun as any planet or planetoid. When they come near to the sun, it turns a fierce eye on them and makes them shine; and when they leave it to go out again to the uttermost parts of its realm, they keep the glow for a long time on their backward journey. Small as they are, they obey laws like those which rule the planets. The planets go round the sun in paths which, if we drew them on this page, would look like circles, but which are really ellipses.

Suppose we were to turn the rays of a magic lantern on a sheet held close to it. If the lantern is held quite square, a circle of light appears on the sheet. If the lantern is put a trifle askew, the circle turns into an ellipse, and the more askew the lantern, the longer and flatter the ellipse. If the lantern is turned askew enough, the sides of the ellipse will go right off the sheet, however close the lamp is held, and then the lighted space has sides like the sides of a parabola, which never join again.

If we keep these figures in mind, we can form an idea of the paths of some of the comets which are so flat and go so far out that it seems sometimes that they can never come back again. But most, if not all, will come back. Some astronomers used to think that now and again a comet would come into the solar system from outer space, and then disappear. This might be so, but in general we may take it that all comets belong to the



All comets have a more or less solid core, or nucleus. Around the core there is a veil, and then a long tail streaming from the head. Some comets have more than one tail, as you can see above. Top—The Comet of 1744. Middle—The Comet of 1858. Bottom—The Comet of 1861, with its double tail.

sun; that, however far they go out adventuring, the sun keeps a tight hand on them, and they follow a regular route, though it may be many years or even centuries before one of them completes its round. Those whose paths we have traced are now called periodic

comets, the remainder, unexpected comets.

The Germans used to speak of their setting out to see the world as their "wander-year." The comets have their wander-years, too. However, instead of lasting 365 days, as the year of the earth does, or almost 248 of our years, as that of the planet Pluto, their years may turn out to be hundreds and even thousands of times greater than our own. Halley's Comet, which was last seen in 1910 and has a history of recorded appearances going back as far as 240 B.C., will be back in 1985, and some of us will live to see it. But nobody living will ever again see the comet of 1811, which had a tail 15 millions of miles across, for it will not be back for another 2,900 years; and there are others whose journey takes longer.

The Comet of 1882 had a very long journey.

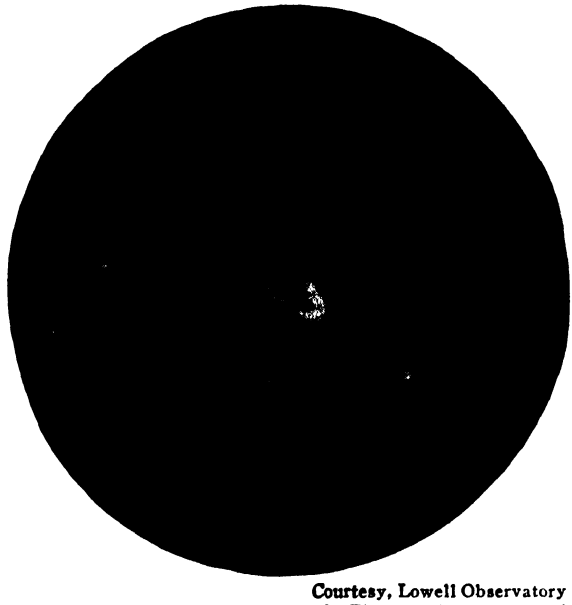
What a strange and wonderful journey is theirs! Imagine them far, far away, beyond the planet Pluto, where the sun's rays hardly light up the darkness. Sometimes they jog along at only ten feet a second, but quicken up as they round the far end of their elongated orbit to race back again toward the sun, on the homecoming stretch.

But it will not be all plain sailing for them. Sometimes a giant planet, Saturn or Jupiter, will stretch out an invisible arm to clutch at them, causing them to swerve from their path.

Jupiter captured a comet in your grandfather's time—Comet Brooks, 1889—and changed its path altogether. Comet Brooks was handled so violently that it broke in *half. Saturn was* suspected of having annexed another comet and converted it into a satellite, but this is not probable. Thus a comet may encounter strange adventures. The majority keep fairly close to the plane of the rings which the solar family travels and they are likely to be affected by one or more of our planets.

Let us suppose that all danger points have been passed, and the comet is approaching the sun. All appearance of leisure is thrown off as it approaches the family mansion. It runs, it gallops, it flies on faster and faster and faster yet—till it is rushing round the sun in a delirium of speed which can rise to 300 miles a second and even greater speeds have been recorded. As it approaches the sun it puts forth all its hidden glories. Like a peacock of the skies it flaunts its tail to honor the sun. The comet's head faces the sun, the tail streams away behind. It may be a little tail, for some of the comets are very modest bodies; it may be a splendid apparition, stretching far across the sky.

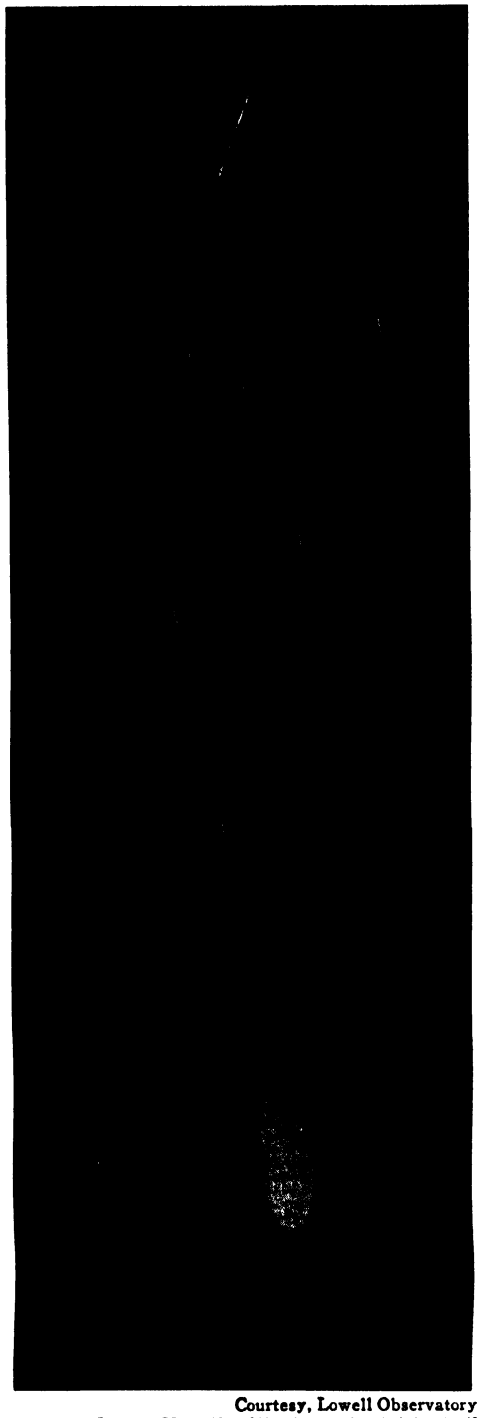
Some comets have flung out more than one tail—the comet of 1744 had several tails—some had tails on which the sun would appear no larger than the "eye" of a peacock's feather, so wide and long were they; and some would reach farther than the sun's corona. The comet of 1843, the finest in history, is supposed to have had a tail 150,000,000 miles long. Had it stretched from the sun toward us, it could have enveloped the earth and reached beyond the planet Mars.



Courtesy, Lowell Observatory

The Comet Brooks, September 17, 1889. This comet was captured by the planet Jupiter and treated so violently that it was broken in two. Its path and appearance were both changed.

After whirling past the sun, the



Courtesy, Lowell Observatory

Halley's Comet, May 13, 1910. Note the bright trail (near the top) of a meteor passing by the comet.

comet turns back; its tail turns over and shortens, and as the comet gets farther and farther away the tail is tucked between its legs, and disappears. When the comet leaves the sun, in other words, the tail, gradually shortening, streams out in front of the head. The comet may be back in a few years, or in a few centuries. Some comets go no farther away than Saturn before making another return to the sun. Some go to Jupiter's orbit—thirty are known to do so—and it is supposed that Jupiter may have captured some of them.

HALLEY'S COMET TRAVELS OUT AS FAR AS NEPTUNE BEFORE TURNING AROUND

By capturing them is not meant that the giant planet took them away from the sun, but that, whereas at some unknown time they went far out to the nethermost planets, they now have to turn round Jupiter as their farthest mark. By way of contrast Saturn has taken only two. The long-period comets still go on to Uranus, or Neptune, or beyond. Neptune has six, certainly, of which Halley's Comet is one.

We can not be more sure, because they take such a long time to go and return that only a Methuselah could live long enough to identify them. Some sail out to the uncharted seas beyond Pluto. The long-period comets are usually those which are the brighter and more resplendent. It is suspected that the glorification of the homecoming to the sun, and the mighty display of the tail, are purchased at the loss of some of the comet's substance. Those that come home least often preserve their glory longest.

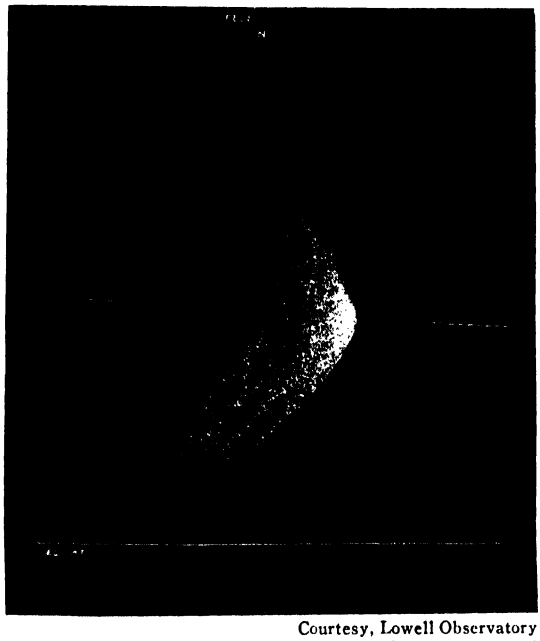
Some of the comets appear to belong to families of their own—to be, as one might say, cousins. By that we mean that they move in the same way, though not in the same paths. There was a favorite trio, all very bright, which came in 1843, 1880 and 1882. Each was a comet which had a very long journey, which came very near to the sun in going round it and went round in the unusual way—opposite to the hands of a clock. So we might expect that these three had a common ancestor.

WE THINK THAT COMETS ARE MADE UP OF LEFTOVERS FROM THE SUN AND THE PLANETS

What could have been the common ancestor of all the comets? We naturally suspect that they must have had one, because they are so like one another and so different from everything else that goes round the sun. It is supposed that perhaps when the great curling nebula that formed itself at last into

the sun and all the planets was beginning to cool and become solid, there was a fragment of the same sort of stuff "left over," or even "not belonging" at all, but nevertheless traveling the same way as the sun. By and by bits of this fragment would be dragged toward the sun, and at first they would seem to come from nowhere and to nowhere return. But in the course of ages their movements would be timed and regulated, their paths would be changed from parabolas to ellipses; they would, in short, be captured by the solar system.

How far the comet has changed from this original stuff of which worlds were made is not easy to know. Comets are not so light as they were supposed to be when someone spoke of the possibility of packing them into a traveling-bag. Their tails are indeed light; but the bodies of comets are of respectable weight. It is believed that the thing to which they can most closely be compared is the substance of the rings of tiny moons that fly round the planet Saturn. The nucleus is probably a collection of stones widely separated from one another and shining by their own light as they jostle together. We shall think of them for a moment as meteoric stones. The combined mass of any comet's stones can certainly never amount to one-hundred-thousandth of the mass of the earth, and is probably a good deal less than that. Even so, they may weigh millions of tons. We have learned that in the substance of comets are such metals as iron, sodium, magnesium and certain gases. We know that when meteoric stones are heated, gases are driven out, so after these facts about comets had been shown by the spectroscope, astronomers surmised that the huge tails of comets were volumes of gases "boiled out" of the stones of the nucleus by close approach to the sun, and pushed away from the comet, as it came nearer, by the pressure of the sun's radiation.



Courtesy, Lowell Observatory

The comet with the shortest known journey is the one named after the German astronomer, Johann Encke. It takes about three years to complete a trip around Jupiter and back.

As three separate tails could sometimes be discerned—one flying straight back from the comet, one curving over a little like a scimitar, and the third curving still more like a claw—it was supposed that the radiation pressure sorted out the gases and pushed them back more or less powerfully. Thus, the gas tail pushed back nearly straight would be hydrogen; the next tail would be the carbon gases; the stubby claw-like tail would be composed of metallic gases.

If we take the best of air pumps and try to produce a vacuum, there are always some molecules of gas left after every effort. The tail of a comet is even thinner than the vacuum produced by an air pump. But it is most likely made up chiefly of a cloud of particles, like molecules, but very far apart, which are repelled by the sun's light. They are, despite their smallness, not of the same weight, and therefore are pushed back in different degrees. Though they make such a show, being lighted up by the sun's electric forces—as a Crookes tube is lighted up when electricity passes through it—their weight is almost too small to reckon.

We may, however, make a calculation from what was observed about the tail of Halley's Comet when last it came in sight. When its tail was between the earth and the sun it was entirely invisible. The density was only a tiny fraction of the density of hydrogen gas. The earth, therefore, could not possibly be poisoned by any emanation from a comet's tail, even if a comet struck us, which can happen only about once in fifteen million years—though a comet in

1921, called Pons Winnecke's Comet, came very near to the earth. The earth did, in fact, pass through the tail of Halley's Comet.

But if the tail is very thin, there is plenty of it. The weight of all the particles that would be caught by the earth, on all its lands and all its seas, would at most amount in a day to 250 tons. Still, we can now be sure that a great comet, when approaching the sun, loses a good deal of substance, which never returns to it but just becomes the wandering dust of space.

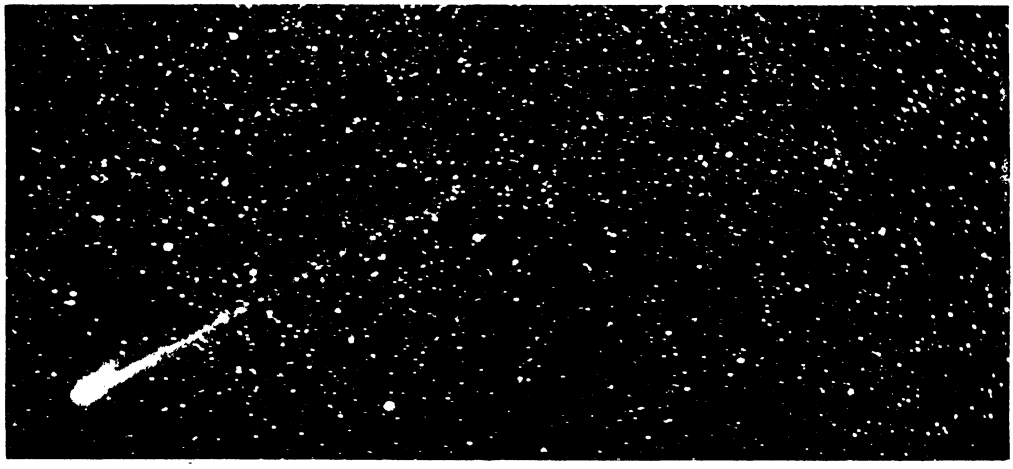
For some reason that can not be explained there have been few bright comets visible to the naked eye since the twentieth century began, though there are always several comets picked up each year by the telescopes. Halley's was a disappointment; its appearance fell far short of its two-thousand-years reputation; it had perhaps visited the sun too often. Only one bright comet which all could see easily has visited the skies since the great one of 1882, and this visitor showed to advantage only to those who looked at it from the Southern Hemisphere. Yet the number of bright comets which visit us is between twenty and thirty in a hundred years, so that perhaps the future will see a new outburst of them.

New comets are continually being discovered, but they are small. In September, 1940, Leland E. Cunningham of the Harvard Observatory announced that a new comet was speeding toward the sun. It was named Cunningham's Comet, and it was watched by astronomers with great interest. However, it was a disappointment in that it did not grow in brightness as they had hoped.

However, if there have been few comets in this century, there have been some very interesting ones, because they have told us a great deal about the life of comets. There is Encke's Comet, for example, which has the shortest journey known, for it takes only three years over its journey to Jupiter and is so unpunctual that it was thought to be slowing down preparatory to falling into the sun. There is Morehouse's Comet, the particles of whose tail in 1908 were shown to be flying at 66,000 miles a second—very nearly the speed of some of the particles of radium. There is Comet Brooks (1889), which used to have a twenty-seven-year trip, but now, having gone too near giant Jupiter, was captured and torn in half by the planet, the two parts being slowly separated from one another and sent on a trip reduced to seven years.

Biela's Comet has had a still more desperate career. When it was observed in 1826 it had a bright nucleus, and developed in due time a sort of veil round its nucleus and a proper tail. But twenty years later, when it reappeared for the third time, the nucleus parted; in a little less than seven years it came back with the two halves farther apart —and then it was lost. But in 1872, when the earth passed again the track of the lost comet, instead of Biela there appeared a fine display of meteors. Possibly they were all that was left of Biela.

That brings us to the second part of our story—the meteors and meteorites. What are they? Meteors are very small bits of stony or metallic material, usually hardly larger than fragments of gravel. When we see them



Cunningham's Comet, speeding through the heavens in 1940 and 1941. It was named after Leland E. Cunningham. The word comet itself comes from the Greek word "coma," meaning hair—a comet's tail suggests long, flowing locks.

they flash across the sky in an instant, whereas a comet does not appear to be moving any faster than the moon. We give the name of meteorite to the small pieces of mineral matter which fall to earth from outer space.

We never see meteors unless they come into contact with the gases of the earth's atmosphere and are set on fire by friction. Most of them burn themselves out in the air, but they may fall to the earth as meteorites. It is supposed that some meteors are the pieces of broken-up comets; and the stones are strung out on the comet's old orbit.

THE THICKEST SWARM OF STONES EXISTS WHERE THE COMET'S NUCLEUS USED TO BE

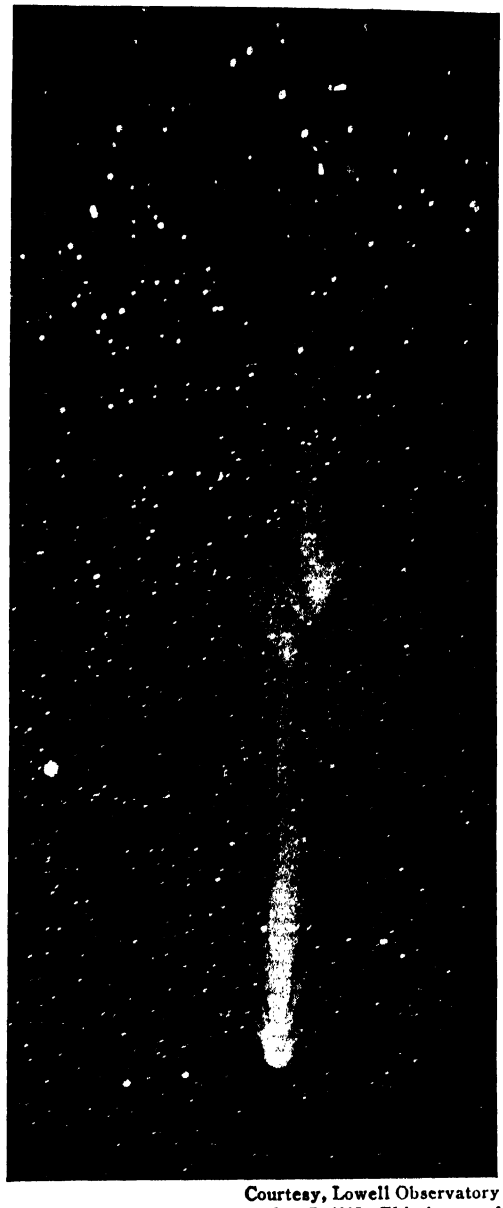
When the earth, on its path round the sun, crosses one of these old cometary paths, a shower of meteors always occurs. If the earth should chance to run into the thickest part of the swarm, where once the nucleus was, there is a great shower. This is what happens with the most famous of the showers, the Leonids, as well as with those which are called the Bielids, because they are the dispersed fragments of Biela's Comet. With these two the shower, or swarm, does not happen every year, because the stones have not been strung out very far; though we may mention that the swarm of the Leonids takes three years to pass a given point.

Some think that the Leonids are part of a comet which used to have a journey of thirty-three years, so that the swarm of Leonids occurs only once in that time. But the last great shower of Leonids was in 1867, while in 1901 a much smaller shower occurred. The attractions of the planets Jupiter and Saturn appear to have pulled the stream aside, and it may be that we shall never see another spectacular shower of these Leonids.

BESIDES THE REGULAR SHOWERS THERE ARE MANY, MANY "FREE-LANCE" METEORS

The Bielids have a six-and-three-quarter-year period, and, like the Leonids, when they come they appear in November. But the Lyrids, which arrive in the third week of April, and the Perseids, in the second week of August, are punctual visitors every year, because the stones are strung out all along the old path. Possibly the Lyrids were part of a comet which performed a 415-year journey of old; the Perseids may be part of a comet with a journey of 120 years. The Aquarids, arriving in May, may be the tail of Halley's Comet.

But besides these regular sharpshooters of the heavens there are thousands of others—



Courtesy, Lowell Observatory

The Morehouse Comet, November 7, 1908. This is one of the most active comets. The particles of its tail were shown to be speeding along at 66,000 miles a second! Note the unusual loop midway in this tail.

free lances which belong to no regular regiment. The number of meteors which a close watcher may see on a clear night varies from six or seven on some nights to ten times that number on others; and if we could keep all the sky in sight, the average would be about forty. But our eye can see a starry stone that shoots only if it enters the air a couple of hundred miles or so away from our position.

If all that come in every day could be counted, the daily shower would run into millions. Some are so small that they could never be seen at all; they are mere dust. Many that make a good show—a streak of light in the skies—can be no larger than walnuts. Some that never reach the earth's surface, but are burned to powder in the rush of their fiery passage, may be the size of small bricks. The "shooting stars" that are burned up are called meteors, and when we sweep out the dust of a room we may be sure that some of it was once part of a meteor.

Sometimes a greater mass comes almost unscathed to earth, in spite of having had a speed of twenty miles per second when it first reached the earth's envelope of gas, and having been slowed down as it encountered the denser air near the surface of the earth. Many such masses have been seen to fall. There are fine collections in London, Washington and New York. It is not correct to call them shooting stars or meteors as we often do; they are really meteorites. They may properly be called aerolites when they are masses of stone only; or siderites when they are masses of iron and nickel; or siderolites when they are a mixture of roughly equal parts of stone and iron.

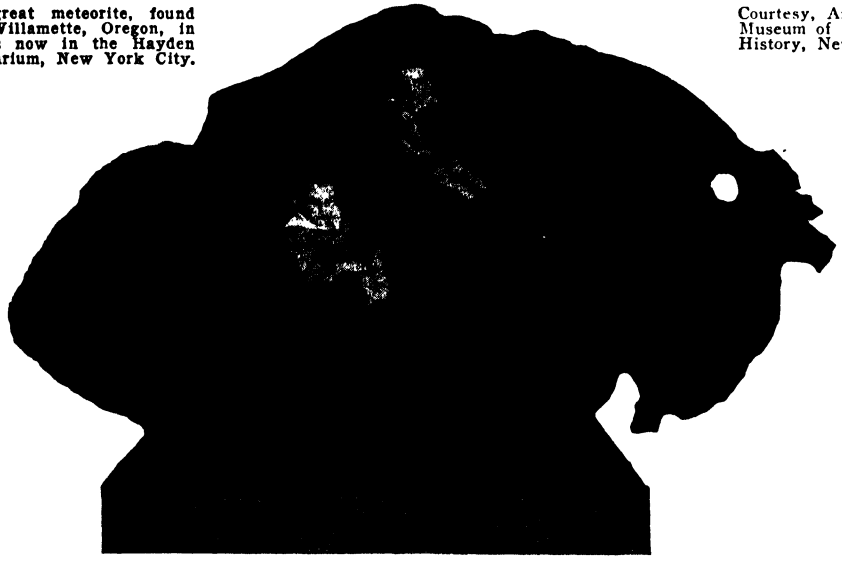
The strangest thing about these stones from the skies is that many minerals known on earth have been found in smaller or greater number in some of them. In the fragments of one from Canyon Diablo, Arizona, which may have been originally the largest that ever fell, though it split into fragments in its fall, were found diamonds; they were black and not suitable for gems. From some others Dr. Odling, at the Royal Institution in London, once extracted enough gas to light up the lecture theater—a wonderful sight indeed—illumination brought from the skies after being shut up in stone before the earth was born.

One of the largest meteorites known, weighing more than 20 tons, is an iron one at Bacubirito, Mexico. Another large one was brought from Greenland by Commander Peary, the discoverer of the North Pole. It weighs more than 36 tons. It is in New York. The very largest meteorite ever found weighs about 60 tons and is in Southwest Africa. A very interesting one, weighing 15½ tons, is shown below. All these very large meteorites are of iron; the largest stone meteorite to fall weighed only about 1,000 pounds.

In June, 1908, what must have been a tremendous meteorite or swarm of meteorites fell in Siberia and blasted out of existence an area of forest as large as New Jersey. But it must have torn itself into tiny pieces, and even into separate molecules of gas, for no trace of the meteorite itself has ever been found. There are several craters in a marsh where the thing struck, but exploration of the craters has not revealed any traces of solid material.

Article prepared with the assistance of Roy K. Marshall, Director, Fels Planetarium.

THE NEXT STORY OF THE EARTH IS ON PAGE 3783.



This great meteorite, found near Willamette, Oregon, in 1902, is now in the Hayden Planetarium, New York City.

Courtesy, American Museum of Natural History, New York

THE WONDER OF A GREAT STORE

Courtesy, Westinghouse Electric Corporation

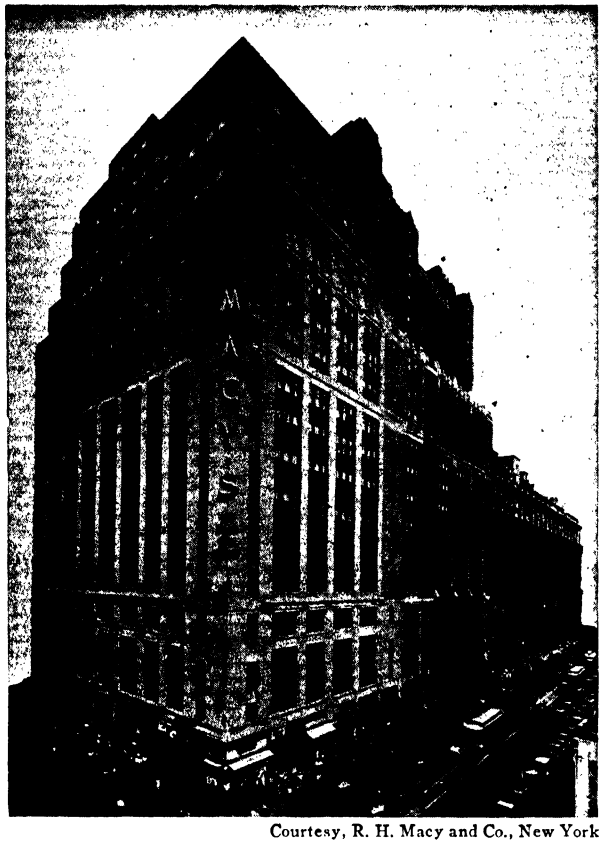
ONE of the marvels of our age is the great department store. Here you may buy everything from groceries to works of art. You could spend a whole delightful day wandering up and down the aisles, seeing goods from many lands displayed with taste and "showmanship." This type of store is seen at its grandest in the United States, though Canada, England, France and several other countries have large department stores, too.

The department store probably grew from the village general store, still to be found in some small towns. Such a country store is crowded with goods of all kinds: cotton dresses, sides of bacon, shoes and rubbers, farm tools and dishes. Mr. Jones, the owner, keeps these things because his customers ask for them; they create what we call *demand.* He furnishes these articles and thus provides *supply.* Supply and demand lie at the root of all trade. (See our article on Value, Supply and Demand.)

Modern merchandising is based on the use of money. As you know, men did not always have this handy way of buying and selling. There was a time when goods were bartered, or exchanged. That is, a man with a cow to sell traded it for a pig and a piece of homespun cloth, or whatever else he needed. Later, various things—skins, grain, cattle, stones and so on—began to be used as money. The use of coins made of precious metals began in Lydia, a little nation on the shores of the Mediterranean, about 800 B.C.

Bartering was still common in Europe in medieval times, when men brought their goods to fairs or markets. (See our Story of Fairs.) As money came into wider use, men set up shops, which were often little more than showrooms for articles made by craftsmen. Goods were made by hand. In time, groups of skilled workers in leather, fabrics and metals banded together. They called their bands guilds. Four or five hundred years ago, the streets of any large town were lined with a number of small shops, each one supplying a single type of goods. There would be a street of shoemakers, a street of cloth merchants, a silversmith's street and so on.

As more and more machines were invented, goods were made in large quantities



Courtesy, R. H. Macy and Co., New York
A great department store, whose building covers an entire city block.

in factories, and stores began to sell many different products. The railroads helped to bring this about. Even an out-of-the-way place in Kansas or Nebraska or Alberta could supply its customers with goods brought in by freight car from the East or the South. For their part, customers found it convenient to do their shopping in one place. The demand for stores supplying every need became continually greater, and thus the general store and the modern department store came into existence.

To be successful, a store must correctly estimate the demand, get together the supply, display it in attractive form and, lastly, deliver the goods safely and promptly. The great modern department store must do something more. It must create, or arouse, or increase demand for its goods. In these days when there are so many stores and competition is keen, the demand is stirred up in many ways. There are newspaper advertisements, special displays, bargain sales. Fashion itself, playing upon the vanity of men and women, helps greatly to increase the demand.

The ways of fashion are often quite remarkable. The discovery of a tomb in Egypt plunges the ladies of two continents into Egyptian ornament, fabric and style. A group of Russians appear in a successful play, and Russian styles become the talk of the town. War breaks out, and people wear clothes with military dash.

Sometimes a very large store adopts the practice of having resident buyers in the great fashion centers of the world, and these are able to obtain the newest things as they appear and to take advantage of any drop in prices or special purchases.

Though clothes are important, they form only a part of the department store's stock. Groceries, dairy products, house furnishings, toilet articles, radios, musical supplies, athletic equipment, silverware, china, art objects, perhaps even live pets—these are only a few of the numberless products that are on display. Each of these products is sold in its own department; and each department manager must have special knowledge about his goods. He must know where and when to buy, how to display his wares and how to increase the demand for them.

In many cases department stores buy their goods in the open market, that is, from the manufacturers or from wholesalers. The larger stores often make contracts with factories to manufacture certain articles especially for them; some stores have factories of their own.

Most modern department stores run a research bureau. In one department of this bureau, highly trained scientists—perhaps we might call them "industrial scientists"—are ready to cope with the problems and emergencies that every day brings. Perhaps a young buyer comes in with two samples of cloth which look alike, even to his practiced eye. It is up to the scientist to find out which of the two is the better purchase.

BACK TO SCHOOL!

Courtesy, Maison Blanche Company

Vacation's over. An attractive window display shows some of the school supplies this store has for sale.

An ingenious machine with a friction pad is brought into use. After a few seconds it is apparent which cloth, in the same time and exposed to the same friction, stands up better.

The store must make a choice between a number of refrigerators. Which is the buyer to recommend? A good housewife wants a refrigerator which will be sturdy enough to stand the strain of constant operation; one in which the ice cubes will freeze quickly and in which stronger smelling food will not spoil butter and milk. The "industrial scientist" gets to work on the problem, testing and comparing the refrigerators, and you may be sure that his recommendation will be followed.

Courtesy, Marshall Field & Co., Chicago

Interior displays do not always advertise the store's merchandise. Here, for example, is a visit to the zoo. Such a display serves to beautify the store and, also, to call attention to local affairs.

Customers who buy woolen goods want to be absolutely sure that they are all-wool. Beneath the microscope the fabric yields up its secrets. A ball of twine, after stretching to a certain length, will break at what pressure? A Swiss machine gives the answer. Often the research bureau is used in another way. Its scientists examine goods that come into the stock rooms, in order to make sure that they correspond to the description of them given in the order books.

Perhaps you have not thought it so very wonderful that your bottle of ink came home unbroken, or that your flowers arrived fresh. But remember that thousands of other parcels, fragile and perishable, precious or inexpensive, have gone out today in the city or district where you live. It is evident that the delivery system is quite important.

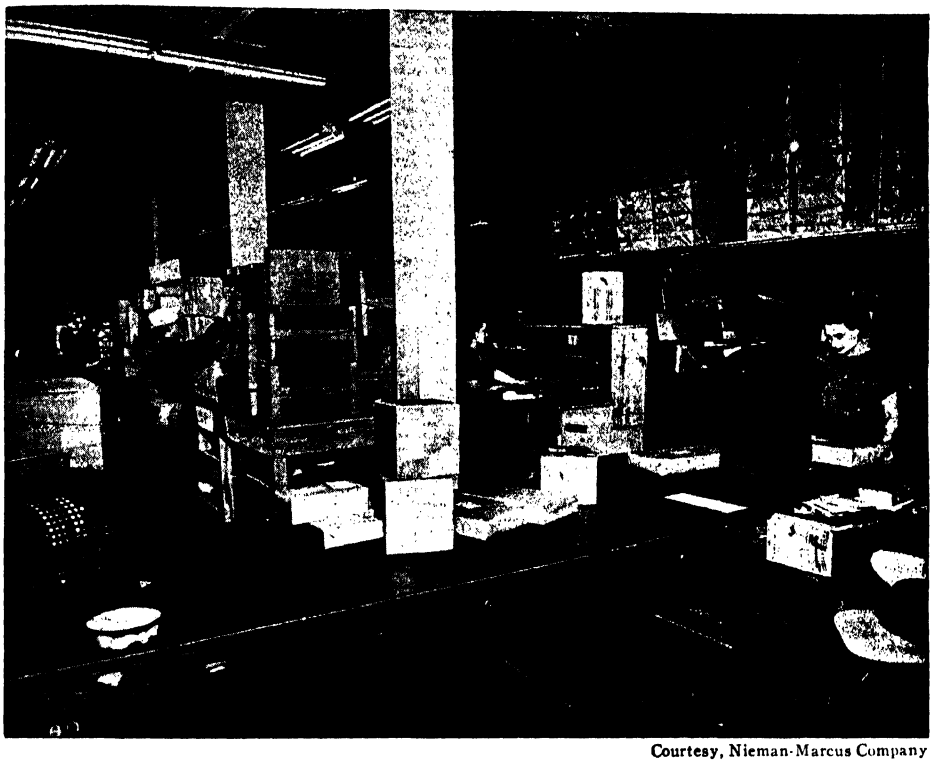
Some large stores have their own delivery service. Suppose we buy a boy's overcoat in one of these stores, and ask to have it sent to our home in the city. After it is wrapped, our parcel is dropped into a spiral chute which takes it to the basement. Here the various parcels are sorted. If our street is in the same part of town as the store, the parcel is loaded on a delivery truck which takes it to our house. If we live in an outlying section of the city, the parcel is loaded on a van together with other parcels bound for this part of town. If we live out of town our purchase may be mailed.

The van will take all these parcels to a delivery station near the place where we live. Here the parcels are routed by streets and sent off in a delivery truck. Each driver is responsible for the parcels in his truck after they have left the sorters. Any mistakes can thereby be traced directly back to the person who is to blame.

Generally heavy articles like furniture are kept in a special warehouse. Suppose we wish to buy a bed. We make a selection from the sample beds that are kept in the furniture department of the store. A duplicate of the bed that we have chosen is loaded on a truck at the special warehouse and is delivered to our house.

In some cities many large stores do not have their own delivery trucks but use a special package-delivery service. Thus in the borough of Manhattan, in New York City,

DELIVER IT, PLEASE!

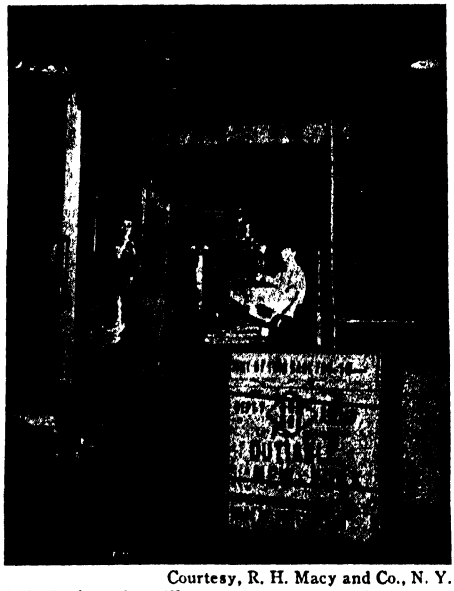


Courtesy, Nieman-Marcus Company

All merchandise that is to be delivered by truck or by mail must be very well packed to prevent costly breakage.

Courtesy, R. H. Macy and Co., N. Y.

After the parcels have been wrapped, they slide down a chute, to be sorted out according to delivery areas.



Courtesy, R. H. Macy and Co., N. Y.

A fleet of trucks will carry the packages all over the city. Deliveries outside the city may be made by mail.

the United Parcel Service delivers goods for all the large department stores with the exception of R. H. Macy and Company.

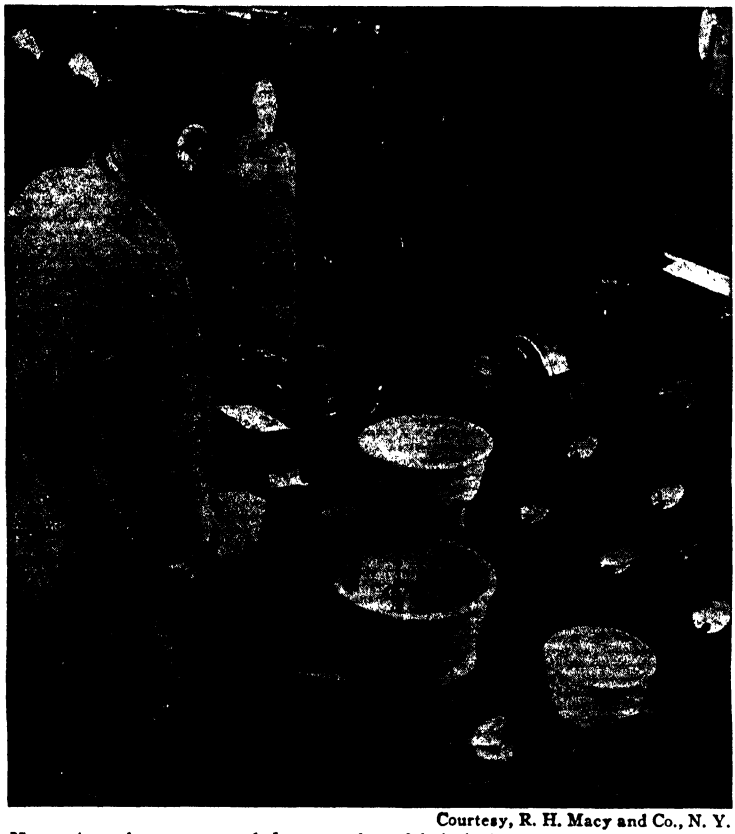
The mail-order service is an important part of the activities of many department stores. These stores issue a catalog, usually in the spring and fall of the year. Customers buy by mail, from the catalogs. When people who live outside the regular delivery area order goods, the packages are delivered by one of the express companies or the post-office department.

Busy housewives, who know that they can rely on the quality of the merchandise in department stores, often use the telephone in ordering goods, instead of breaking up their day by going to town. The large stores have their own direct lines and exchanges. Boards containing lists of articles and their prices are set in full view of the operators. When the orders have been taken, they are sorted and routed to the proper departments.

In the groceries department a clerk will collect the articles called for in an order—cheese, flour, tea, soap and so on—and place them in a single package or carton; and this is sent by the conveyor belt to the routers for delivery.

There are many other ways in which a great store serves its customers. For people who shop in person there are lunchrooms, rest rooms, information bureaus and even beauty salons. Some stores even have offices where you may learn about concerts and theaters and may buy tickets for any that you wish to attend. The shopping service is of tremendous value to out-of-town customers. Trained shoppers will select and buy goods from your description; they will also make suggestions and supply information.

The standard of service given by a store depends, needless to say, upon the people who do the work—the employees. Good business men realize this and put forth every possible effort to train employees so that they will do their work effectively. Even a person with previous business experience must be given some special training when he begins work in a department store. Office workers generally receive most of their training in high schools and business schools; they need to learn only the special routines which a store finds best for itself. This can be done by working right in the office, under the supervision of experienced workers. Sales people are taught in special classrooms, where all their duties are made clear.



Courtesy, R. H. Macy and Co., N. Y.

Many stores have a research bureau, whose job it is to test various goods before they are offered for sale. The customer who buys an electric mixer like the one in picture can be sure that he will receive good value for his money

In practically all modern department stores employees work in healthful surroundings. Cases of illness or accident are looked after

BEHIND THE SCENES IN A DEPARTMENT STORE

In the busy alterations department men's clothing is tailored to fit the individual buyer.

Both pictures, courtesy, Nieman-Marcus Company

The gay and exciting gift wrappings which you have admired are often designed by the store's own artist.

OTHER STORE SERVICES

A hospital where both customers and employees who are ill may rest or be given emergency treatment.

Both pictures, courtesy, R. H. Macy and Co., N. Y.

After a morning of shopping, you will enjoy lunch in the store's gaily decorated tea room.

AN ISLE IN A FOREST OF TUBES

Courtesy, R. H. Macy and Co., N. Y.

From almost every sales counter in the store a pneumatic tube runs, to carry the customer's money to a central desk, and to carry back change, if there is any, with hardly ever an error.

in small, well-equipped hospitals. Often, too, a dentist is in attendance to give advice and treatment. Some stores conduct summer camps for their employees. Group insurance is available; so is an inexpensive hospitalization plan, which provides for payment of part or all of one's hospital expenses. Some of the larger stores arrange for pensions for their older employees when they retire.

visit is the refrigerating plant, where ice is manufactured for all the grocery, meat and dairy cold storage, and where ice cream is prepared for the lunchroom.

Little offices, tucked into odd corners of the upper floors, take care of parts of the business that you never would have thought of. The stock rooms, with piles of bales and boxes all neatly numbered and ticketed,

Courtesy, Nieman-Marcus Company

A great deal of merchandise is charged, or sold on the installment plan. Therefore, a large credit office is needed, where references are checked, accounts kept and monthly reminders sent out to credit customers.

A day spent in investigating the parts of a store building which the public does not usually see would be well spent. The large structure is like a beehive, its layers of cells humming with industry. As a rule, the offices of the store are at the top of the building, away from confusion and noise. Here are kept the accounts, records of purchases and sales and exchange transactions.

Not all the stock is bought by traveling or distant buyers. Sometimes "the mountain comes to Mahomet," and agents from other firms bring samples of their wares to the store. In small rooms on the office floors, resident buyers look over the goods and place their orders.

A place that you would probably like to

are dark and silent and suggest interesting mysteries.

The modern department store is equipped with every device that could possibly add to the convenience and comfort of employees and customers. Passenger elevators and escalators are in continuous movement. To hasten the making of change, carriers shoot through an intricate system of pneumatic tubes. The store has a filtering plant to furnish a constant supply of cooled and filtered water. An air-conditioning system makes shopping a delight. An automatic sprinkler system provides protection against fire. In short, the department store is worthy of the remarkable century in which we live.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 3909.

The Diamond Necklace

By GUY DE MAUPASSANT

SHE was one of those pretty, charming young ladies, born, as if through an error of destiny, into a family of clerks. She had no dowry, no hopes, no means of becoming known, appreciated, loved and married by a man either rich or distinguished; and she allowed herself to marry a petty clerk in the office of the Board of Education.

She was simple, not being able to adorn herself; for women belong to no caste, no race; their grace, their beauty, and their charm serving them in the place of birth and family. Their inborn finesse, their instinctive elegance, their suppleness of wit are their only aristocracy, making some daughters of the people the equal of great ladies.

She suffered incessantly, feeling herself born for all delicacies and luxuries. She suffered from the poverty of her apartment, the shabby walls, the worn chairs, and the faded stuffs. All these things, which another woman of her station would not have noticed, tortured and angered her. The sight of the little Breton, who made this humble home, awoke in her sad regrets and desperate dreams. She thought of quiet antechambers, with their Oriental hangings, lighted by high, bronze torches, and of the two great footmen in short trousers who sleep in the large armchairs, made sleepy by the heavy air from the heating apparatus. She thought of large drawing rooms, hung in old silks, of graceful pieces of furniture carrying bric-a-brac of inestimable value, and of the little perfumed coquettish apartments, made for five o'clock chats with most intimate friends, men known and sought after, whose attention all women envied and desired.

When she seated herself for dinner, before the round table where the tablecloth had been used three days, opposite her husband who uncovered the tureen with a delighted air, saying: "Oh! the good potpie! I know nothing better than that—" she would think of elegant dinners, of shining silver, of tapestries peopling the walls with ancient personages and rare birds in the midst of fairy forests; she thought of exquisite food served on marvelous dishes, of the whispered gallantries, listened to with the smile of the sphinx, while eating the rose-colored flesh of the trout or a chicken's wing.

She had neither frocks nor jewels, nothing. And she loved only those things. She felt that she was made for them. She had such a desire to please, to be sought after, to be clever, and courted.

She had a rich friend, a schoolmate at the convent, whom she did not like to visit, she suffered so much when she returned. And she wept for whole days from chagrin, from regret, from despair, and disappointment.

* * *

One evening her husband returned elated bearing in his hand a large envelope.

"Here," he said, "here is something for you."

She quickly tore open the wrapper and drew out a printed card on which were inscribed these words:

"The Minister of Public Instruction and Madame George Ramponneau ask the honor of M. and Mme. Loisel's company Monday evening, January 18, at the Minister's residence."

Instead of being delighted, as her husband had hoped, she threw the invitation upon the table murmuring:

"What do you suppose I want with that?"

"But, my dear, I thought it would make you happy. You never go out, and this is an occasion, and a fine one! I had a great deal of trouble to get it. Everybody wishes one, and it is very select; not many are given to employees. You will see the whole official world."

She looked at him with an irritated eye and declared impatiently:

"What do you suppose I have to wear to such a thing as that?"

He had not thought of that; he stammered:

"Why, the dress you wear when we go to the theatre. It seems very pretty to me—"

He was silent, stupefied, in dismay, at the sight of his wife weeping. Two great tears fell slowly from the corners of his eyes toward the corners of his mouth; he stammered:

"What is the matter? What is the matter?"

By a violent effort, she controlled her vexation and responded in a calm voice, wiping her moist cheeks:

"Nothing. Only I have no dress and consequently I cannot go to this affair. Give your card to some colleague whose wife is better fitted out than I."

He was grieved, but answered:

"Let us see, Matilda. How much would a suitable costume cost, something that would serve for other occasions, something very simple?"

She reflected for some seconds, making estimates and thinking of a sum that she could ask for without bringing with it an immediate refusal and a frightened exclamation from the economical clerk.

Finally she said, in a hesitating voice:

"I cannot tell exactly, but it seems to me that four hundred francs ought to cover it."

He turned a little pale, for he had saved just this sum to buy a gun that he might be able to join some hunting parties the next summer, on the plains at Nanterre, with some friends who went to shoot larks up there on Sunday. Nevertheless, he answered:

"Very well. I will give you four hundred francs."

* * *

The day of the ball approached and Mme. Loisel seemed sad, disturbed, anxious. Nevertheless, her dress was nearly ready. Her husband said to her one evening:

"What is the matter? You have acted strangely for two or three days."

And she responded: "I am vexed not to have a jewel, not one stone, nothing to adorn myself with. I shall have such a poverty-laden look. I would prefer not to go to this party."

He replied: "You can wear some natural flowers. At this season they look very *chic*. For ten francs you can have two or three magnificent roses."

She was not convinced. "No," she replied, "there is nothing more humiliating than to have a shabby air in the midst of rich women."

Then her husband cried out: "How stupid we are! Go and find your friend Mme. Forestier and ask her to lend you her jewels. You are well enough acquainted with her to do this."

She uttered a cry of joy: "It is true!" she said. "I had not thought of that."

The next day she took herself to her friend's house and related her story of distress. Mme. Forestier went to her closet, took out a large jewel-case, opened it, and said: "Choose, my dear."

She saw at first some bracelets, then a collar of pearls, then a Venetian cross of gold and jewels and of admirable workmanship. She tried the jewels before the glass, hesitated, but could neither decide to take them nor leave them. Then she asked:

"Have you nothing more?"

"Why, yes. Look for yourself. I do not know what will please you."

Suddenly she discovered, in a black satin box, a superb necklace of diamonds, and her heart beat fast with an immoderate desire. Her hands trembled as she took them up. She placed them about her throat against her dress, and remained in ecstasy before them. Then she asked, in a hesitating voice, full of anxiety:

"Could you lend me this? Only this?"

"Why, yes, certainly."

She fell upon the neck of her friend, embraced her with passion, then went away with her treasure.

* * *

The day of the ball arrived. Mme. Loisel was a great success. She was the prettiest of all, elegant, gracious, smiling, and full of joy. All the men noticed her, asked her name, and wanted to be presented. All the members of the Cabinet wished to waltz with her. The Minister of Education paid her some attention.

She danced with enthusiasm, with passion, intoxicated with pleasure, thinking of nothing, in the triumph of her beauty, in the glory of her success, in a kind of cloud of happiness that came of all this homage, and all this admiration, and this victory so complete and sweet to the heart of woman.

She went home toward four o'clock in the morning. Her husband had been half asleep in one of the little salons since midnight, with three other gentlemen whose wives were enjoying themselves very much.

He threw around her shoulders the wraps they had carried, modest garments of everyday wear, whose poverty clashed with the elegance of the ball costume. She felt this and wished to hurry away in order not to be noticed by the other women who were wrapping themselves in rich furs.

Loisel retained her: "Wait," said he. "You will catch cold out there. I am going to call a cab."

But she would not listen and descended the steps rapidly. When they were in the street, they found no carriage; and they began to seek for one.

They walked along toward the Seine, hopeless and shivering. Finally they found on the dock one of those old, nocturnal *coupés* that one sees in Paris after nightfall, as if they were ashamed of their misery by day.

It took them as far as their door in Martyr Street, and they went wearily up to their apartment. It was all over for her. And on his part, he remembered that he would have to be at the office by ten o'clock.

She removed the wraps from her shoulders before the glass, for a final view of herself in her glory. Suddenly she uttered a cry.

Her husband, already half undressed, asked: "What is the matter?"

She turned toward him excitedly:

"I have—I have—I no longer have Mme. Forestier's necklace."

He arose in dismay: "What! How is that? It is not possible."

And they looked in the folds of the dress, in the folds of the mantle, in the pockets, everywhere. It was gone.

He asked: "You are sure you still had it when we left the house?"

"Yes, I felt it in the vestibule as we came out."

"But if you had lost it in the street, we should have heard it fall. It must be in the cab."

"Yes. It is probable. Did you take the number?"

"No. And you, did you notice what it was?"

"No."

They looked at each other utterly cast down. Finally, Loisel dressed himself again.

"I am going," said he, "over the track where we went on foot, to see if I can find it."

And he went. She remained in her evening gown, not having the force to go to bed, stretched upon a chair, without ambition or thoughts.

Toward seven o'clock her husband returned. He had found nothing.

He went to the police and to the cab offices, and put an advertisement in the newspapers, offering a reward; he did everything that afforded them a suspicion of hope.

She waited all day in a state of bewilderment before this frightful disaster. Loisel returned at evening with his face harrowed and pale; and had discovered nothing.

"It will be necessary," said he, "to write to your friend that you have broken the clasp of the necklace and that you will have it repaired. That will give us time to turn around."

She wrote as he dictated.

* * *

At the end of a week, they had lost all hope. And Loisel, older by five years, declared:

"We must take measures to replace this jewel."

The next day they took the box which had inclosed it to the jeweler whose name was on the inside. He consulted his books:

"It is not I, Madame," said he, "who sold this necklace; I only furnished the casket."

Then they went from jeweler to jeweler seeking a necklace like the other one, consulting their memories, and ill, both of them, with chagrin and anxiety.

In a shop of the Palais-Royal, they found a chaplet of diamonds which seemed to them exactly like the one they had lost. It was valued at forty thousand francs. They could get it for thirty-six thousand.

They begged the jeweler not to sell it for three days. And they made an arrangement by which they might return it for thirty-four thousand francs if they found the other one before the end of February.

Loisel possessed eighteen thousand francs which his father had left him. He borrowed the rest.

He borrowed it, asking for a thousand francs of one, five hundred of another, five louis of this one, and three louis of that one. He gave notes, made ruinous promises, took money of usurers and the whole race of lenders. He compromised his whole existence, in fact, risked his signature, without even knowing whether he could make it good or not, and, harassed by anxiety for the future, by the black misery which surrounded him, and by the prospect of all physical privations and moral torture, he went to get the new neck-

lace, depositing on the merchant's counter thirty-six thousand francs.

When Mme. Loisel took back the jewels to Mme. Forestier, the latter said to her in a frigid tone:

"You should have returned them to me sooner, for I might have needed them."

She did not open the jewel-box as her friend feared she would. If she should perceive the substitution, what would she think? What should she say? Would she take her for a robber?

* * *

Mme. Loisel now knew the horrible life of necessity. She did her part, however, completely, heroically. It was necessary to pay this frightful debt. She would pay it. They sent away the maid; they changed their lodgings; they rented some rooms under a mansard roof.

She learned the heavy cares of a household, the odious work of a kitchen. She washed the dishes, using her rosy nails upon the greasy pots and the bottoms of the stewpans. She washed the soiled linen, the chemises and dishcloths, which she hung on the line to dry; she took down the refuse to the street each morning and brought up the water, stopping at each landing to breathe. And, clothed like a woman of the people, she went to the grocer's, the butcher's, and the fruiterer's, with her basket on her arm, shopping, haggling to the last sou her miserable money.

Every month it was necessary to renew some notes, thus obtaining time, and to pay others.

The husband worked evenings, putting the books of some merchants in order, and nights he often did copying at five sous a page.

And this life lasted for ten years.

At the end of ten years, they had restored all, all, with interest of the usurer, and accumulated interest besides.

Mme. Loisel seemed old now. She had become a strong, hard woman, the crude woman of the poor household. Her hair badly dressed, her skirts awry, her hands red, she spoke in a loud tone, and washed the floors in large pails of water. But sometimes, when her husband was at the office, she would seat herself before the window and think of that evening party of former times, of that ball where she was so beautiful and so flattered.

How would it have been if she had not lost that necklace? Who knows? Who knows? How singular is life, and how full of changes! How small a thing will ruin or save one!

* * *

One Sunday, as she was taking a walk in the Champs-Elysées to rid herself of the cares of the week, she suddenly perceived a woman walking with a child. It was Mme. Forestier, still young, still pretty, still attractive. Mme. Loisel was affected. Should she speak to her? Yes, certainly. And now that she had paid, she would tell her all. Why not?

She approached her. "Good-morning, Jeanne."

Her friend did not recognize her and was astonished to be so familiarly addressed by this common person. She stammered:

"But, Madame—I do not know—you must be mistaken—"

"No, I am Matilda Loisel."

Her friend uttered a cry of astonishment: "Oh! my poor Matilda! How you have changed—"

"Yes, I have had some hard days since I saw you; and some miserable ones—and all because of you—"

"Because of me? How is that?"

"You recall the diamond necklace that you loaned me to wear to the Commissioner's ball?"

"Yes, very well."

"Well, I lost it."

"How is that, since you returned it to me?"

"I returned another to you exactly like it. And it has taken us ten years to pay for it. You can understand that it was not easy for us who have nothing. But it is finished and I am decently content."

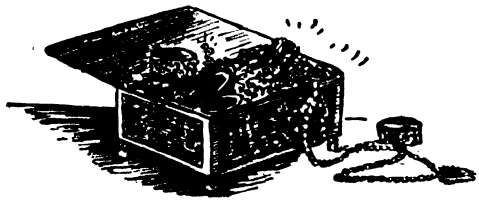
Madame Forestier stopped short. She said:

"You say that you bought a diamond necklace to replace mine?"

"Yes. You did not perceive it then? They were just alike."

And she smiled with a proud and simple joy. Madame Forestier was touched and took both her hands as she replied:

"Oh! my poor Matilda! Mine were false. They were not worth five hundred francs!"



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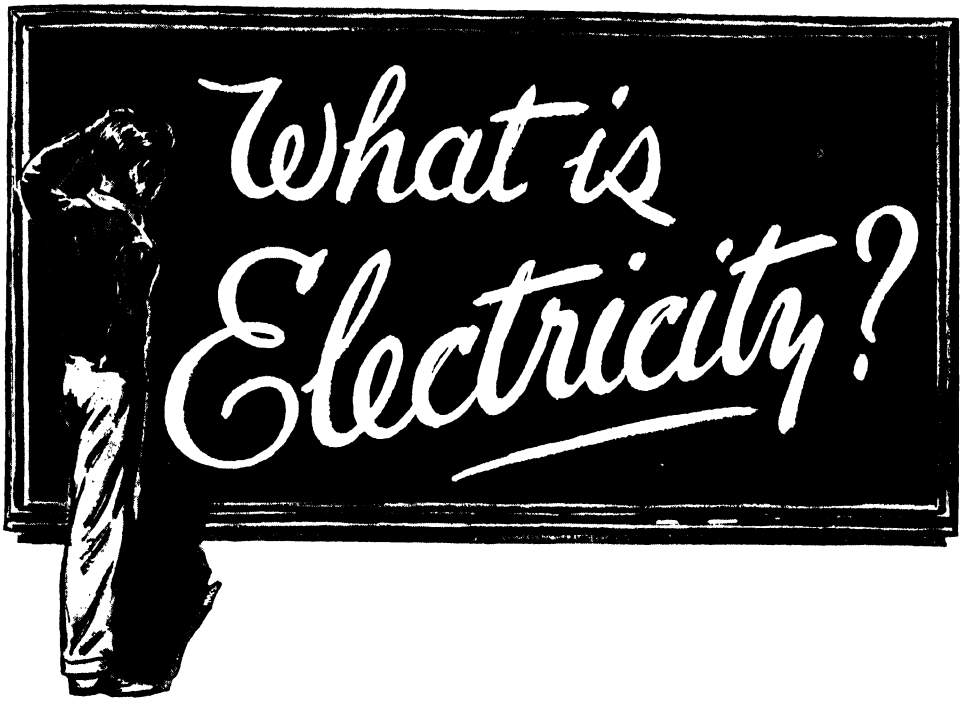


WHAT is electricity? Not very long ago the only answer would have been simply, "No one knows." Today, however, scientists feel sure that they have an answer to the problem. This answer came by piecing together information obtained from the laboratories of chemists and physicists the world over. It is called the electron theory.

The electron theory, in its modern form, is complicated, for, like other scientific theories, it must account for numerous experimental observations. The basic ideas of the theory we have already explained in the articles on Atoms and Molecules in Volumes One and Two. In this chapter it will be necessary to review briefly the points set forth in detail in those earlier basic articles.

The first step in solving the problem of the nature of electric current came from the chemist. Chemists have always been interested in finding out about materials of which the universe is made. From their years of experimentation they arrived at a very startling conclusion. They found that there are only ninety-odd simple substances, which, separately or in combination with one another, make our earth and everything in it. Scientists are also reasonably sure that these same ninety-odd substances, which have been given the name elements, are the building blocks of which the sun, the stars and even the whole universe is made.

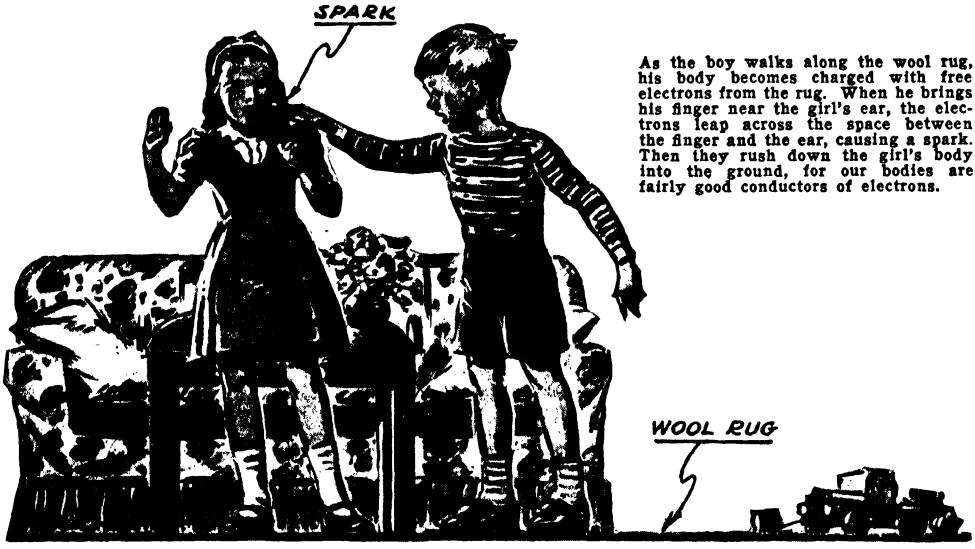
If we were to take a piece of chalk and break it in half we would have two pieces of chalk. If we continue to break the chalk into smaller and smaller pieces, how far could we go and still have chalk? Scientists tell us that we can reach a stage in which we have a single particle of chalk. If we break this particle, we no longer have chalk. The smallest particle of chalk is called a molecule of chalk.

When the chalk molecule is broken we find that it is composed of smaller particles of calcium, carbon and oxygen. By the ordinary means employed by chemists, calcium, carbon and oxygen can not be broken into simpler substances. Calcium, carbon and oxygen are the elements of which chalk is composed. Such a combination of elements is called a compound. Chalk is a compound. The smallest particle of a compound is a molecule; the smallest particle of an element is an atom. A molecule is made up of one or more atoms.

Are atoms of the elements the very smallest particles of matter? Or can atoms be broken into bits? If so, what are the bits like? These questions the physicists undertook to answer. By using very special means they

discovered that atoms were made up of still smaller particles—the subatomic (smaller than atom) particles. In this article we shall deal only with the ones called electrons and protons. We find them in all the ninety-odd chemical elements, from the lightest to the heaviest. Electrons and protons are almost incredibly small particles of matter, so small it is hard for us to think of them as matter at all. Electrons are

What keeps the moving electron whirling around the nucleus? Scientists say that there is a mysterious attraction between proton and electron which is one of the basic facts of our universe. Though men do not know the source of the attraction, the electron theory does account for the way in which it works. We have found that electrons are attracted by protons; but electrons are repelled by other electrons, and protons are



As the boy walks along the wool rug, his body becomes charged with free electrons from the rug. When he brings his finger near the girl's ear, the electrons leap across the space between the finger and the ear, causing a spark. Then they rush down the girl's body into the ground, for our bodies are fairly good conductors of electrons.

thought to whirl about the nucleus, or heavier central portions of atoms. The nucleus is made of much heavier bits of matter, called protons, plus other particles which we need not discuss now. Thus the atom is pictured as consisting of a central nucleus together with one or more electrons whirling about it, in regular paths, or orbits. Most of the space occupied by the atom is empty, just as most of the space occupied by our solar system is empty.

Now all electrons are alike, regardless of the atoms from which they come; they are also much lighter than the protons. The proton is about 1,840 or 1,850 times heavier than the electron, hence, almost all of the weight of an atom is in the nucleus.

The number of electrons surrounding the nucleus of the atom varies with each type of atom. Hydrogen is the simplest atom of all. It has one proton as its nucleus and one "planet electron." The other elements have 2, 3, 4, and so on up. Man has made elements in the laboratory with more than 92 electrons and 92 protons.

repelled by other protons. We say protons have a "plus charge" and electrons have a "minus charge." The minus charge of an electron is as large as the plus charge of a proton. Thus the hydrogen atom, with one electron (minus) and one proton (plus) possesses no net charge; it is neutral. The minus charge is usually called negative; the plus charge is usually called positive.

Every atom is neutral. Every atom has an equal number of plus (or positive) and minus (or negative) charges. That means that every atom has an equal number of protons and electrons. If by some accident an atom should lose one of its electrons, the nucleus would make every effort to attract another to fill up the vacancy.

The key to understanding the nature of electricity lies in the discovery that by the use of energy electrons can be set free from the atom. It does not matter whether a substance is an element or a compound, energy can set free electrons from the atoms of that substance. Protons can not be set free from an atom by ordinary means.

Heat, for example, will dislodge electrons. It was Thomas Edison who discovered that when the filament (wire) of an electric-light bulb is heated so that it gives out light it throws off charged particles of itself. These particles were found to have a negative charge and were later identified as electrons.

Light, another form of energy, can cause the removal of electrons from materials, particularly from certain metals. The electric eye puts to work these electrons which are knocked out of a metallic plate by the energy of light.

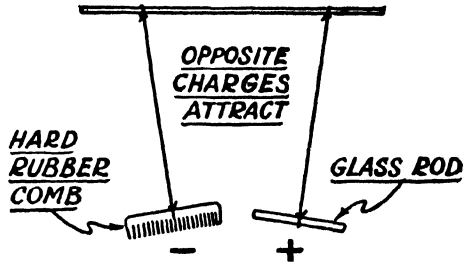
The energy supplied by friction in the process of rubbing can set free electrons from many atoms. The ancient Greeks were probably among the first to discover the effects of this rubbing, though, of course, they knew nothing of electrons or the electron theory. They used a material known as amber. Amber is the resinous sap which oozed from certain softwood trees which lived many thousands of years ago, and has hardened during the ages. Sometimes the amber shows the form of drops and icicles just as it came from the injured trees. Frequently leaves, flowers and even insects are found imbedded in the amber.

The Greeks highly esteemed amber for its use in ornamental objects and jewelry. They could scarcely fail to notice that if amber were rubbed with wool, cloth or fur, it had the power of attracting to itself small pieces of lint and hair. The amber picks up electrons from the fur, and thus becomes negatively charged. As such it attracts the positive protons of the lint, pulling the two things together. We get the word electricity from the Greek word for amber, *elektron*.

A NUMBER OF SUBSTANCES BESIDES AMBER MAY BE ELECTRIFIED BY RUBBING

Amber is not the only substance which may be electrified. You can observe this for yourself by rubbing a hard-rubber comb, or fountain pen, or an inflated balloon on your coat sleeve. After the rubber is rubbed it will pick up small pieces of paper. Hard rubber, glass, mica, paraffin, shellac, sealing wax and sulphur are among the most easily electrified substances.

If you have two hard-rubber combs try this experiment. Tie a silk thread around the middle of one comb and hang the comb from some support. "Charge" the comb by rubbing it with a piece of wool or fur. Be careful not to touch the comb with your hands after electrifying it. Now charge the other comb and bring it near the suspended



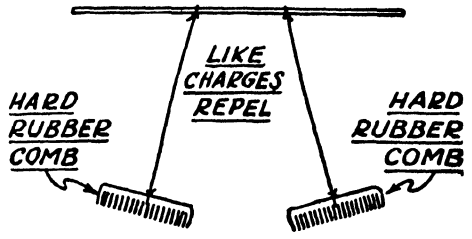
The hard rubber comb, with an excess of electrons, attracts the glass rod, which has lost electrons.

comb. Note how the suspended comb spins away from the similarly charged one held in your hand. From this experiment we see that two charged hard-rubber objects repel each other. If you can get a small glass rod, charge it by rubbing it with silk. Bring this rod near the suspended charged rubber comb. The glass rod and the hard rubber seem to attract each other.

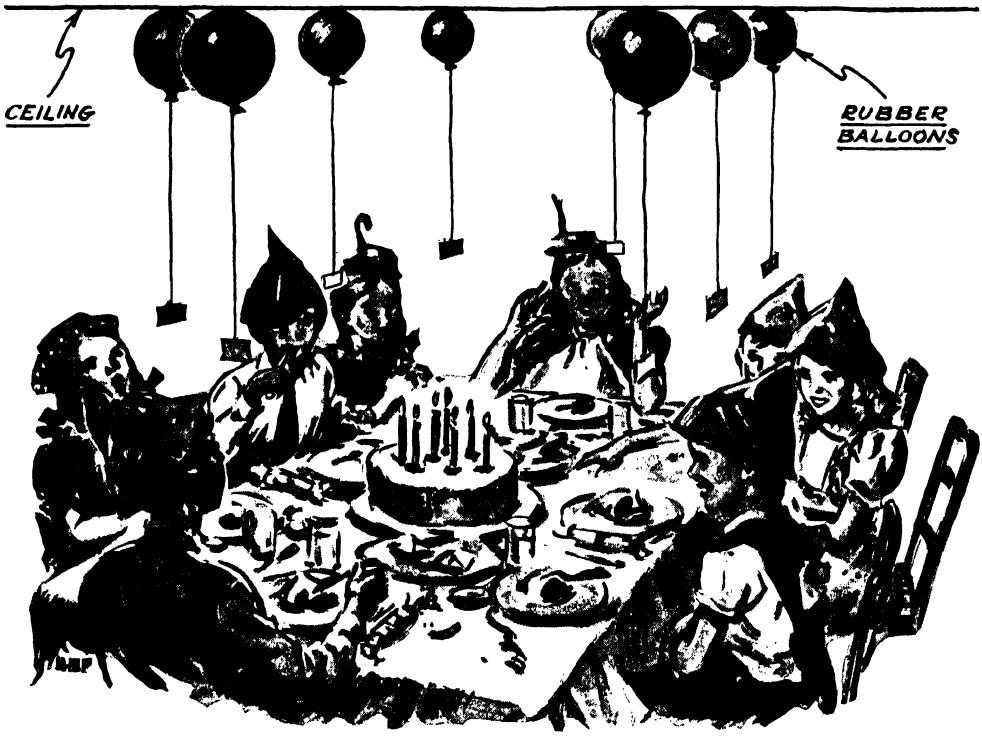
Many other charged substances may be tried. For example, sealing wax rubbed with flannel will be repelled by hard rubber rubbed with fur, while a stick of sulphur rubbed with cotton will attract a charged rubber rod.

Early experimenters in the field of electricity came to the conclusion that there are two kinds of electricity. These were called resinous (hard rubber) and vitreous (glass) electricity. Benjamin Franklin, however, suggested that there was only one kind of electricity and not two, and that the charge on an object was due to either an excess or a lack of this electricity. This was a very shrewd guess on the part of a man who had never heard of electrons.

The electron theory can help us to explain what is meant by an electric charge. An uncharged rubber rod has within its atoms just as many electrons as protons, just as many negative as positive charges. This,



Each of these hard rubber combs has an excess of electrons, and therefore the combs repel each other.



The balloons have been rubbed with flannel and therefore have an excess of negatively charged electrons. These electrons are attracted to the positively charged protons of the ceiling; therefore the balloons remain aloft.

we must remember, is due to the fact that the atoms which make up the rubber rod have an equal number of protons and electrons within them. The entire rod is, therefore, neutral.

WHY A RUBBER ROD CAN BE CHARGED NEGATIVELY AND A GLASS ROD POSITIVELY

What happens when the rod is rubbed with wool? The energy of the rubbing rips some loosely held electrons from the atoms of the wool and deposits them on the hard-rubber rod. The rubber rod now has more electrons than protons; it has an excess of negatively charged electrons. We say that the rod is charged negatively.

Glass rubbed with silk loses electrons to the silk, hence the glass becomes positively charged, since it is left with more protons than electrons. Remember, however, that in the process the silk has taken on a negative charge.

We say, then, that a positively charged body is one which has lost electrons; and a negatively charged body is one which has gained electrons. A body which contains an equal number of positive and negative charges is said to be neutral. Experiment has shown that like charges repel each other and that unlike charges attract each other. Since all electrons possess the same negative charge, they must repel one another. As we said before, this is found to be quite true.

When electrons are deposited on some materials they quickly distribute themselves so as to be as far from one another as possible. To do this they move in and out among the atoms of the material. These electrons, no longer belonging to any atoms, are called free electrons. In certain other materials the free electrons can not move very much through the substance; they remain at about the same point on the material at which they were deposited, in spite of the force which is trying to move them away from one another. Substances which allow electrons to pass through them are called conductors. The best conductors are metals; silver is the best; copper is a close second. Substances which do not allow the passage of electrons through them are called insulators. Hard rubber, mica, porcelain and

glass are some examples of good insulators.

Charge a rubber rod or comb and hold it in your hand. The rubber holds the charge because the electrons deposited on the rod can not move. Bring the rod close to your ear. Do you hear the crackling of electric sparks? This is what has happened. In the process of charging, many, many electrons were piled onto the rubber rod. Each electron repelled its neighbor, but since they were all on an insulator they could not move apart. When the rod was brought near your ear, the electrons on the rod nearest your ear jumped across the space to your ear and rushed down through your body into the ground. Your body is a fairly good conductor of electrons. Once in the ground, the electrons are able to move far away from one another.

This experiment illustrates a very important point. Electrons tend to move from where they are in excess, to places in which they can spread out. They particularly prefer to flow to places where electrons are lacking.

A flow of electrons can be made to do work. As electrons move from places where they are in excess to places in which they are lacking, electrical devices of many different types can capture some of their energy. *An electric current, then, is nothing more than a stream of electrons moving through a conductor.*

The momentary flow of electrons, which make the spark from a charged rubber rod, can not accomplish very much useful work. Within a fraction of a second the excess electrons are lost from the rod and the rod becomes neutral. If by some means we can replace electrons on the negatively charged rod as fast as they are lost, we have a steady flow of electricity. There are several devices which can do just that. We call these devices sources of electric current.

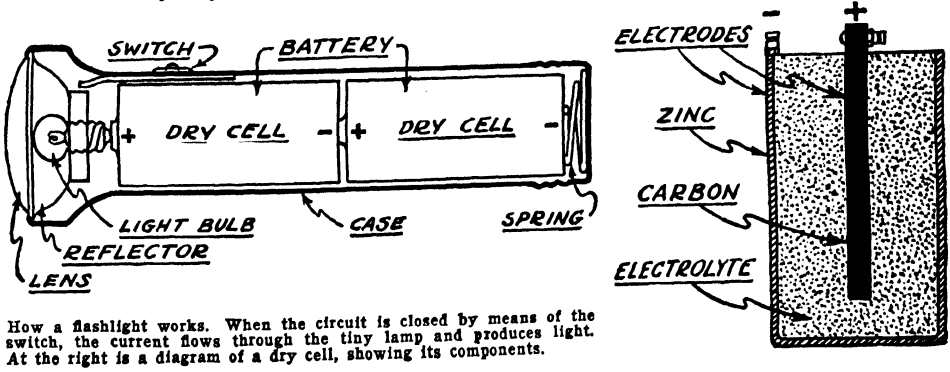
The ordinary dry cell creates a steady flow of electrons by chemical action. There are two terminals, or connecting points, in a dry cell. One connects to a rod of carbon, the other to a plate of zinc. Chemical reactions within the cell cause electrons to be deposited on the zinc plate. The zinc, having an excess of electrons, therefore becomes negatively charged. When a copper wire or other conductor is connected between the zinc and the carbon rod, electrons leave the zinc and flow to the carbon. As rapidly as the electrons arrive at the carbon rod they are removed and transferred back to the zinc plate. The zinc gradually becomes eaten up in this process, but as long as there is zinc left in the cell an electric current will flow. (In other words, the electrons will keep traveling around the circuit.) The zinc terminal of a dry cell is referred to as the negative terminal, while the carbon terminal is called the positive.

IN A BATTERY, CELLS CONNECTED IN SERIES BUILD UP INCREASED CURRENT

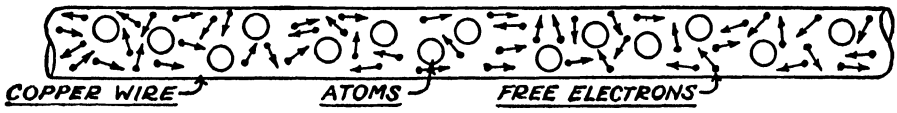
A battery is a number of cells connected "in series," in such a way that current flows from one to another and increased current is built up. Several types of cells and batteries can be made using materials other than carbon and zinc. In each case, however, two unlike metals are used, and in the process of producing an electric current one of them, always the negative, becomes eaten away.

Storage batteries work in a manner very similar to that of ordinary batteries, excepting that when they run down they can be restored, or recharged with electrons, by sending an electric current into the battery.

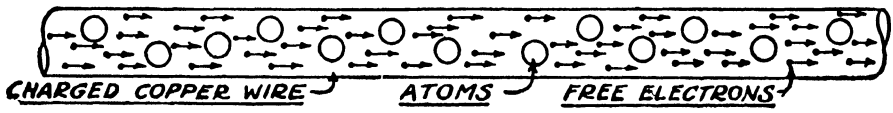
If we had to depend solely on chemical action to produce our electricity its cost would be many times greater and its use far more limited than it is today. Mankind owes a debt of gratitude to Michael Faraday for



How a flashlight works. When the circuit is closed by means of the switch, the current flows through the tiny lamp and produces light. At the right is a diagram of a dry cell, showing its components.



The copper wire shown above has not been charged. The free electrons are drifting aimlessly in all directions.



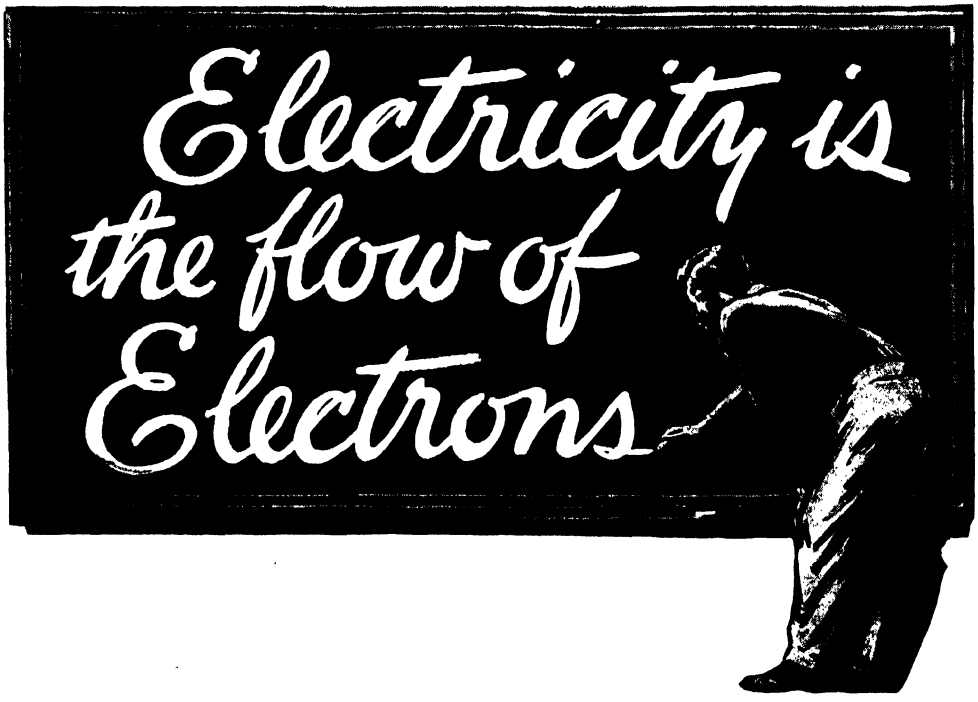
The wire is now charged. The electrons push their way from where they are in excess to where they are lacking.

his discovery of a way of producing an electric current by a means other than chemical action. Faraday discovered that electrons are made to move through a wire if the wire is moved across the field of a magnet. The electric generators which provide us with light, heat and power operate on this principle. Steam or water power is used to turn huge coils of wire in strong magnetic fields. Thus, electrons are removed from one wire and pumped into another. When we connect our electrical appliances between these two wires, the electrons push their way from where they are in excess to where they are lacking. In the mad scramble to move from the negative wire to the positive, the flow of electrons lights our homes, hauls freight over mountains, flashes messages across oceans and even toasts bread.

Science has answered the question of what electricity is, or more correctly, what electric current is. It is a flow of electrons. Of course, no one has ever seen an electron; probably no one ever will. In spite of this, however, scientists are reasonably sure of the truth of the electron theory. Each time new facts come to light, modifications of the theory may become necessary; but the electron theory accounts fairly well for facts known up to this time.

By THEODORE BENJAMIN.

THE NEXT STORY OF SCIENCE IS ON PAGE 4033.



SPORTS IN CANADA

SPORTS-LOVING Canadians are lucky; for, in Canada, every season is ideal for some special outdoor activity. The summers are warm and full of sunlight, but not too hot for exercise. In the winter the cold is dry and bracing; the snow on hill and meadow is deep and crisp; and the ice in lake and pond is smooth and firm. It is hard for a healthy boy or girl—or grown-up person—to stay indoors when all the winter world is calling with such sparkling invitation. Even in city and town the ice games can be enjoyed. Curling, hockey and ice skating go on in thousands of city rinks, both indoors and out.

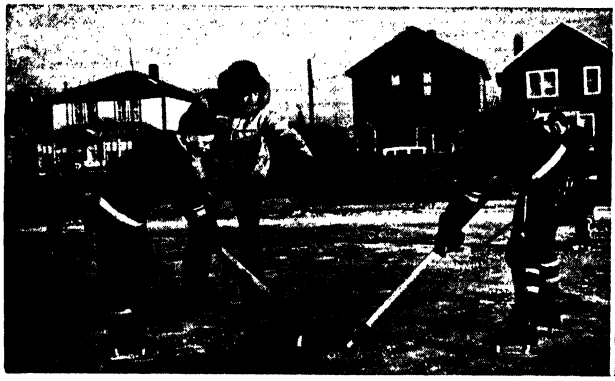
Ice hockey is the most famous of organized winter sports. One way or another it has been played for hundreds of years in Europe; but nowadays we think of it as especially belonging to the Canadians, perhaps because they have produced so many and such great players. It was in 1879 that it was started as an organized game in Canada. In that year the Victoria Club in Montreal played McGill University, and the Royal Military College in Kingston played Queen's University. These contests must have been even more exciting than our present-day matches, because fresh rules were made up before each game. If you would like to know how hockey is played today, look in the Index (Volume 20) for the word Hockey.

For about thirty years hockey flourished as a strictly amateur game, with many teams competing for the Stanley Cup. In 1908, however, professional hockey with paid players began, and soon afterward the Stanley Cup became the professional trophy. Another trophy, the Allan Cup, became the emblem of championship among Canadian amateurs. Canadians have won world amateur championship games played in Switzerland. Many professional hockey players in the United States are Canadian.

Besides the organized professional and

National Film Board

Young Canadians listen intently as a coach shows them how a guard may block a toss in a basketball game.



National Film Board Seigniory Club in the Province of Quebec

Winter play on ice—it may mean the clash of hockey sticks, or "sooping" brooms in a game of curling.

amateur-league hockey games, there are many university, collegiate, high-school and town teams. Some universities have all-girl teams.

Of course, a hockey player has to be a good skater: good enough to be able to dash about on the ice, and turn and twist on the flashing blades as naturally as if he were walking. Most Canadians learn to skate when they are small children, just because it is such good fun, and many develop into really outstanding skaters. Each year contests are held for the figure-skating championships; and the winners of these have often taken the North American championships.

Up to 1947 the queen of all Canadian figure skaters was Barbara Ann Scott of Ottawa. In 1940, at the age of eleven, she won the Canadian Junior Championship, and four years later the Canadian Senior Championship. In 1945 she retained the senior championship and also won the North American Senior Championship, which is held every two years. Again, in 1946, she defended and kept the Canadian senior title; and in 1947 she went to Europe. There she won the European Figure Skating Championship and the World Championship.

The number of games that can be played on skates is amazing. Among the most popular are badminton and broomball. Ice-canoe races are fun and can be quite exciting. An ice canoe is really a toboggan. The canoeist stands on it and drives it swiftly over the ice with a spiked pole.

Snowshoes and skis are ancient means of traveling over the snow, but in our time more people use them for sport than for practical reasons. Skiing was brought to Canada from Europe in the eighteenth century, but it was not until after World War I that it became a really popular winter sport. Now there are hundreds of thousands of skiers in Canada, and the Canadian Amateur Ski Association (founded in 1920) has more than a hundred clubs.

Skiing is a wonderfully thrilling sport. It makes your blood tingle. Each winter, in the rolling Laurentian country north of Montreal and in the Canadian Rockies, the skiers gather. Banff National Park in Alberta and Jasper National Park in British Columbia are famous winter playgrounds. The Banff winter sports festival is among the finest in the world. What is called low-country skiing may be enjoyed at an altitude of 5,000 feet, and for people who like to go higher, high-country skiing can be done at 7,000 feet, just above the timber line. The Alpine Club of Canada, originally formed for mountain climbers, has done much to interest people in ski-mountaineering.

Skis are best for open country; they can not be used in forest land. Snowshoes are best for that. These curious, web-like things were used by the Indians and the French fur trappers in the snow-covered forests of Canada from early times. Snowshoeing is not so swift as skiing, but it has an appeal of its own. There are few things more enjoyable than a long snowshoe hike through the woods and over the fields, especially when it ends with steaks sizzling over an open fire and the long tramp home in the moonlight.

From Scotland, early in the nineteenth century, came the ancient game of curling. Today it is one of the most popular of Canadian winter sports. There are curling clubs in almost every city, and both indoor and outdoor rinks. There you may see the players, four to a rink, or side, sending the

heavy curling-stones sliding along the ice to their opponents' "house" at the other end of the rink. Curling-stones are usually made of polished granite, and they have a curious, hook-like handle for the player to grasp when he swings the stone. As the stone slides along the smooth ice, the player moves in front of it "sooping" or sweeping the ice with a broom so that no little bits of ice dust may interfere with its course.

Curling requires strength of muscle, a cool head and a keen eye. It is a game of skill, and there are a number of championship trophies for which the curling clubs compete every year. The most famous are the Dominion Brier, British Consuls and International Goodwill.

There is not a great deal of bobsledding in Canada, but most cities have toboggan slides. Along the lower Ottawa River near Montreal there is a great deal of iceboating, and here and there, on frozen lakes and streams throughout the country, you may see the sail of an iceboat. Some of them are smart, expensive-looking boats; others are quite simple, home-made affairs; but all of them give swift, thrilling sport.

There are, of course, a large number and variety of indoor games carried on during the winter months, especially basketball, badminton, squash, handball and volley ball. Fencing is popular at the universities, and a number of wrestling and boxing tournaments are organized each season by physical education groups.

SUMMERTIME—AND LAKES, STREAMS AND SEASHORE BECKON

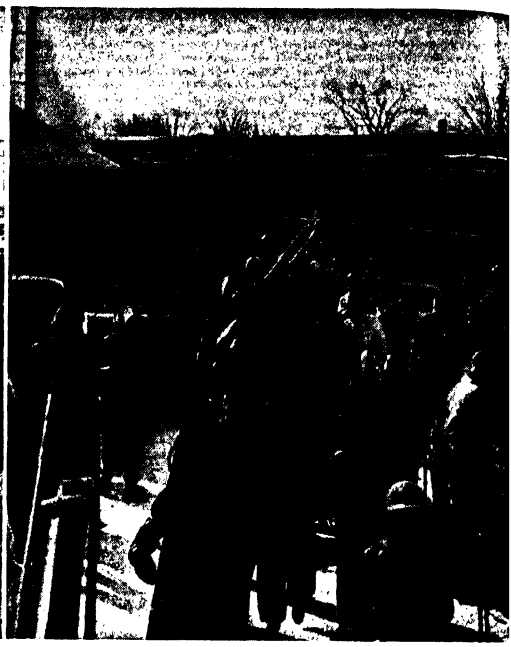
So much for winter sports. The clear, sparkling air of the long, sunny days of a Canadian summer seem to beckon you outdoors. There is a wide choice of things to do. There are group games, individual competitions, racing sports. In addition, the hundreds of lakes and streams and the two seacoasts of the Dominion give Canadians a wonderful opportunity for all kinds of water sports.

Of organized games, lacrosse is the oldest. It was originally an Indian game, and was called baggataway. You may remember from your history books that the great Indian chief Pontiac had his followers start a game of lacrosse near the entrance gates of Fort Detroit. The soldiers in the fort became so interested in the game, as Pontiac had thought they would, that they almost got caught when, at a signal from the players, the Indian warriors near by rushed the fort.

Canadian Pacific Railway Co.

Lake Timiskaming, on the upper reaches of the Ottawa River, is a paradise for sportsmen. The surrounding forests teem with game; and the lake abounds in fish which test the skill and patience of the fishermen. This angler is proud of his big catch.

Down, down, past the Chateau Frontenac, Quebec City.



Specially equipped "ski trains" carry fans from Montreal

Lacrosse is played by a number of professional teams today, especially in Quebec. The Quebec Lacrosse Association is also very active in the schools of that province.

Rugby football and baseball are played all over the country, in schools, by small boys in vacant lots, and by professional teams. Soccer, or Association football, is also a popular game, though less so than Rugby.

There are a number of Canadian organizations that promote individual athletics. Among these are the British Empire Games Association of Canada, the Canadian Intercollegiate Athletic Union and the Canadian Police Amateur Athletic Association. These are groups of sports bodies that organize track and field meets for running, jumping, shot put, discus throwing, pole vaulting, and so on.

Golf is a favorite game, and there are literally thousands of golf links. Of course, most golfers play for recreation, but there are amateur and professional championship matches which attract many competitors. Tennis courts are everywhere, even in the small country towns, and the Canadian Lawn Tennis Association holds annual tournaments for the really serious players. Lawn bowling, or bowling on the green, is especially popular among people of all ages. This is the game that, tradition tells us, Sir Francis Drake was playing on Plymouth Hoe when the news came that the Spanish Armada was in sight. It is said that Drake finished his game before he went off to fight the Spanish fleet. This is not hard to believe if you have ever watched the single-minded absorption of the players in a bowling match.

This kind of bowling is rather like curling, but is played on a velvety green lawn, with large, wooden balls. The balls are not perfectly round, which makes the matter of a successful aim far from simple.

Archery is tremendously popular now, especially in Ontario, Alberta and British Columbia. In Ontario the Field and Hunt Archery Association even encourages hunting with bows and arrows. This takes even greater skill with the bow than does shooting at a target.

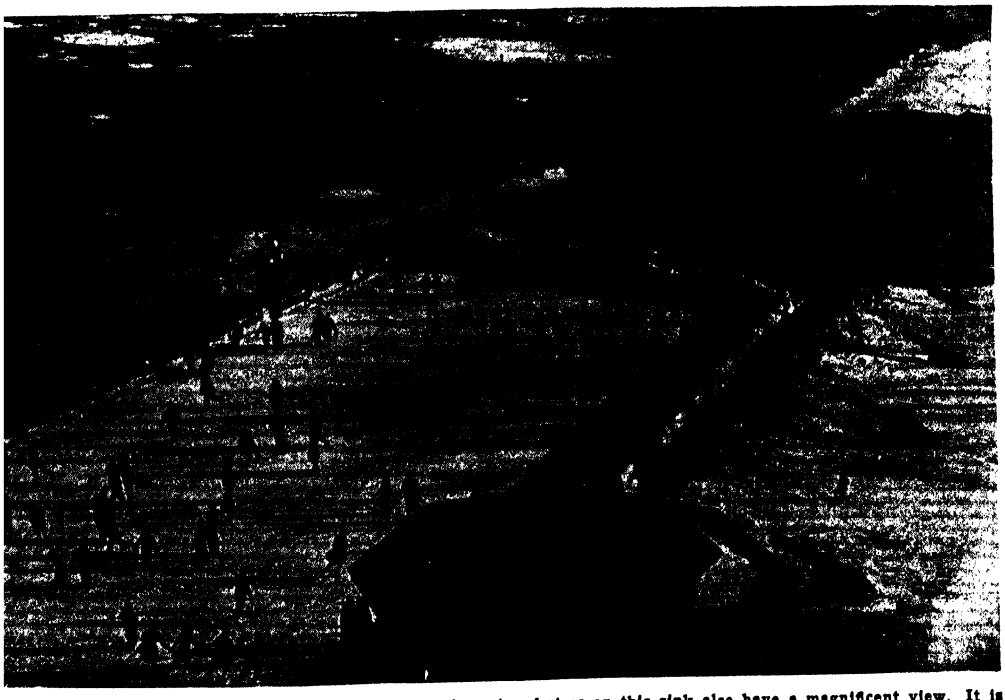
During the summer months the Dominion of Canada Rifle Association holds outdoor shoots. Winners of these contests have often placed high in the British Empire matches at Bisley in England.

Various kinds of racing are popular, especially cycle racing. Motorcyclists compete every year for the Lord Wakefield Trophy, and there are numberless local bicycle races. Neither automobile nor plane racing is

into the Laurentian Mountains.

All pictures, Canadian Pacific Railway

Zooming through the air in faultless style, at Banff, in the Canadian Rockies.



As they glide and circle in the most graceful of sports, skaters on this rink also have a magnificent view. It is just outside the Chateau Frontenac, Quebec, overlooking the shipping piers and the St. Lawrence River.

carried on, but after World War II a number of gliding clubs were formed.

Nearly every Canadian summer resort and water-front city has an annual regatta that features yacht races. Some of these are international, like those off Lake Huron's Manitoulin Island and those in Lake Ontario's Bay of Quinte.

Although horse racing, the "sport of kings," is not so popular in Canada as in the United States, Canada has the oldest established race on the North American continent and the oldest stake race—King's Plate. Since 1808 this mile race has been run at the Blue Bonnet track, Montreal.

In the 1890's polo was very popular, but it later went out of fashion. Although in colonial days riding to hounds (foxhunting on horseback) was carried on in areas settled by English immigrants, the sport never became common, and in a recent year there was only one foxhunting organization in the whole of Canada. It was near Toronto. Other animal sports are not liked by Canadians: there is no bullfighting, no cockfighting, and very little pigeon-racing. In western Canada, especially at Calgary, there are annual rodeos, with bucking bronchos, steers for bull-dogging, and chuckwagon races.

What most of us really like best are the individual sports provided by nature in Canada's great network of lakes and streams and her miles and miles of forests.

Everyone swims, and for those who have real skill there are championship meets sponsored by the Canadian Amateur Swimming Association. Some swimmers organize to play water polo and water-target ball. Rowing and sculling attract some athletes, and Edward Hanlan of Toronto held the world championship for four years. An annual rowing regatta is held by the Canadian Association of Amateur Oarsmen. Campcraft, canoeing and related sports draw enthusiasts to summer camps everywhere, and there is a great deal of motor boating for sport and pleasure.

Great areas of our land—in New Brunswick, northern Quebec and Ontario, the northern parts of the Prairie Provinces, the mountains of British Columbia—are still unspoiled wilderness. Here are forest lands laced with streams and jeweled with lakes. Game animals abound and there are more than fifty varieties of game fish. To such regions every summer tens of thousands of Canadians go to ride the mountain trails, to dip their paddles in the clear waters of the pine-fringed lakes, to lure the trout in the rushing mountain streams or to hunt the caribou and elk. There are many field and naturalist clubs and game and fish associations.

Each year finds more people engaged in one of the many healthful sports for which this great and varied land offers such wonderful facilities.

By CHARLES CLAY.

Canadian Pacific Railway

An arm of the French River, northern Ontario, one of the many Canadian waterways that lure the canoeist.

All pictures courtesy, The Art Gallery of Toronto

The Settler's Log Cabin, by Cornelius Krieghoff, is a vivid scene from pioneer life in Quebec.

PAINTING IN CANADA

THE painter of to-day plays a very different part in the world from the painter of two hundred or even one hundred years ago. Of all those now living in Canada, and there are some hundreds of them, only a handful, including portrait painters, earn their living by painting. The rest must gain their living by teaching art in schools, universities and art galleries, by working as designers in advertising agencies and commercial printing houses, or as illustrators for newspapers and magazines.

Under these conditions few painters can devote all their time to painting. This is one real difference between now and the old days when painters worked for the courts, the noblemen and the church. Then they hardly ever thought of starting to make a painting until they had been given an order to do so and told not only what to paint but where the picture was going to hang. On the other hand, hardly ever does the painter of to-day know where his picture is going to go. As a result, having no particular person in mind to satisfy, he paints what pleases him. A painter is first interested in shapes and colors, and so it is that many of to-day's pictures are landscapes and still-life paintings rather than pictures with people.

Let us compare a picture of the past century with a more modern one. Look first at The Settler's Log Cabin. It is by Cornelius Krieghoff (1815-1872) who was an immigrant to the United States from Germany. He found his way to Quebec, where he settled for many years. He enjoyed French-Canadian life and his pictures found a ready market among people in Quebec, as well as among the officers of the garrison there who took many of them home to England as a reminder of their life in Canada.

Now look at The West Wind by Tom Thomson, who was born in Ontario and died in 1917 at the age of 40. Thomson loved the woods and he earned his living by being a guide in the summer in the Georgian Bay and Lake district and in the winter by working as a designer in a publishing house in Toronto. Krieghoff's picture is painted as naturally as possible—his colors are mostly greens and browns, with blue sky and blue shadows upon the white snow. The picture is full of incidents and little happenings. (Sometimes Krieghoff painted minor accidents as part of his scenes.) The painter gives us a good idea of the cheerful and rollicking side of French-Canadian life. Even in this picture of a lonely cabin there is a very real cheerfulness and gaiety, and no hint of the hard and bitter work the *habitant*

had to do to earn his living. (A *habitant* is a French-Canadian settler in Quebec.) Krieghoff's paintings have but little interest in the majesty of the Quebec landscape with its old rounded hills, its sweeping rivers and wide forests, beyond their use as a setting for the courageous and happy people who lived there.

Thomson's picture has no people. It is all water, sky, rocks and trees, painted in blues, reds, purples and browns. It presents in a dramatic way the endless struggle of the trees on the coast of the Georgian Bay with their enemy, the West Wind. See how the tree is twisted and deformed, and yet each time it is beaten down by the wind it seems to rise again defiantly and to set its arms against the marching clouds and waves and to dig itself ever more firmly into the rocky ground from which it springs.

Bare rocks, ragged cloud masses, white-capped waves and a single storm-twisted tree show the power of the West Wind in Tom Thomson's painting.

Carl Schaefer, who lives in Toronto (he was born in Hanover, Ontario) feels something of that continual struggle, but in his case it is the struggle of the farmer of Ontario to make nature give him crops. In his picture, Farm near Carlsruhe, he paints the rolling hills with their barns and houses and poplar trees, with the straight roads and bush lots, the stacked grain in regular rows, and over it all the great sweep of sky carrying its constant burden of clouds, sometimes threatening, sometimes kindly, but always as part of the landscape. The rolling country and great cloudy sky are set in sharp contrast to the perky-looking houses and barns and the spidery lines of the fences.

Neither Thomson's nor Schaefer's pictures have the human interest and story-telling qualities of Krieghoff's. Instead, they present an arrangement of shapes and colors which speak to your mind without telling a story. Look at them for a few minutes. Do they not carry to you a clear impression about the scenes they show? Krieghoff, too, if you study his painting, uses careful arrangement. However, often his story is so interesting that we give it all our attention and do not notice how he has arranged shapes and colors for the purpose.

In this striking picture by Lawren Harris, called Country North of Lake Superior, we see the effective use of sharp, clean outlines and strongly contrasting color tones. Details are left out and forms are smoothed to give a streamlined effect.

Emily Carr, who lives in Vancouver, is a painter whose pictures carry a general impression rather than tell a story. The impression is a sort of thought-wave from her mind to yours. She became interested many years ago in the Indian tribes on the west coast and began to make drawings and paintings of their villages and totem poles. Later she began painting the great trees of the western forests. She paints these forests as strange, unending, shadowed spaces full of flickering lights, pale and glowing among the dark and aged tree trunks. These pictures do not look like any one place in the woods but seem to recall and bring again to poetic life on canvas, through her pale greens, purples and deep reds, that hushed, waiting secrecy of what writers call the "living forest." The trunks of the great trees with their over-hanging foliage make a sort of vast mysterious stage for the vigorous young saplings which seem bursting with life and thrusting eagerly upward to reach the sunlight far above.

Not all painters are concerned with landscape. Pegi Nicol, another woman painter, who comes from Ottawa, finds her subjects

In Farm Near Carlsruhe, Carl Schaefer paints the rolling Ontario farmlands with thin, precise brush-strokes.

in the streets. Painters, when they paint with people around them, are objects of curiosity, so Pegi Nicol does her pictures from a window or some other hiding place where she will be less interrupted. For her, people are queer, moving shapes which, as they move about, form patterns and lines, and because people so often look queer, especially if you look at them from above, her pictures have a slightly funny look. The people in them move like twisted colored shadows and, ragged as the pictures may seem, their tender colors, pale and watery (she generally paints in water color) have something of the charm of a bunch of wayside flowers.

How different this is from the strong note of Tom Thomson's picture and how much more different from Krieghoff's cheerful, happy *habitants* who seem to be people without any dreams!

Krieghoff came to Canada just at the time when the first great settlement after the Napoleonic wars was at its height and his interest and delight in the new and free but frugal life of old French Canada was shared by every newcomer. He was, however, by no means the first to make pictures describing this great new country. Many years before, soldiers and officers of the garrison were making and sending home just such pictures, and travelers with a talent for painting were doing the same. In fact, these painters did much to make Canada known to people in England, Ireland and Scotland.

One of these painters was George Heriot (1758?-1816), Postmaster General of Canada, who wrote and illustrated, in 1808, a book called Travels through the Canadas. There were many other men whose sketches, thousands of them, went home to England. Many drawings were reproduced in print form, some in black and white, some in color. They began to appear early in the 18th century and continued to be sold widely until about 1860 when cheap methods of reproduction, the invention of photography and new interests of the artists combined to bring their production to an end. Probably the greatest collection of these prints in Canada can be seen in the Manoir Richelieu at Murray Bay, Quebec, on the St. Lawrence. Another collection is in the Royal Ontario Museum in Toronto.

Paul Kane (1810-1871) was another traveler who wrote and painted. His work is less colorful than Krieghoff's or Heriot's. He was deeply interested in the strange variety of Indian tribes and customs. There is one thing that all three of these painters have in common—they are far more concerned with getting in their pictures a faithful copy or

John, by Frederick Varley, is a fresh, vivid portrait.

description of the people and scenes than in trying to pass on to us any hint of their feelings about them. As you look at Kane's Portrait of an Indian Chief, you feel: "Here is a strange sort of person." In fact, he is so strange that you have no idea what kind of savage he was.

By contrast, look at Frederick Varley's picture of John. There is nothing strange about John. You will find him on any playground. He will stop suddenly, as he goes racing by, look at you out of his shy eyes, pause a second, grin and then run on. This picture, all in soft greys, browns and greens, is not a description of John in detail. It is a sort of flashing impression of him, and its whole scheme of painting is designed for that purpose.

Frederick Varley was a member of a small group of men (some, like him, of English birth, some Canadians, all of whom had studied in Europe) who set out to paint the wild, untouched landscape of northern Ontario. They called themselves The Group of Seven and for several autumns, after 1918, they went north and, living in a box car, tramped far and wide, painting what they saw. Afterwards they went much wider afield, to the Rocky Mountains, to the Arctic, to the Canadian Prairies and to Quebec and the east coast.

There were, besides Varley, Lawren Harris, A. Y. Jackson, J. E. H. MacDonald (1873-1932), Arthur Lismer, L. L. Fitzgerald, A. J. Casson and Frank Carmichael and Edwin Holgate. Although they had a similarity of aim they arrived at very different results.

Harris' picture, Country North of Lake Superior, is, for instance, very different from Jackson's Early Spring, Quebec. Harris' aim is to simplify, to reduce all the various haphazard details of a hilly forest landscape to its natural order of rounded hills, trunks of burnt trees, and wide water and sky.

Jackson has always been sensitive to the translucent variety of local color in combination with the underlying structure of the landscape, the folding hills, slow and rhythmic and eternal, in contrast to the jagged flimsiness of the buildings man sets upon their bosom.

The painting of Lismer is full of movement and a sort of roving energy, much like the man himself. In addition to his work as an artist, Lismer has taken a leading part in the study of children, their interests, their development and education, and the use they make of the arts to express their ideas of the world around them.

It might fairly be said of The Group of Seven that they were all nature painters, for their subjects are the wild natural landscape of Canada, with its rocks, its forests, hills and mountains, and scarcely ever of its towns and people. Harris did paint houses also and Varley painted people, too, but their main interest was the land of Canada itself. This group had its headquarters in

Paul Kane's Indian Chief is an interesting study.

Toronto and they were in touch with another group in Montreal which never called itself by name and made its mark a little earlier. Maurice Cullen (1866-1934) was the first of these, and he was followed by James Wilson Morrice (1864-1924), Clarence Gagnon (1881-1942), Albert Robinson and Aurèle Suzor-Coté (1869-1937). As you can see by their names, some were French Canadians; others, like Morrice, were of English parentage. All of these men had been in touch with painting in Paris. Their interest in Canada lay in what its settlers were making of it. Their paintings as a rule were made in the long-settled province of Quebec, with its ancient houses and villages and orderly, frugal farms. If The Group of Seven painted wild nature, these men painted nature where man had got a good foothold.

TWO PAINTERS WHO LOVED TO PAINT PEOPLE AND THEIR ACTIVITIES

Morrice lived in Paris for most of his painting career, but he paid yearly visits to Canada, to paint and to hold exhibitions of his work. Although his painting has less violent color than that of The Group of Seven and a more European character, he can still be regarded as Canadian (and one who made a name for himself in Paris, at that time the centre of the world of painting). The prominence he gives to human figures and to architecture set him apart from some others of the Montreal group.

The same thing may be said of Clarence Gagnon. His landscapes are village landscapes and they usually have some human activity going on; if it is not a sleigh passing, or a group of figures, there is a hint of active life inside the houses. In his picture, Village Street, Laurentians, this interest in human beings and what they do is very evident and very refreshing to the beholder.

THE GROUP WHO LEARNED FROM THE FRENCH IMPRESSIONISTS

Both Morrice and Gagnon used bright and gay color, sometimes rich, for they had come under the influence of the Impressionist painters of France whose great contribution was this same brilliancy of color. The impressionists found that color gained in brightness by their method of putting it on in small blended strokes which, though it blurred the outlines and made shapes seem less solid, gave a strong effect of vivid light. The Montreal group introduced to Canada in a modified form the impressionist way of looking at things and their method of painting.

An account of the French Impressionists is given in the chapter French Art Goes Out of Doors. This chapter begins on page 2475. On page 2480 you will find directions for an experiment which you can make in impressionist painting.

The Impressionists' interest in color has profoundly affected modern painting. However, there has been a strong reaction to regain the appearance of solid shape which was sacrificed by the Impressionists for brilliancy and vibration of color.

THE FOUNDING OF SOCIETIES FOR THE ENCOURAGEMENT OF ART

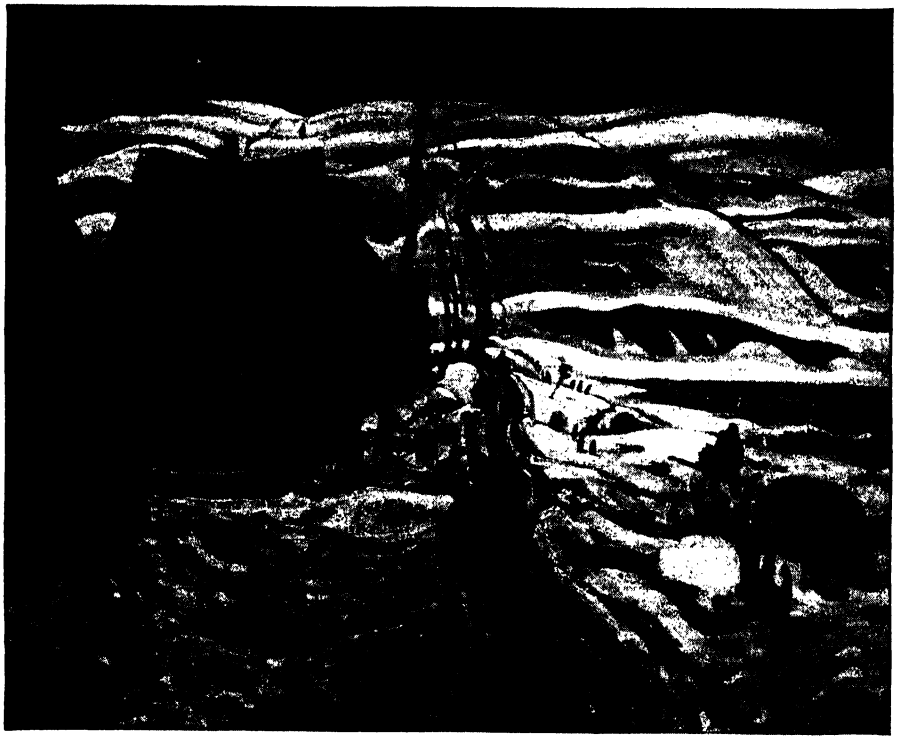
As we have seen, painters have a habit of keeping together. There was a society formed in Toronto as early as 1834, called The Society of Artists and Amateurs. This shortly disappeared. The Ontario Society of Artists is the oldest permanent organization of artists in Canada. It was founded in Toronto in 1872 and has held exhibitions every year almost without a break ever since. It also founded an art school, now the Ontario College of Art in Toronto, and has been constantly active in other ways. In about 1880, the Royal Canadian Academy was founded with much the same aim, this time Dominion-wide, and it too has held annual exhibitions almost without interruption. Official societies such as these have their influence throughout Canada for they encourage the teaching of painting, they circulate pictures in traveling exhibitions and it is through them that the painters come to know each other and become known to the layman.

The exhibitions arranged by these two bodies are not confined to their members. Anyone may send his pictures to the jury which passes or rejects paintings for exhibition. Generally about half the pictures on view are by non-members.

CANADIAN PAINTING BECOMES A NATIVE GROWTH

For some years before these societies were founded, a number of painters had come out to Canada from Great Britain and a smaller number of Canadians had gone to Europe to study art and returned to paint in Canada, and it was these men who organized the two societies. Canada by now was no longer regarded as a strange new country as in the days of Krieghoff, Kane and Heriot. The market for pictures was now in Canada itself and sometimes in the United States, and in consequence the kind of picture was changing. Artists painted the scenes of their own country for their own people.

Let us examine some of the work of these artists of the late nineteenth century. It is difficult to single out individuals, but perhaps Horatio Walker (1885-1938), Franklin Brownell, Homer Watson (1855-1936), Robert Gagen (1848-1926), Lucius O'Brien (1832-1900), Daniel Fowler (1810-1894), William Brymner (1855-1925), Laura Muntz (1860-1930), George Reid and C. W. Jefferys were in varying ways the leaders. Watson, show something of the accepted viewpoint of the time. Though differing in treatment as they do, they are both concerned with the romantic aspects of country life: Walker with the simple *habitant*, his two fine oxen at the trough, lifted up into a sort of glory by the flaming sunset overhead; Watson, his color all brownish greens and greys, dramatizing the sudden onslaught of a summer thunderstorm over a peaceful



In A. Y. Jackson's Early Spring, Quebec, the artist has built up his picture with thick, free strokes of paint.

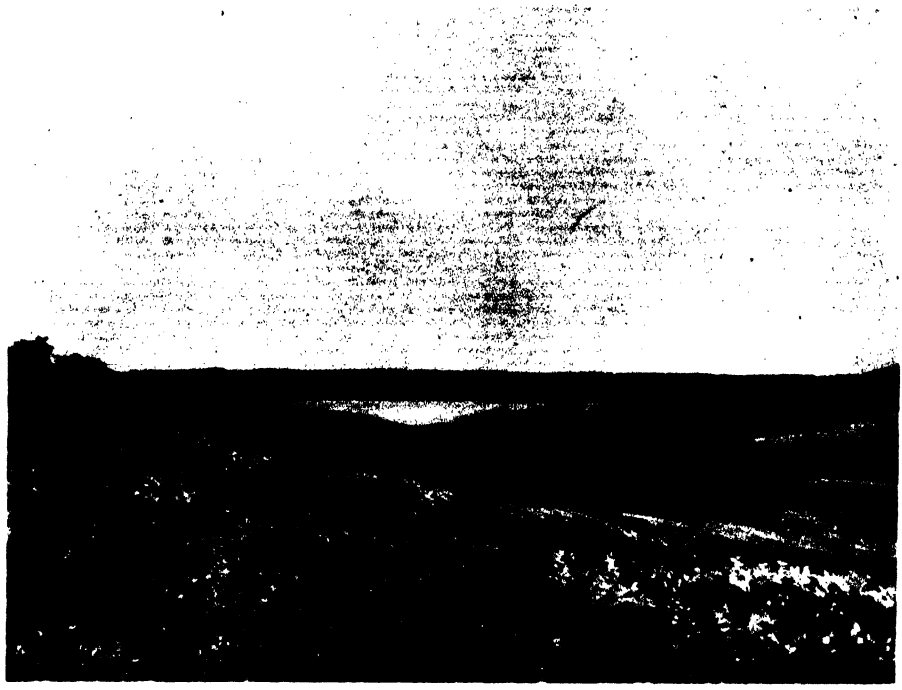
All of them were prominent in the Ontario Society of Artists or the Royal Canadian Academy, both for their painting and for their various other activities such as teaching, lecturing and illustration. Jefferys' illustrations for Canadian history books are well known, and his research into all sorts of details of historical material from the shape of the old buildings put up by Champlain at Port Royal to the motto on the button of a soldier's uniform at the battle of the Plains of Abraham, or the kind of tools the pioneers used on their farms, is exact, extensive and of the utmost value.

The picture Oxen Drinking by Walker, together with The Flood Gate by Homer river flat echoing its power in the burst of foam, the man straining at the windlass and the bending trees, all in the strongest contrast to the quiet huddled cattle and the long flat lines of the landscape. Both these pictures are full of incident. Compare them with the modern West Wind by Tom Thomson and with Schaefer's Farm near Carlsruhe. How differently artists thought and painted in the days of Walker and Watson!

It is not true to say that this kind of painting done by Walker and Watson and many others of their group died with them. Their influence was very great and still is, and many pictures are painted to-day which are based on the same principles. It is, how-

PAINTINGS BY CANADIAN ARTISTS

OXEN DRINKING, BY *HORATIO WALKER*



WESTERN SUNLIGHT, BY C. W. JEFFERYS, A.R.C.A.

CACHE RIVER IN THE LAURENTIANS, BY MAURICE G. CULLEN

WINTER, GEORGIAN BAY, BY A. Y. JACKSON, R.C.A.

QUEBEC VILLAGE STREET, WINTER, BY CLARENCE A. GAGNON, R.C.A.

THE SPIRIT OF MOTHERHOOD

MADONNA WITH ANGELS, BY LAURA MUNTZ

The pictures on these pages are reproduced by courtesy of the National Gallery of Canada, Ottawa.

ever, true that Thomson and The Group of Seven and their followers brought to Canada a new kind of painter's vision for the natural landscape. These modern pictures, almost without exception, have no story. They stand or fall, as indeed any painting must in the end, by their own effectiveness and power. There is, for instance, no hint of a human being in Harris' Lake Superior picture. All we have is an arrangement, carefully and consciously built up, of rounded, flat and sharp forms and colors which suggest the immensity, the grandeur and solitude of nature. It is this indifference to the human factor and to story-telling that makes pictures of this kind harder to enjoy.

The Flood Gate, by Homer Watson, is painted in sombre colors, but is filled with brilliant glints and patches of light.

In the work of all artists, however, those of the past as well as of the present, you find what might be called architectural quality. The group of trees thrusting into the sky in Watson's picture, the sturdy solid group of figures in Walker's, are both set against strong horizontal lines in the background. All the lines in the Varley picture, except the rounded head, sway slightly in both directions from the vertical and suggest a pose held only for an instant and lightly and easily broken. Look at Kane's Indian Chief and at Krieghoff's picture and you will find those same arrangements of lines, colors and masses, perhaps less clear and less direct, but still there to give the picture its own balance.

There are in Canada a number of societies of painters and draftsmen whose interest is centred on the medium employed. By medium is meant the materials used in making a painting or drawing—water color, etching and graphic art. Painters are by no means confined to one medium; many work with ease in oils, tempera, water color, with a pencil or crayon or with an etching needle on copper or the graver on a wood block, or on a lithographic stone. Societies such as the Canadian Society of Painters in Water Color and the Society of Canadian Painter-Etchers and Engravers, by the very fact of limiting their interest to one medium, have less range than either the Ontario Society of Artists or the Royal Canadian Academy.

One other society should be mentioned in more detail, The Canadian Group of Painters which grew out of The Group of Seven. As it is still quite young its policy has not been rigidly set, but in general it may be said that its purpose is to encourage by inviting to its exhibitions those whom it considers promising painters throughout Canada.

There are now and have been many scores of painters in Canada whose works we cannot discuss in detail; painters like Maurice G. Cullen, for instance, who called attention to the fact that painters could paint Canada under snow in the winter, or like William Brymner, who for many years was one of the great teachers in the art schools; or George Reid and Challener and, later, Charles Comfort, who painted large mural decorations for public buildings. There are

others, too, who, besides being painters themselves, worked hard for others in the hope of establishing in a new country a wide love and appreciation of painting as a means of expression.

Canadian portrait painters have scarcely been mentioned. Their work is distinguished from that of other Canadian artists because it still continues the old relationship of painter and patron which has almost completely disappeared in the more general field of art. Professional portrait painters generally know where their picture is to go and they know, too, whom their work must satisfy. Under these conditions the painter has little opportunity for experiment.

CANADA HAS HAD MANY EXCELLENT PORTRAIT PAINTERS

It is impossible to give more than a scant list of Canadian portrait painters. In the early 1830's many of them roamed from place to place painting as they went. One, a Frenchman, G. T. Berthon (1806-1892), settled in Toronto and painted during his long life hundreds of portraits. J. W. L. Forster (1850-1938) also painted in Toronto, in Ottawa and in Montreal. Sir Wyly Grier, past President of the Royal Canadian Academy, has a national reputation as have Kenneth Forbes, Archibald Barnes and Alphonse Jongers, and many others. Among the woman portraitists, Lilias Torrance Newton, Dorothy Stevens and Marion Long have all done notable work.

The work of the portrait painters can be seen in the great halls of the universities, the Provincial Parliament Buildings and the city halls throughout the country. It presents an idea of what the public of Canada, over a long period of years, has required of the painter. From time to time these requirements have changed and painting has changed with them. As the formality of life has broken down, so too has that of the portrait, though in a lesser degree for it must be remembered that sitting for your portrait is still a ceremonial occasion.

THE LANGUAGE THAT NEEDS NO TRANSLATION

Painting is a universal language which has no dictionary and needs no translation —except for the reproductions of the pictures themselves, such as those which accompany this article. It may tell stories, but so do books, motion pictures and music, so do our churches and houses and roads and fields. The thing to remember is not the story the pictures tell but the vision they open up—a lift of the heart stirred by the color, the lines and the masses which are worked together so cunningly by the painters.

WHERE TO SEE THE WORK OF CANADIAN PAINTERS

Black and white reproductions, and for that matter most color reproductions too, are poor substitutes for the pictures themselves. Nearly all of those illustrated in this article are in public collections scattered across Canada. It might be useful to give you some idea of where fine pictures can be seen.

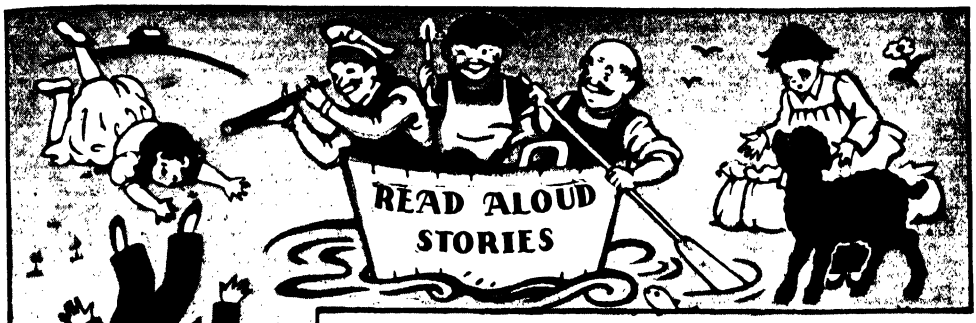
In British Columbia the Vancouver Art Gallery has a number of English and European paintings as well as a fine Canadian collection. In Regina, Saskatchewan, the Norman Mackenzie Foundation of Regina College has mainly European paintings. The Edmonton Museum of Arts, the Winnipeg Art Gallery and the Williams Memorial Art Gallery of London, Ontario, have periodic exhibitions of Canadian painting. In Sarnia the public library has a collection of fine work brought together by the Women's Conservation Art Association. In Toronto both Hart House, University of Toronto, and the Art Gallery of Toronto have good collections of Canadian paintings and hold several exhibitions each year. At the National Gallery of Canada, in Ottawa, a substantial part of its Canadian pictures is always on view, exhibitions of Canadian painting are held periodically, and circulating exhibitions are sent throughout Canada. This is also done to a lesser degree in Ontario by the Art Gallery of Toronto. The Montreal Art Association has a Canadian collection and holds exhibitions of Canadian painting periodically throughout the year.

MANY CANADIAN CITIES HAVE PUBLIC ART GALLERIES

The Museum of the Province of Quebec in Quebec City has a collection of Canadian paintings, mostly by artists of the Province of Quebec, and holds occasional exhibitions. Occasional exhibitions are also held in Halifax, Wolfville and Saint John.

The Provincial Museum of New Brunswick, at Saint John, has Dr. Webster's fine collection of Canadiana (early prints, drawings and water colors) and that of the Manoir Richelieu has already been mentioned. The Royal Ontario Museum in Toronto has a Canadiana collection and a large number of Paul Kane's pictures.

THE NEXT STORY OF FINE ARTS IS ON PAGE 3873.



THE UGLY DUCKLING

This version is by Helen Merrick

ONCE there was a Mother Duck who was very proud of her family.

"Quack, quack, quack," she would say, "see how pretty my children are."

But one day she hatched a little one who was not pretty at all. He was fuzzy and brown and awkward. He was so ugly that everybody called him the Ugly Duckling.

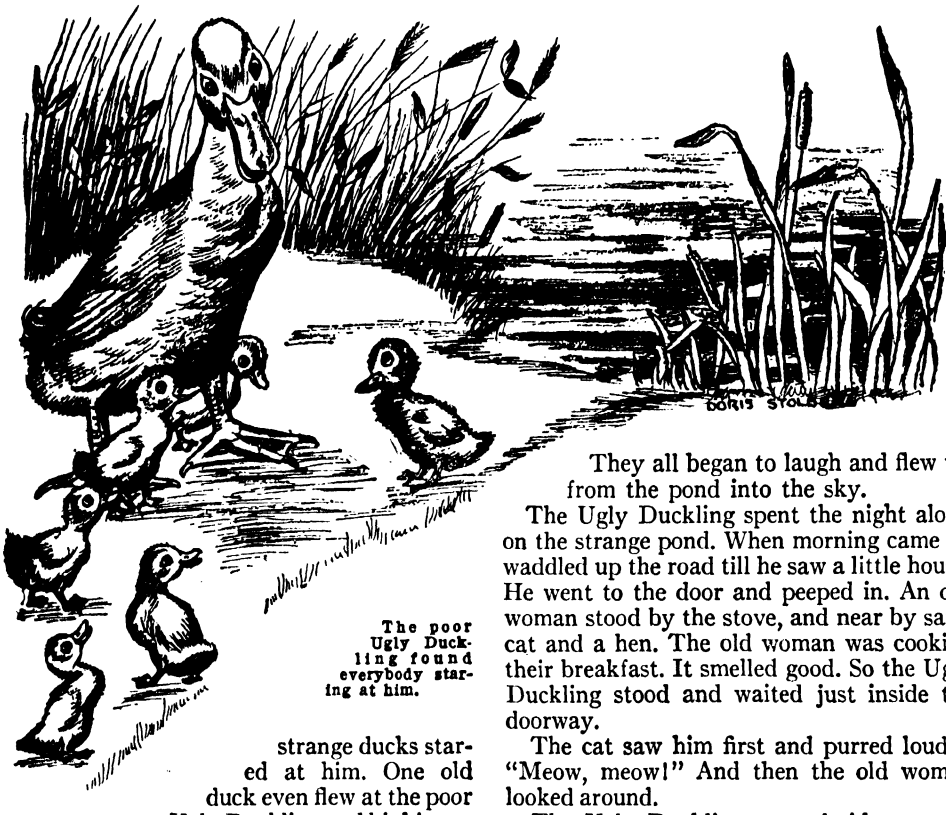
When a friend came to visit her, Mother Duck would say, "My, I never thought that I should have such an ugly child. Just look at the others. Our family has always been very handsome."

It was not long before the ducklings grew old enough to have their first swimming lesson.

"Quack, quack!" cried Mother Duck, and they all came waddling after her, as fine a brood of ducklings as any mother could wish. Far behind them waddled the poor Ugly Duckling, alone and sad. None of his brothers and sisters would waddle with him.

But when they came to the water the Ugly Duckling swam about better than anyone else and he beat all the others at their games and races. This made them very jealous. How could anyone so ugly do anything better than they, who were so pretty? They were so angry they could hardly quack.

One fine day Mother Duck took all her children to visit some friends in a near-by farmyard. The poor Ugly Duckling found everybody staring at him. The chickens stared at him. The cows stared at him. The horses stared at him. All the



The poor Ugly Duckling found everybody staring at him.

strange ducks stared at him. One old duck even flew at the poor Ugly Duckling and bit him on the neck.

"You are not like the rest of us," the old duck said. "What did you come here for?"

"Let him alone," said Mother Duck. "He may not be pretty like my other children, but he is good-natured and he swims better than any of them."

But when Mother Duck's back was turned, the poor Ugly Duckling had a bad time of it. They made more fun of him than ever and gave him sharp pecks.

"They all hate me because I am so ugly," sighed the poor Ugly Duckling, "and it is not my fault. No one wants me. I shall go away."

And so, when no one was looking, he stole away. On and on he waddled until he came to a big pond. Here he met a number of wild ducks who came to have a look at the stranger.

"How do you do?" said the Ugly Duckling politely. "How do you do?"

But the wild ducks were rude and didn't answer. They just stared at him for a long time, and then one said, "How ugly you are!"

They all began to laugh and flew up from the pond into the sky.

The Ugly Duckling spent the night alone on the strange pond. When morning came he waddled up the road till he saw a little house. He went to the door and peeped in. An old woman stood by the stove, and near by sat a cat and a hen. The old woman was cooking their breakfast. It smelled good. So the Ugly Duckling stood and waited just inside the doorway.

The cat saw him first and purred loudly, "Meow, meow!" And then the old woman looked around.

The Ugly Duckling was afraid to move. But a smile spread over the old woman's face. "How lucky I am," she cried; "now I shall have some duck's eggs to eat!"

But the Ugly Duckling didn't give her any eggs, and after a time the cat and the hen began to quarrel with him.

"I don't know what use you are in the world," said the hen, with her head up in the air. "You can not lay eggs as I can; you can not catch mice like the cat; and nobody could call you handsome." And the cat hissed to say that she agreed.

"I think I had better go before they turn me away," sighed the Ugly Duckling. So he left the little house and waddled down the road to the lonely pond.

That evening, at sunset, a flock of birds flew by. They were big and beautiful and white, with long, white graceful necks, and pink bills and strong yellow feet. The Ugly Duckling gazed at them in wonder. They were swans. It was the first time that he had ever seen a swan, and he thought that he had never seen anything so beautiful. They made

strange cries as they flew, and the duckling watched and watched until they were out of sight.

The Ugly Duckling stayed all alone on the pond. When winter came the water froze, and he was cold and hungry. One day he was so tired and stiff that he could hardly move. The ice formed around him and pretty soon he was frozen fast. He would have died if a farmer had not come along. The farmer broke the ice with a stick and took the duckling home to his barn.

The poor Ugly Duckling thought that at last he had found friends. Every afternoon, when the farmer's children came home from school, they ran to the barn with cries of joy, and fed him and made him happy. He ate more and more. "He is growing big," said the children.

But one day when the children were at school and the barn door was open, the Ugly Duckling waddled out into the sunshine. He waddled across the farmyard into the pantry of the house. The farmer's wife was baking pies in the kitchen. When she came into the pantry for a bowl of flour from the flour barrel, she saw the Ugly Duckling. "Shoo!" she said, waving her apron at him.

In his fright he fluttered into the barrel of flour and scattered the flour far and wide. This made the farmer's wife very angry. She picked up a stick to beat him. But the Ugly Duckling flew out of the pantry very quickly. He was afraid to go back to the farm, so he waddled off to his lonely pond again.

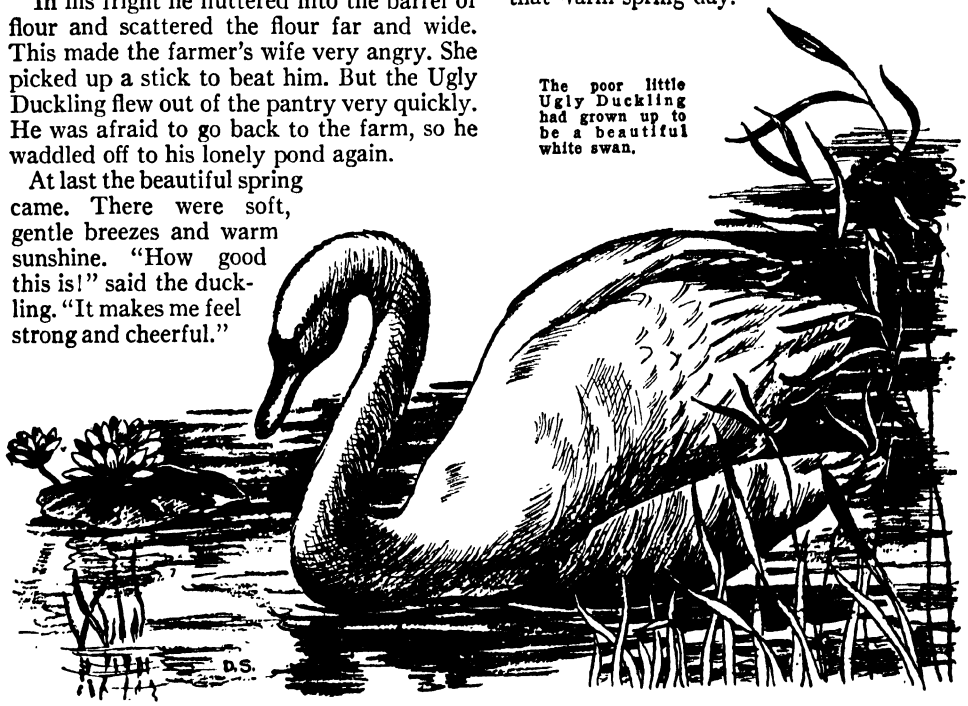
At last the beautiful spring came. There were soft, gentle breezes and warm sunshine. "How good this is!" said the duckling. "It makes me feel strong and cheerful."

The pond was as smooth and as clear as a looking-glass. One day the Ugly Duckling looked down at the smooth water. He was startled. Surely something was wrong! He looked again, and then he gazed all around, but no one was in sight. What could it mean? Who could the creature be, in the water? He saw a tall, graceful swan, as white and as beautiful as the birds he had seen long before. It had a fine long neck and a pretty pink bill and great, strong yellow feet. Why! Those were like his own feet!

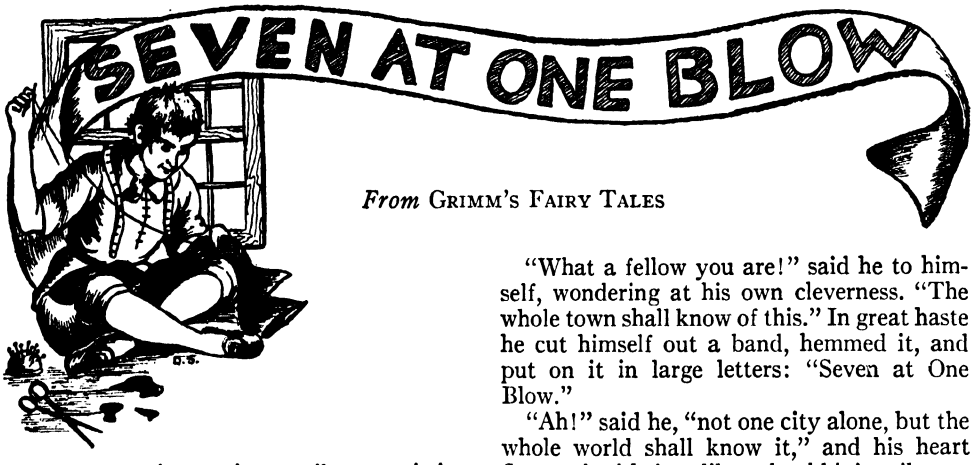
He looked up. A number of the beautiful white creatures were gliding toward him across the pond. They greeted him politely. "Come with us," they cried, "come with us. You are such a fine fellow. You must be our cousin."

The Ugly Duckling drew back a little. Perhaps these beautiful birds were only making fun of him, as everyone else had done. But then he remembered what he had seen in the water only a minute before.

Lifting his head proudly, and quivering with excitement and joy, the Ugly Duckling, who had grown into a wonderful white swan, took his place with his cousins; and they all swam up and down and around the pond on that warm spring day.



The poor little Ugly Duckling had grown up to be a beautiful white swan.



From GRIMM'S FAIRY TALES

ONE summer's morning a tailor was sitting in his shop by the window sewing away with all his might and singing a merry tune. Presently up the street came a boy calling: "Jam for sale! Jam for sale!"

This cry sounded good to the tailor, and putting his head out of the window he called out: "Bring your basket here, Boy!"

The boy went up the steps to the tailor's shop with his heavy basket and began to unpack the jars. "It's good jam," he said. "My mother made it only yesterday."

"Then give me a jar of the strawberry," said the tailor, and he added an extra penny to the charge to pay the boy for his trouble.

"Now for a treat!" exclaimed the tailor, and taking the bread out of the cupboard he cut himself a slice as large as a small loaf and spread the whole jar of jam upon it. But just as he raised this to his mouth, he caught sight of the clock that sat busily ticking away the minutes upon the cupboard shelf. It was a quarter before noon.

"Dear me!" said the tailor. "Here I promised to have that coat ready by noon and I have only fifteen minutes left!"

So he laid the bread down and stitched away, whistling as loud as he could and making larger and larger stitches in his haste. Meanwhile the smell of the jam rose to the ceiling where flies were sitting in great numbers, and soon a regular swarm of them had settled down on the bread.

"Hello, who invited you?" cried the tailor, and snatching up a rag of cloth he brought it down with a great swoop upon them. When he raised the cloth, he counted no less than seven flies lying dead before him while the others flew up to the ceiling with a loud buzzing.

"What a fellow you are!" said he to himself, wondering at his own cleverness. "The whole town shall know of this." In great haste he cut himself out a band, hemmed it, and put on it in large letters: "Seven at One Blow."

"Ah!" said he, "not one city alone, but the whole world shall know it," and his heart fluttered with joy, like a lambkin's tail.

The little tailor bound the belt around him and prepared to travel forth into the wide world, thinking the workshop too small for one as brave as he. Before he set out, however, he looked round to see if there was anything he could take with him, but he found only an old cheese which he put in his pocket. As he went out the door he saw a bird caught in the bushes, so he took that and put it in his pocket also. Now he was ready to set out on his travels.

His road led up a hill, and when he reached the highest point he found a great giant sitting there who was looking about him very contentedly. The little tailor went boldly up and said:

"Good day, comrade. I am on the road to try my luck. Have you a mind to go with me?"

The giant looked down at the little tailor and laughed aloud. "You miserable little fellow!" said he.

"That may be," replied the tailor, "but here you may read what sort of a man I am." And unbuttoning his coat he showed the giant his belt. The giant read: "Seven at One Blow!" and thinking it meant that the little man had killed seven men at one blow he wished he had been more friendly. However, in order to test him, he took up a stone and squeezed it in his hand so that the water dripped out.

"Do that—if you have any strength," said he.

"That's play to me," said the tailor. And diving into his pocket he brought out the cheese and squeezed it until the whey ran out of it, and said: "You see, I squeeze milk out, while you only get water!"

The giant did not know what to say, and could not believe it of the little man, so taking up another stone, he threw it so high that one could scarcely see it with the eye, saying: "There, you manikin, do that!"

"Well done," said the tailor. "But your stone must fall down again to the ground. I will throw one up which shall not come back." And dipping into his pocket he took out the bird and threw it into the air. The bird, happy in its freedom, flew straight upwards and then far away, and did not return.

"How does that please you, comrade?" asked the tailor.

"You can throw well, certainly," replied the giant. "Now let us see if you are in trim to carry something." He led the tailor to a huge oak tree which lay upon the ground and said: "If you are strong enough, help me carry this tree out of the forest."

"Delighted!" said the tailor, "And I'll take the end with the branches for it's sure to be heavier."

The giant took the trunk upon his shoulder, but the tailor placed himself on a branch, so that the giant, who was not able to look round, had to carry the whole tree and the tailor besides. The tailor was very merry and sang and whistled as though carrying the tree was nothing to him. The poor giant, after he had staggered along a short distance with his heavy burden, could go no farther, and shouted: "I must let the tree fall!" The tailor, springing down quickly, put both arms around the tree as if he had been carrying it, and said to the giant: "How can such a big fellow as you mind carrying a tree when I do not?"

Now the giant shook his head in wonderment. "Come to our house and stop a night with us," he said.

So they set off together for the giant's home which was in a cave. And there by the fire sat two other giants. Each one had in his hand a roast sheep, which he was gnawing. The tailor sat down, thinking, "Ah, this is much more like the world than is my workshop." Soon the giant showed him a bed where he might go to sleep. The bed, however, was too big for him, so he slipped out of it and crept into a corner. When midnight came and the giant thought the tailor would be in a deep sleep, the giant got up and, taking a great iron bar, beat the bed right through at one stroke, and supposed he had thereby killed the tailor. At the earliest dawn of morning the giants went forth into the forest, forgetting the tailor, when presently up he came, quite merry and showed himself before them. The giants were frightened, and fearing he would kill them all, they ran away in great haste.

The tailor journeyed on, always following his nose, and after he had wandered some distance, he came into the courtyard of a royal palace, and there he lay down on the grass and went to sleep. While he slept, people came and read upon his belt: "Seven at One Blow." "This must be some mighty hero," said they. And they went and told the king who sent one of his courtiers to the tailor to ask him to be a captain of the army.

"That I will," replied the little man. "It is just the sort of thing that will suit me."

But before he was hardly settled in his fine new house, the soldiers began to make trouble for him. They went to the king and said: "We are afraid to serve under a man who kills seven at one blow. We wish to leave your service." Now the king did not want to lose his soldiers, but he was afraid to dismiss the tailor for fear such a mighty killer would kill him and all his subjects, so he thought of a plan. He sent for the tailor and said: "In a certain forest in my kingdom, there live two giants who rob and kill, and no one dares go near them. If you get rid of these giants, I

will give you my only daughter in marriage and the half of my kingdom. A hundred soldiers shall go with you to help you."

"Ah," thought the tailor, "that is something for such a man as I. A beautiful princess and half a kingdom are not offered to one every day."

He said to the king: "A hundred men, Your Majesty? Pray, what do I want with a hundred men? He who kills seven at a blow need not fear two."

So he set off into the forest alone, peering about him right and left, and after a while he saw the two giants lying asleep under a tree, snoring so loudly that the branches above them shook. The little tailor filled his pockets with stones and climbed up into the branches so that he sat just above the sleepers. Then he let fall one stone after another right in the face of one of them. Awakening, the giant pushed his companion and cried: "Why are you striking me?"

"You are dreaming," the other one replied. "I didn't strike you."

They laid themselves down again to sleep, and presently the tailor dropped a big stone upon the second giant. Awakening, like the first, he cried: "Why are you striking me?"

"I didn't touch you; you must have dreamed it," said the first.

They sank down again, and closed their eyes. But now the tailor threw the stones down as fast and hard as he could upon both of them. Up they sprang, each one thinking the other had struck him, and they set upon each other and began to fight with such anger that they rooted up trees and beat one another until both fell dead upon the ground. Now the tailor hopped down, saying: "What a piece of luck they did not uproot the tree on which I sat, or else I must have jumped on another like a squirrel, for I am not given to flying."

Then back to the king went the little tailor and told him to send his courtiers and soldiers into the forest where they would find the giants lying dead. "It was a hard job," the tailor said, "for they uprooted trees to defend themselves with; still, all that is no use when such a one as I come, who kills seven at every stroke."

When the king found that the giants were indeed dead he was more than ever anxious to be rid of the terrible tailor. "Before you marry my daughter," he said to the tailor, "you must do one more heroic deed: capture the unicorn that has done so much damage in my kingdom."

The little tailor cheerfully agreed to do this, and he went out into the forest, taking only a rope and an axe. The unicorn saw him coming and sprang forward to kill him, but the little tailor stepped aside and the unicorn, who was going too fast to stop, ran into a tree. His horn stuck in the tree trunk and the animal was helpless. When the tailor saw this he tied his rope around the unicorn's neck, freed the horn with his axe and led the animal to where the king and his courtiers were waiting. This time the king was forced to keep his promise, so the tailor married the princess and was given half of the kingdom.

But his adventures were not yet quite over. Some little while afterwards the princess heard her husband talking in his sleep and saying: "Now I have finished stitching the coat." Then she knew she had married a common tailor.

"Whatever shall I do!" she thought. And in the morning she ran to tell her father, the king.

"Now this is a great disgrace, if tailor he be," said the king. "Leave your door open tonight, my daughter, and when this tailor-prince is asleep, my men will enter and carry him off to a ship which will take him to a far country."

That night, when the princess thought her husband was fast asleep, she crept to the door and opened it. She did not know that a faithful servant had heard her talking to the king that morning and had told her husband everything. Now as soon as the door was opened and the men hidden outside were about to rush in, the tailor began to speak in a loud voice, but as though he were still asleep:

"Boy, make me this waistcoat and stitch up these trousers, or I will beat the yard-measure about your ears! Seven have I killed with one blow and giants have I slain; shall I be afraid of those who stand outside my door?"

When the king's men who were standing outside the door heard these words, they were so frightened they ran away as if wild animals were behind them. After that, no man dared go against the brave tailor who had killed seven at a blow. He became king, and so remained the rest of his days.

THE NEXT READ ALOUD STORIES ARE ON PAGE 4113.

WHO KILLED COCK ROBIN?

I, said the Sparrow,
With my bow and arrow,
I killed Cock Robin.

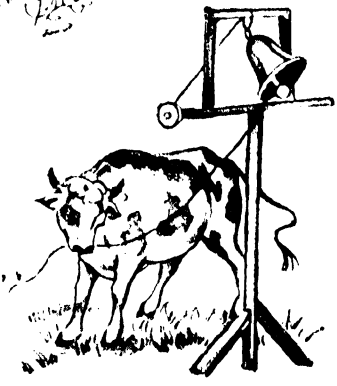
Who saw him die?
I, said the Magpie,
With my little eye,
I saw him die.

Who caught his blood?
I, said the Fish,
With my little dish,
I caught his blood.

Who'll be the parson?
I, said the Rook,
With my little book,
I'll be the parson.

Who'll make his shroud?
I, said the Beetle,
With my thread and needle,
I'll make his shroud.

Who'll bear his pall?
We, said the Wren,
Both the cock and the hen,
We'll bear his pall.



Who'll carry him to the grave?
I, said the Kite,
If not in the night,
I'll carry him to the grave.

Who'll be chief mourner?
I, said the Dove,
I'll mourn for my love,
I'll be chief mourner.

Who'll toll the bell?
I, said the Bull,
Because I can pull,
I'll toll the bell.

Who'll dig his grave?
I, said the Owl,
With my spade and trowel,
I'll dig his grave.

Who'll lead the way?
I, said the Martin,
When ready for starting,
I'll lead the way.

All the birds in the air
Fell to sighing and sobbing
When they heard the bell toll
For poor Cock Robin.

To all it concerns,
This notice apprises,
The Sparrow's for trial
At next bird assizes.

UNDER A TOADSTOOL

Under a toadstool
Crept a wee Elf
Out of the rain,
To shelter himself.

Under the toadstool,
Sound asleep,
Sat a big Dormouse
All in a heap.

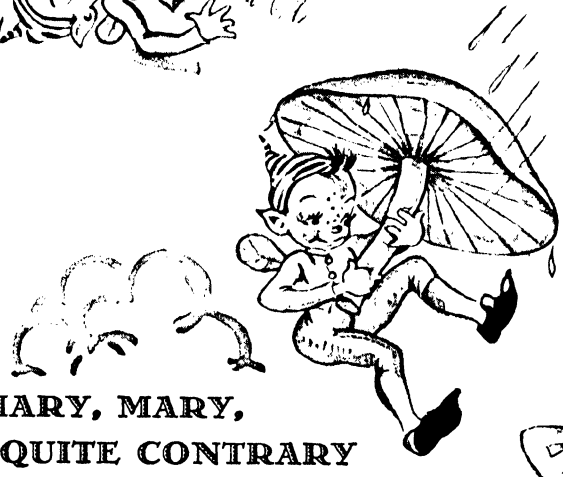
Trembled the wee Elf,
Frightened, and yet
Fearing to fly away
Lest he get wet.

To the next shelter—
Maybe a mile!
Sudden the wee Elf
Smiled a wee smile.

Tugged till the toadstool
Toppled in two.
Holding it over him,
Gaily he flew.

Soon he was safe home,
Dry as could be.
Soon woke the Dormouse—
"Good gracious me!"

"Where is my toadstool?"
Loud he lamented—
And that's how umbrellas
First were invented.

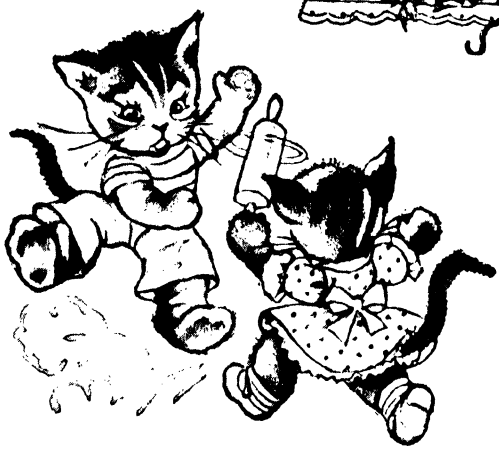


MARY, MARY, QUITE CONTRARY

Mary, Mary, quite contrary,
How does your garden grow?
With silver bells and cockle-shells,
And pretty maids all in a row.

TWO LITTLE KITTENS

Two little kittens, one stormy night,
Began to quarrel and then to fight;
One had a mouse,
and the other had none,
And that's the way
the quarrel begun.



"I'll have that mouse,"
said the biggest cat,
"*You'll have that mouse?*
we'll see about that!"
"I will have that mouse,"
said the eldest son.
"*You sha'n't have the mouse,*"
said the little one.

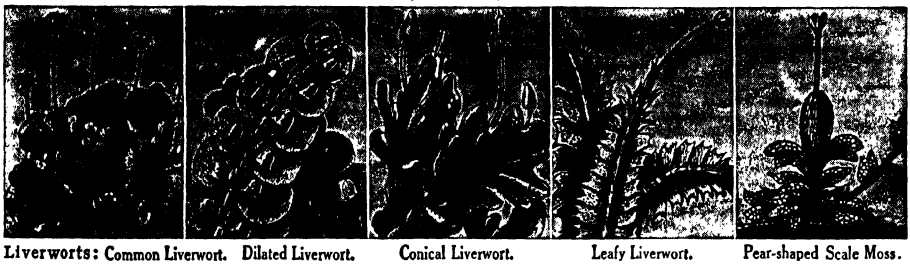
I told you before 'twas a stormy night,
When these two little kittens began to fight;
The old woman seized her sweeping broom,
And swept the two kittens
right out of the room.

The ground was covered with frost and snow,
And the two little kittens had nowhere to go;
So they laid them down on the mat at the door,
While the old woman finished sweeping the floor.

Then they crept in,
as quiet as mice,
All wet with the snow,
and as cold as ice;
For they found it was better,
that stormy night,
To lie down and sleep
than to quarrel and fight.

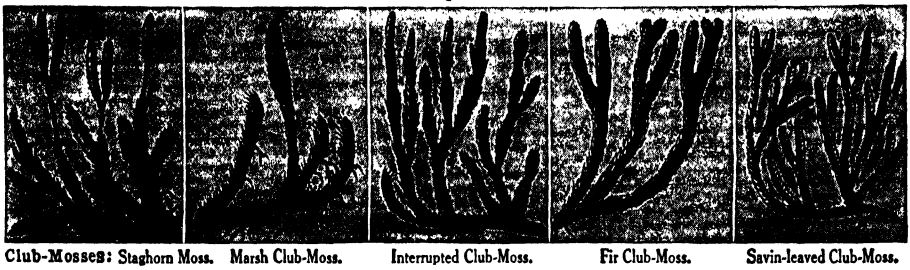
FIVE KINDS OF FLOWERLESS PLANTS

Lichens: Bearded Lichen. Liverwort Lichen. Daisy-flowered Cup Moss. Wall Lichen. Easter Lichen.



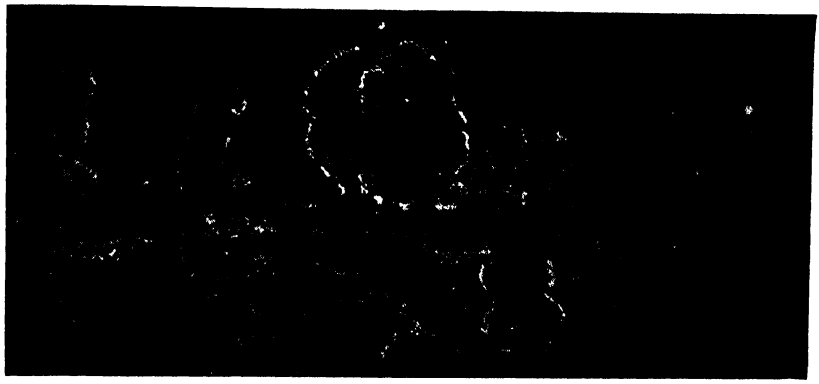
Liverworts: Common Liverwort. Dilated Liverwort. Conical Liverwort. Leafy Liverwort. Pear-shaped Scale Moss.

Mosses: Greater Water Moss. Common Hair Moss. Shining Hookeria. Blunt-leaved Bog Moss. Thyme Thread Moss.



Club-Mosses: Staghorn Moss. Marsh Club-Moss. Interrupted Club-Moss. Fir Club-Moss. Savin-leaved Club-Moss.

Horsetails: Great Horsetail. Variegated Rough Horsetail. Wood Horsetail. Great Rough Horsetail. Shore Horsetail.



Mosses and lichens on an old wall.

THE FLOWERLESS PLANTS

THE plants we have so far been considering—the cereals, the fruits, the forage plants, the vegetables, the textile plants, the medicine and spice plants, and the grasses—are all flowering plants; they all belong to the most important division of the vegetable kingdom, the Phanerogams, or plants which produce flowers and seeds.

The word phanerogam comes from two Greek words meaning "evident marriage," and is a reference to the method by which the plants reproduce their kind. The other great division, the Cryptogams, a word meaning "hidden marriage," includes the plants that have no flowers and do not produce seeds. Since these names were given the reproductive methods of all kinds of plants have been more carefully studied by botanists. It would be true to say now that these operations of the simpler cryptogams are more evident than those of the more complex phanerogams.

There are three great groups of flowerless plants, the lowest comprising the algæ (seaweeds) and the fungi; the second the liverworts and mosses; and the third and highest includes the ferns, horsetails and club-mosses.

The first group is called by the rather hard name of *thallophytes*, because the plants in it consist of a thallus—a body having no division into stem and leaf. The group comprises the lowest and simplest forms of plant life. In some cases the plant has only a single cell. In the higher members there is considerable complexity. In every case the entire plant consists of a more or less uniform mass without the differences of tissue found in the various parts of a flowering plant.

Thallophytes reproduce their kind in various ways. Some of the lower forms simply divide. Each part develops into a new plant; but in the higher forms a special reproductive cell called a spore is produced, and this is capable of growing into a mature plant.

As we know, all life is believed to have begun originally somewhere in the water, and the more primitive of the two classes that make up the group are the algæ, which live in water or on damp earth or rocks and similar moist places. They are quite familiar to us, because their best-known representatives are the seaweeds. All seaweeds are algæ, though not all algæ are seaweeds, for the algæ are quite as common in fresh water as in the sea. Some of them grow even in hot springs, and wherever there are damp places

exposed to the light some members of this class are generally to be found.

Of course, many are so small as to be visible only through the microscope. On the other hand, we have among the algæ the tallest plants to be found anywhere on the earth. During the expedition of the Quest to the Southern Seas, seaweeds were found in the ocean at the southern tip of South America over six hundred feet long—greater than the giant sequoia trees of California, or the great eucalyptus trees of Australia. One of the enormous seaweeds is shown on page 880.

Anyone who visits the seacoast can see that seaweeds are of three distinct color groups—green, brown and red. The difference in structure generally agrees with this division. It is an interesting fact that the seaweeds can be classified scientifically according to color. This division is plain to the most unscientific person, because among flowering plants color has very little to do with the botanical grouping of the plants.

THE BROWN SEAWEEDS THAT PROTECT THE RED ONES

Though there are a few exceptions, the green seaweeds are found in abundance near the shore, where they are covered only at high tide. The brown forms grow mostly in the region between high and low tide, but here also certain of the red seaweeds are found, protected by the brown among which they flourish. Some vigorous forms of brown seaweeds thrive beyond the low-tide mark, and there too they often shelter the reds. In the deep waters the red seaweeds flourish, but below a depth of three hundred feet plant life is rare.

The green of the green seaweeds is due to chlorophyl, or "leaf-green," as we have called it, and if these plants are soaked in fresh water their green color still remains; but if the brown and red seaweeds are placed in fresh water for any length of time they lose their colors, which are due to pigments, and it is then seen that they also have green chlorophyl, which is simply concealed by the stronger colors. The brown and red coloring matters have a duty to perform. According to some botanists they act as light-filters and modify the sunlight shining upon them. This makes the grains of protoplasm containing chlorophyl more susceptible to those rays of light that best assist carbonization.

Each kind of seaweed is of a color that best suits the depth of water at which it lives. The fact already mentioned, that the brown seaweeds often protect the reds, is explained by the need which the deep-sea reds have of some protection when they grow in shallow waters. The browns between them and the sun act as parasols, and keep off the bright light. In the deep seas the greater thickness of water makes this protection unnecessary.

THE SEAWEEDS THAT GIVE FOOD TO MAN AND BEASTS

Seaweeds are very abundant, growing from Pole to Pole, in Arctic seas and in tropical waters. In the Arctic alone there are over 250 species, nearly 900 in West Indian waters, and about 1,200 in Australian seas. Anyone who begins to collect specimens of the seaweeds that grow round our coasts will be amazed at the number and variety, as well as the beauty, of the marine plants he finds.

Seaweeds have many uses. Some are eaten by man and beast, others are used for manure, and from others kelp is prepared for use in the manufacture of carbonate of soda and iodine. From Ceylon moss, an Eastern seaweed, is prepared agar-agar, or Japanese isinglass, which is used in the manufacture of jams and sweetmeats, and also in medicine. The way in which seaweeds reproduce their kind is shown on page 883.

The fungi are higher in the scale of life than seaweeds or any of the algæ, and already over 40,000 species have been distinguished. Several thousand grow in this country, and fresh species are constantly being added to the list. Their appearance and method of growth are so remarkable that ignorant people through the ages have regarded fungi with much superstition, and their growth has always been associated, in the popular mind, with fairies. We all know the familiar fairy rings, which are made up of numbers of toadstools of a species called the champignon, growing, not in groups like other fungi, but in circles.

THE MYSTERY OF THE FAIRY RING IN THE FIELDS

So regular and geometrical are these rings that it is not surprising that the superstitious and ignorant have thought they were planted by fairies. Science, however, has taught us better. The rings originate from a single fungus, which takes so much nourishment from the

ground immediately round it as to render the soil unsuitable for further reproduction of fungi. The spawn, however, spreads, and in the second year a crop of champignons is produced in a circle. Again the same thing happens, and so the circle is an ever-widening one. Another feature of the fairy ring that has added to the superstitious awe with which it is regarded is the exceptional greenness of the grass just inside the circle. This is due to the fact that the dead fungi have manured the soil and made it particularly suited to grass-growing. It is richer in this respect than the soil outside the ring.

THE SOFT FUNGUS THAT CAN LIFT A HEAVY PAVING-STONE

Although many of the fungi are tough and hard growths, like those found on the trunks of trees, the majority are very soft, and have an amazing power of growth. They will spring up in a night, and will, by their persistence, raise even a paving-stone if it is in the way. Yet a baby can crush the fungus with its foot.

We generally regard as the fungus the mushroom or toadstool that appears above ground, but this is really the reproductive or fruiting portion. Much of the vegetative portion of the plant is in the soil.

Many of our common fungi are highly poisonous, but, on the other hand, large numbers form excellent and nourishing foods. Of these, of course, the common mushroom is the best known, and truffles are regarded as one of the choicest. There are scores of edible fungi that should find a place in our menus. In fact about seven hundred sorts have been found to be edible, but some are not very good to the taste. Some of the best sorts are the common field mushroom, the meadow mushroom, the morels, the chantarelle, the beefsteak, or liver, mushroom and the oyster mushroom. The last two grow on trees. Other kinds are: fairy ring, the forest mushroom, the edible boletus, the variable russula, the bear's-head, the horse's tail, the coral, the clitocybe, inky caps, shaggy manes, and many others.

THE GIANT PUFF-BALL ON WHICH A FAMILY CAN BREAKFAST

One of the most delicious of these is the giant puff-ball, which cannot be mistaken for any other fungus as it is unique in being like a great football. If gathered fresh and cut into slices while still white, it can be fried with egg and breadcrumbs, and provides a breakfast for a whole family. Slices can even be cut from it day after day and the puff-ball left growing. But in gathering fungi for food great care must be taken not to confuse the poisonous with he edible species. We must never eat any that we cannot identify with absolute certainty. There is no general rule for telling the edible from the poisonous kinds. In Volume Eleven you will find a special article on mushrooms, with some colored pictures.

These curious plants grow in all sorts of positions. Some are found on tree trunks, some under the ground, and others on damp walls. All have not the toadstool or mushroom form, for the fungi include the rusts and smuts that affect cereals, the mildews and molds found in damp rooms and on jams and cheese and other foods, and the yeasts, so useful in making good bread. While many are extremely useful to man, others, especially the smaller kinds, are great pests, and cause as much damage to crops as insect pests. In fact, it is safe to say that in countries like the United States and Canada millions of dollars are lost every year through fungus pests. The way in which the mushroom grows and propagates its kind is told on page 3906, and the life-story of the rust and the potato disease, another fungus, is given on page 2617.

Perhaps the most striking fact about the fungi is that while many of them are very brilliantly colored, all are destitute of chlorophyl. They are, therefore, unable to manufacture the carbon compounds they need from the carbon dioxid of the air, and must obtain their carbonaceous food from organic material. That is why we find them growing on manure heaps, decaying vegetation, dead bodies, and the waste matter of plants and animals, or feeding upon living creatures.

CURIOUS PLANTS THAT USED TO PUZZLE THE BOTANIST

A lichen, as we have already seen on page 882, is not really an individual plant at all, but a partnership between an alga and a fungus, and the partnership is one of the most remarkable things in nature. The alga needs moisture and salts in solution and also protection, and these it obtains from the fungus; but it does not take them and give nothing in

return. The alga manufactures organic food by means of its chlorophyl, and supplies this to the fungus, so that, while neither can thrive alone naturally in the barren and desolate situations where they often flourish, together they are able to present one of the hardiest forms of plant life in existence. Both can, however, live if placed artificially in congenial circumstances. The fungus element is more important, and lichens are classed as fungi, and not as algæ.

How a Wrong Name Has Stuck to a Family of Plants

The second great division of the flowerless plants is the *bryophytes,* a name that means moss plants, and these include the liverworts and mosses. It is curious how a name, given in haste and quite inappropriate, can stick to a class. The liverworts were so named by an Italian botanist, Micheli, in the eighteenth century, because of a fancied likeness to a liver, and the name has continued though the majority of the liverworts have no resemblance whatever to a liver. There are about four thousand species in this class.

They live in moist places and do not thrive where there is a smoky atmosphere. They will generally be found growing on wet banks and rocks, on damp walls, and near waterfalls where the spray can fall upon them and keep them moist. Very often they are found growing with mosses. They have been well described as amphibious, for, while they mostly live on land, the male elements or sperms in them are furnished with two cilia, or hair-like attachments, to enable them to swim to the female part of the plant in order to fertilize the egg cells, and it is therefore necessary for the cilia to have sufficient water across which to ferry the sperm.

The Mosses John Ruskin Thought Were Creatures Full of Pity

The mosses are higher in rank than the liverworts, and are far more familiar, for even the most unobservant of us notices a moss-covered wall or rock, and many will remember Ruskin's unmeasured praise of the mosses, which he calls "meek creatures, the first mercy of the earth, visiting with hushed softness its dintless rocks; creatures full of pity, covering with strange and tender honor the scarred disgrace of ruin, laying quiet finger on the trembling stones to teach them rest." It is a beautiful description, but it is not altogether true botany, for the mosses are neither in simplicity of structure nor in the order in which they appear "the *first* mercy of the earth."

The highest group of flowerless plants is that which includes the ferns, the horsetails and the club-mosses. It goes by the name of the *pteridophytes,* which simply means "fern plants." Here we have a much higher type than the previous group. Whereas the liverworts and mosses have mere rhizoids, or hairs, serving as roots, the ferns and their allies have true roots, a proper system of vessels or ducts for the passage of water, and leaves as advanced in structure as many flowering plants.

The interesting life-story of a fern is told in pictures on page 1015 of this book, and need not be repeated here. Altogether over three thousand living species of ferns have been recorded by botanists, and in addition there are many extinct species. Indeed, the golden age of the fern family was in the past. They have, however, survived wonderfully through the geologic ages to the present time, far better than their allies the horsetails and the club-mosses, of which there are comparatively few survivors. Those plants thrived exceedingly in the forests of the Carboniferous Age.

The Horsetails That Men Use for Polishing Ivory

There are only about twenty-five species of horsetails now living. They all grow in damp places, such as marshes and bogs and moist woods; and, though they are found all over the world, they are more abundant in the temperate and colder regions of the northern hemisphere than elsewhere. The horsetails are of little use to man, but some species have a large quantity of silica in their stems, and on this account are used in polishing.

The club-mosses are most abundant in warm countries, but, like the horsetails, they are generally distributed all over the world, and there are altogether about a hundred species still existing. The common ground pine is a club-moss and so is the so-called resurrection plant. The spores of some species, known as lycopodium powder, are used for various purposes. Pills are coated with the powder, and it is used in making flash-lights for fireworks. The spores of certain species are of considerable medicinal value, and one kind is used as a dye.

THE NEXT STORY OF PLANT LIFE IS ON PAGE 3905.

SOME NORTHERN FERNS

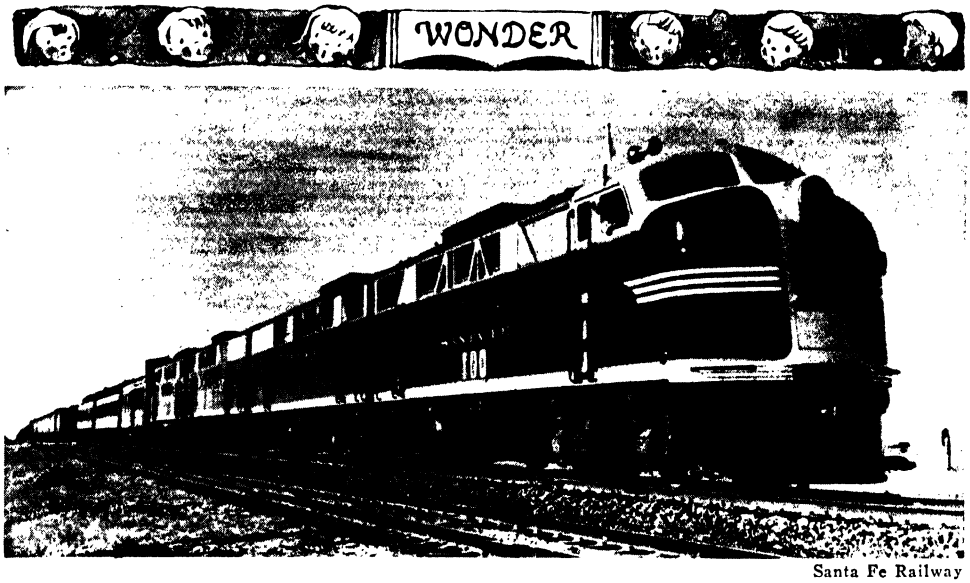
Although ferns do not produce flowers, they are exceedingly graceful and attractive, and their beauty is admired by all lovers of nature. Altogether it is estimated that there are more than four thousand kinds of ferns growing in the world. Here we give forty-five kinds that grow in the North.

1. Brittle Bladder Fern. 2. Hard Fern. 3. Tunbridge Filmy Fern. 4. Mountain Bladder. 5. Rigid Buckler Fern. 6. Oblong Woodsia. 7. Royal Fern. 8. Crested Buckler. 9. Marsh Buckler. 10. Male Fern. 11. Alpine Woodsia.

1. Alpine Polypody. 2. Mountain Polypody. 3. Annual Maidenhair. 4. Little Adder's Tongue. 5. Black Maidenhair Spleenwort. 6. Three-branched Polypody. 7. Hart's Tongue. 8. Soft Prickly Shield Fern. 9. Holy Fern. 10. Hard Prickly Shield Fern.

1. Lanceolate Spleenwort. 2. One-sided Filmy Fern. 3. Limestone Polypody. 4. Lady Fern. 5. Adder's Tongue. 6. Moonwort. 7. European Bristle Fern. 8. European Sea Spleenwort. 9. True Maidenhair. 10. Hay-scented Buckler Fern. 11. Common Polypody.

1. Forked Spleenwort. 2. Alpine Bladder Fern. 3. European Parsley Fern. 4. Green Spleenwort. 5. Alternate Spleenwort. 6. Mountain Buckler. 7. Rock Spleenwort. 8. Scaly Spleenwort. 9. Common Maidenhair Spleenwort. 10. Rue-leaved Spleenwort. 11. Prickly-toothed Buckler. 12. Broad Buckler. 13. Bracken.



Santa Fe Railway

Modern streamlined trains are built to reduce strain and stress in the metal—aluminum alloys and steel.

Does a Piece of Metal Get Tired?

WHEN we speak of anything getting tired, we naturally think of a living creature, such as ourselves. We know that when we are not tired, we can do certain things. When we are tired, some change has occurred inside our bodies that prevents us from doing those things. The proper word for this is fatigue. Now, if we take a piece of steel, like a razor, that can do certain things, and if we overwork it—we may find it will not cut as it used to do, however carefully we prepare its edge. Something has happened that prevents it from doing what it was able to do before. We may call this "getting tired."

The fatigue of metals has an important bearing on their strength, and many experiments have been carried out to show that repeated pulling and releasing of a piece of metal tires the material and makes it more and more liable to break under the strain. In some of the experiments the strains took the form of pressure applied again and again in the same place, while in others it consisted of twisting and bending. In some cases the action had to be repeated several millions of times before the metal broke. In this the various pieces of metal acted very much like tired human beings. Some were able to bear the strain and stress much longer than others before they grew fatigued, and broke.

The condition of metals when fatigued has been carefully examined by means of high-powered microscopes. These examinations show that when a metal is tired through strain, the crystalline grains of which the metal is made up change their shape, and are drawn out in the direction of the strain.

It may be that if we could learn fully about the causes of tiredness and the cures of tiredness in metals, we might better understand fatigue in ourselves.

WHY WILL A HAMMER BREAK A STONE WHEN A PIECE OF WOOD WILL NOT?

The force of a moving body depends upon two things, its mass and the speed at which it moves. A hammer falling freely and a piece of wood falling from the same height will hit the ground at the same speed. When you give a stone a blow with an iron hammer, and another with a piece of wood, there is little if any difference in the speed of the descending blows. But there is a great difference in the two masses. Iron is one of the most tightly packed substances in the world. Its mass is far greater than the mass of the wood. You know that wood is so loosely packed, with so many air spaces, that it will usually float on water.

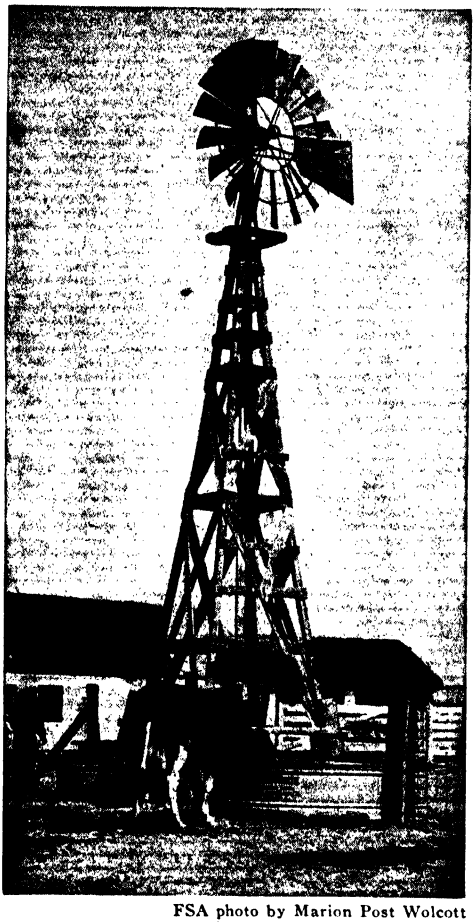
The force of the blow from the iron hammer is strong enough to overcome the force of cohesion that keeps the molecules of stone together. The stone breaks. The blow from

the less massive wood is not strong enough to overcome the force of cohesion that locks the stone molecules together.

WHAT IS A WINDMILL AND WHAT WORK DOES IT DO?

A windmill is a machine that uses the power of the wind to do various kinds of work—pumping water, sawing wood, grinding corn, generating electric power and so on.

There are two chief types of windmills. The older or European type, still found to some extent in Holland and other European countries, has changed little in the last eight centuries. It consists, first of all, of a wooden or brick tower, usually broad at the base and narrowing considerably toward the top. The tower is generally crowned by a dome so constructed that it can turn freely.



FSA photo by Marion Post Wolcott

An American windmill, used on farms to pump water, grind, saw, and sometimes to generate electricity. This one has a number of blades on the small windwheel.

Set within the tower is a central vertical shaft. It is connected at the top, by means of gears, with a horizontal or nearly horizontal shaft, both ends of which project from the movable dome of the tower. At one end of the shaft is a set of four or six huge sails, set at regular intervals around the horizontal shaft and forming what is known as the windwheel. Some European windwheels have a diameter of one hundred feet.

The sails generally consist of a light wooden framework, upon which canvas is stretched; sometimes they are made up of slats, like those of Venetian blinds. As they turn in the wind, these sails look like the arms of a mighty giant. Don Quixote, a famous character in Spanish fiction, thought that windmills were indeed giants. He tried to run one of them through with his trusty lance, in one of the most famous duels in all fiction. As was to be expected, the windmill won the duel!

In some cases, as we have noted, the shaft upon which the sails turn is not quite horizontal; it is tilted upward a bit at the end on which the sails are set. This is done so that the sails will clear the base of the tower as they swing downward in their endless turning.

The movable dome, the horizontal shaft, the windwheel and the rudder, all form a sort of huge weather vane. As the winds shift, this big weather vane turns, dome and all, so that the sails of the windwheel face the wind at all times.

The power of the wind, that makes the sails turn round, is transmitted, by means of gears, to the vertical shaft set within the tower. In some windmills, the vertical shaft drives a water pump; in others it is connected with machines that grind corn or saw wood or do other useful things.

Naturally, the faster the wind blows, the more rapidly the sails will turn. If they turn too quickly, they are likely to damage the machinery within the mill. To control the speed of the windwheel, a friction brake is sometimes used. Sometimes, too, the same result is brought about by exposing less of the sail area to the wind. The canvas forming the sail surface is rolled up; if the sail is made up of slats, these are opened wide.

The newer kind of windmill is often called the American type, because it was first introduced in the United States. The American windmill is more efficient than the old-fashioned kind. It has a tower of wood or steel, which ranges up to one hun-

Western Electric Elevator Co.

An escalator in a department store can move more customers a minute from floor to floor than an elevator can.

dred feet in height. Generally speaking, the tower is made high enough so that the windwheel will not be affected by near-by houses or trees or rises in the ground. Sometimes the tower consists of framework; sometimes it is entirely enclosed.

As in the case of the older type of windmill, a vertical shaft runs the length of the tower; it is connected at the top with a horizontal shaft, which has a rudder or vane at one end and a windwheel at the other. In most of the windwheels of the American type, there are a considerable number of blades, of wood or metal, set around the horizontal shaft. These windwheels are comparatively small in diameter —rarely more than thirty feet. In certain models, the number of blades has been reduced to four or even two; these blades resemble the propellers of an airplane.

When the pressure of the wind upon an American-type windwheel is so great that it approaches the danger point, the horizontal shaft is automatically turned, by means of a spring, in such a way that the blades of the windwheel no longer face the wind fully. This means that less surface is exposed to the wind; hence the speed of the windwheel is reduced.

Windmills of the American type are generally to be found on farms. They are used to pump water or for grinding or sawing purposes. They are also used to generate electricity by driving a small dynamo. Dynamos driven by wind power are not always satisfactory; it is sometimes hard to keep up the steady speed that is desirable. On certain farms wind power has been replaced by power provided by gasoline engines, in generating electricity.

WHAT IS THE PRINCIPLE OF AN ESCALATOR?

An escalator is a flight of stairs that moves, so that it carries us to the top while we stand still. It may also move downward. Our great-great-grandfathers would have thought such a thing a miracle, but the escalator—which simply means moving staircase—is quite common today.

The escalator developed from the endless band used for conveying goods in factories, and many years ago such a band, placed at an incline, used to carry visitors to the top

of a cliff. It was an early form of escalator without steps.

The escalator differs from the moving inclined plane in having stairs that travel up or down, the steps being horizontal all the time. Passengers going up can increase their rate of progress by walking up the moving stairs.

When the steps reach the top they form a horizontal plane and carry the passenger to the stationary landing, where he is left while the steps, turning round a roller, go upside down underneath the staircase to the bottom again.

The average escalator travels about forty feet a minute, which is not too fast to allow passengers to step on or off with perfect safety. A handrail on each side moves with the stairs and helps people to steady themselves. The great advantage of the escalator over the elevator is that it is always moving and can be used by a larger number of passengers in the same time. Large stores in many cities use both escalators and elevators. Escalators are found also in some railroad and subway stations.

WHY IS A NEEDLE NO HEAVIER WHEN MAGNETIZED?

This question puzzles us because we have not clearly distinguished in our own minds what weight really is.

Weight is a direct consequence of gravitation. The power of gravitation depends entirely upon the amount of stuff that is concerned, or the mass of matter that is acted upon. In other words, the weight of a thing depends entirely upon its mass—the amount of matter in it.

If we take a needle and heat it or cool it, magnetize it or demagnetize it, or do anything else to it, so long as we do not take away any of the matter from it or add any new matter to it, its weight remains the same. When we magnetize it, we endow it with a new power that is very wonderful, and that can even overpower the force of gravitation, so that the needle can lift ten times its own weight. But the weight of the needle itself has not been changed.

DOES A BRIDGE EXPAND IN THE SUN?

Yes. A bridge expands in the sun and in the daytime and in the summer, and shrinks in the shade and at night and in winter. The general rule is that heat makes everything expand, while cold makes everything shrink. Cold is nothing but the absence of heat. So we may say that, within a wide range of temperatures, most substances occupy more or less space according to the amount of heat in them—that is, of course, if other circumstances, such as the pressure around the substances, are kept the same. Metals have a way of changing their volume, or size, under the influence of heat. This change is very noticeable in the case of iron and steel bridges. The engineer has to reckon on the amount of expansion that will occur under the influence of such heat as the bridge is likely to be exposed to, and he must allow for it. In a big bridge many inches have to be allowed for change of size when hot or cold.

HOW DOES A VACUUM CLEANER WORK?

Elsewhere we tell you how Otto von Guericke proved the immense power of a vacuum. The vacuum cleaner is one of the finest examples of how man has put this power to work.

This wonderful machine cleans by sucking air, laden with dirt and dust, into a vacuum. The vacuum is made by a fan that is driven by a powerful little electric motor. The fan and the motor are located in a metal case with a narrow opening that can be conveniently moved around. Often there are moving brushes to loosen the dirt. Have you ever felt the suction at the back of an electric fan? The blades of the fan pull air from the back and thus leave a vacuum. Similarly, the fan in the cleaner pulls the air up through the metal case into the vacuum created by its whirling blades. Just as wind carries dust, so does the air rushing into the vacuum carry dirt into the cleaner. The dirt is trapped in a cloth bag while the air filters through it. When the cleaning is done, the bag is taken off and emptied.

There are also big cleaners that are mounted on trucks and driven from house to house or used to clean railroad coaches, airplanes and soot from chimneys. Smaller cleaners are used for furniture and draperies.

CAN ANYTHING BOIL WHEN IT IS COLD?

Boiling is the conversion of a liquid into vapor, or gas, and the temperature at which this happens is called the boiling point of the substance. The boiling point of water is 212° Fahrenheit, or 100° Centigrade, but the boiling point varies according to the pressure of the atmosphere, so that water will boil at a lower temperature at the top of a mountain than at the bottom. At the

top of Mont Blanc, for instance, water boils at 185° Fahrenheit, or 85° Centigrade.

Some substances boil at a very much higher temperature than water. Gold, for instance, which melts, or becomes liquid, at 1064° Centigrade, boils at 2530°. Copper melts at 1082° Centigrade and boils at 2300°. Silicon, which forms about a quarter of the earth's crust, melts at 1500° Centigrade and boils at about 3000°. Tin melts at 231° Centigrade and boils at 2275°. These are all substances that are solid in the ordinary temperatures at which we live. Mercury, or quicksilver, which is normally a liquid, boils at 357° Centigrade.

But when we come to substances that are gases at ordinary temperatures we find that their boiling point is very low. Hydrogen gas boils, or changes from the liquid into the gaseous state, at *minus* 152° Centigrade. In other words, it requires 152 degrees of frost to make hydrogen boil! Fluorine requires 187 degrees of frost to make it boil, nitrogen 194 degrees of frost, and oxygen 182 degrees of frost—all reckoned by the Centigrade thermometer. Boiling is therefore not necessarily to make a substance very hot, as many people suppose, but may actually mean to make the substance very cold. Boiling is actually the changing of a substance from the liquid state to the gaseous state.

WHAT DO THE THREE BALLS OVER A PAWNBROKER'S SHOP MEAN?

The three golden balls were originally the arms of the famous family of the Medici who flourished in Lombardy, in the northern part of the peninsula of Italy, in the fourteenth to the eighteenth centuries. The three gold balls were probably intended to represent gilded pills, either as a pun on the name Medici or in honor of the profession of medicine in which some members of the family had excelled. When some of the Medici family went to London and set up as merchants and moneylenders in what is now Lombard Street, they displayed the three balls over their places of business as their sign. Soon other moneylenders copied their example. The three golden balls came to be the recognized symbol of those who lent money, receiving the property of the borrowers as a pledge.

The familiar sign of a pawnshop in London, in 1720. The scene is "Change Alley," which ran into Lombard Street, where the moneylenders from Lombardy, in northern Italy, set up business under the sign of three balls.

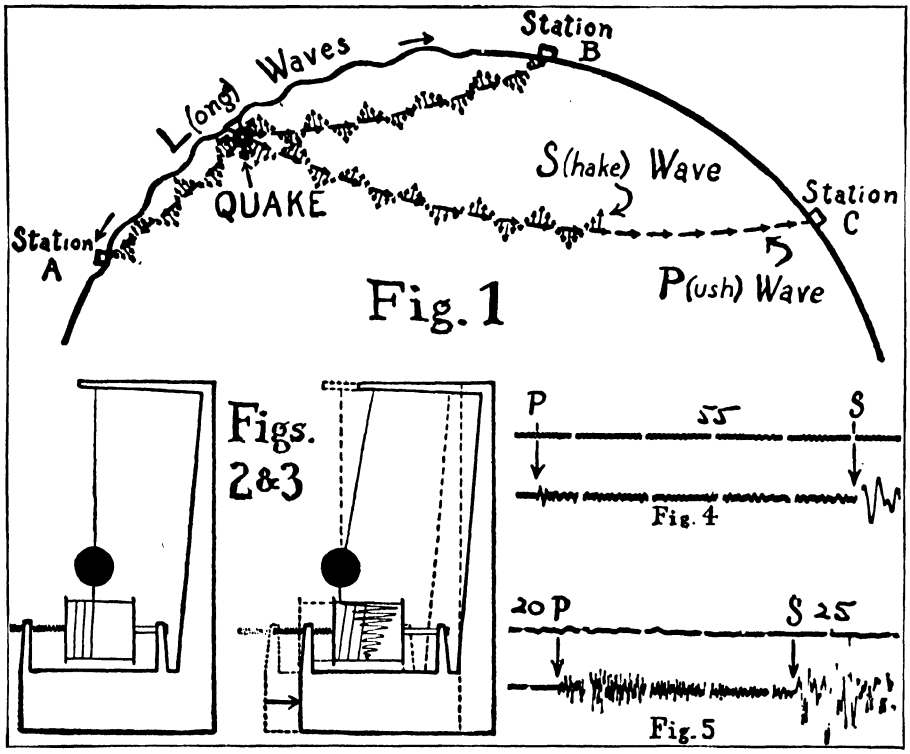
HOW DOES AN EARTHQUAKE REGISTER ITSELF ON A MACHINE?

Earthquakes in any part of the world are recorded in scientific laboratories by means of an instrument called a seismograph. The principle on which such instruments work is shown in the pictures on this page. A heavy weight is delicately suspended and to it is attached a pen which touches a revolving cylinder moved by clockwork.

When an earthquake occurs it sets up vibrations in the earth which reach the place where the seismograph stands. The tremors shake the framework holding the cylinder, while the suspended weight with the pen lags. The result is that the pen records a wavy or zigzag line on the cylinder, more or less defined according to the strength of the quake.

As shown in Fig. 1, a quake sets up waves both along the earth's crust and through its interior. The latter are of two kinds, push waves and shake waves. The speed of both kinds is definitely known, and the push waves travel faster than the shake waves. Each makes it own kind of record in the seismograph. From their distance apart—the distance between P and S in Figs. 4 and 5—the scientist can calculate how far away the earthquake is. To tell where the quake actually occurred, he needs at least three pens, one recording vertical movements, one horizontal movements east and west, and the third horizontal movements north and south.

In some modern seismographs a beam of light does the work of the pen. This beam is reflected from a tiny mirror on the suspended weight to a roll of photographic paper which, like the drum, is moved by clockwork. The developed paper then shows the earthquake record. The word seismograph comes from the Greek words for earthquake and write.



The different kinds of earth waves set up by an earthquake are illustrated in Fig. 1, as they would be received by seismographs at A, B and C. Figs. 2 and 3 show the principle of the seismograph; in Fig. 3 the frame is being shaken by earth waves, but the weighted pen lags and thus traces the waves on the cylinder. Figs. 4 and 5 show actual seismograph records. It will be seen that the shake waves (S) always follow the push waves (P). The upper lines were made by the preceding revolution of the drum. The numerals indicate the time.

Drawings by Father J. Lynch, Fordham University, N. Y., reproduced by courtesy of The Scientific American.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3769.

Poems of Farewell

Illustrated by James MacDonald

If the Lost Come Back

From IN MEMORIAM

By ALFRED, LORD TENNYSON (1809-1892)

IF ONE should bring me this report,
That thou hadst touched the land to-day,
And I went down unto the quay,
And found thee lying in the port;

And standing, muffled round with woe,
Should see thy passengers in rank
Come stepping lightly down the plank,
And beckoning unto those they know;

And if along with these should come
The man I held as half divine;
Should strike a sudden hand in mine,
And ask a thousand things of home;

And I should tell him all my pain,
And how my life had drooped of late,
And he should sorrow o'er my state,
And marvel what possessed my brain;

And I perceived no touch of change,
No hint of death in all his frame,
But found him all in all the same,
I should not feel it to be strange.

Soldier, Rest

From THE LADY OF THE LAKE

By SIR WALTER SCOTT (1771-1832)

SOLDIER, rest! thy warfare o'er,
Sleep the sleep that knows not breaking;
Dream of battled fields no more,
Days of danger, nights of waking.
In our isle's enchanted hall,
Hands unseen thy couch are strewing,
Fairy strains of music fall,
Every sense in slumber dewing.
Soldier, rest! thy warfare o'er,
Dream of fighting fields no more:
Sleep the sleep that knows not breaking,
Morn of toil, nor night of waking.

No rude sound shall reach thine ear,
Armor's clang, or war-steed champing,
Trump nor pibroch summon here
Mustering clan, or squadron tramping.
Yet the lark's shrill fife may come
At the daybreak from the fallow,
And the bittern sound his drum,
Booming from the sedgy shallow.
Ruder sounds shall none be near,
Guards nor warders challenge here,
Here's no war-steed's neigh and champing,
Shouting clans, or squadrons stamping.

Huntsman, rest! the chase is done;
While our slumbrous spells assail ye,
Dream not, with the rising sun,
Bugles here shall sound reveille.
Sleep! the deer is in his den;
Sleep! thy hounds are by thee lying;
Sleep! nor dream in yonder glen,
How thy gallant steed lay dying.
Huntsman, rest! thy chase is done,
Think not of the rising sun,
For at dawning to assail ye
Here no bugles sound reveille.

How Sleep the Brave

By WILLIAM COLLINS (1721-1759)

HOW sleep the brave, who sink to rest
By all their country's wishes blest!
When Spring, with dewy fingers cold,
Returns to deck their hallowed mould,
She there shall dress a sweeter sod
Than Fancy's feet have ever trod.

By fairy hands their knell is rung;
By forms unseen their dirge is sung;
There Honor comes, a pilgrim gray,
To bless the turf that wraps their clay;
And Freedom shall awhile repair
To dwell, a weeping hermit, there!

I Strove with None

By WALTER SAVAGE LANDOR (1775-1864)

I STROVE with none; for none was worth my strife.
Nature I loved and, next to Nature, Art;
I warmed both hands before the fire of life;
It sinks, and I am ready to depart.

For the Fallen*

By LAURENCE BINYON (1869-1943)

WITH proud thanksgiving, a mother for her children,
England mourns for her dead across the sea.
Flesh of her flesh they were, spirit of her spirit,
Fallen in the cause of the free.

Solemn the drums thrill: Death august and royal
Sings sorrow up into immortal spheres.
There is music in the midst of desolation
And a glory that shines upon our tears.

They went with songs to the battle, they were young,
Straight of limb, true of eye, steady and aglow.
They were staunch to the end against odds uncounted,
They fell with their faces to the foe.

They shall grow not old, as we that are left grow old:
Age shall not weary them, nor the years condemn.
At the going down of the sun and in the morning
We will remember them.

They mingle not with their laughing comrades again;
They sit no more at familiar tables at home;
They have no lot in our labor of the daytime:
They sleep beyond England's foam.

But where our desires are and our hopes profound,
Felt as a well-spring that is hidden from sight,
To the innermost heart of their own land they are known
As the stars are known to the Night.

As the stars that shall be bright when we are dust,
Moving in marches upon the heavenly plain,
As the stars that are starry in the time of our darkness,
To the end, to the end, they remain.

*Reprinted by special permission of The London Times and Elkin Mathews, Limited, publishers of THE FOUR YEARS, in which this poem appears.

Crossing the Bar

By ALFRED, LORD TENNYSON (1809-1892)

SUNSET and evening star,
And one clear call for me!
And may there be no moaning of the bar,
When I put out to sea,

But such a tide as moving seems asleep,
Too full for sound and foam,
When that which drew from out the boundless deep
Turns again home.

Twilight and evening bell,
And after that the dark!
And may there be no sadness of farewell,
When I embark;

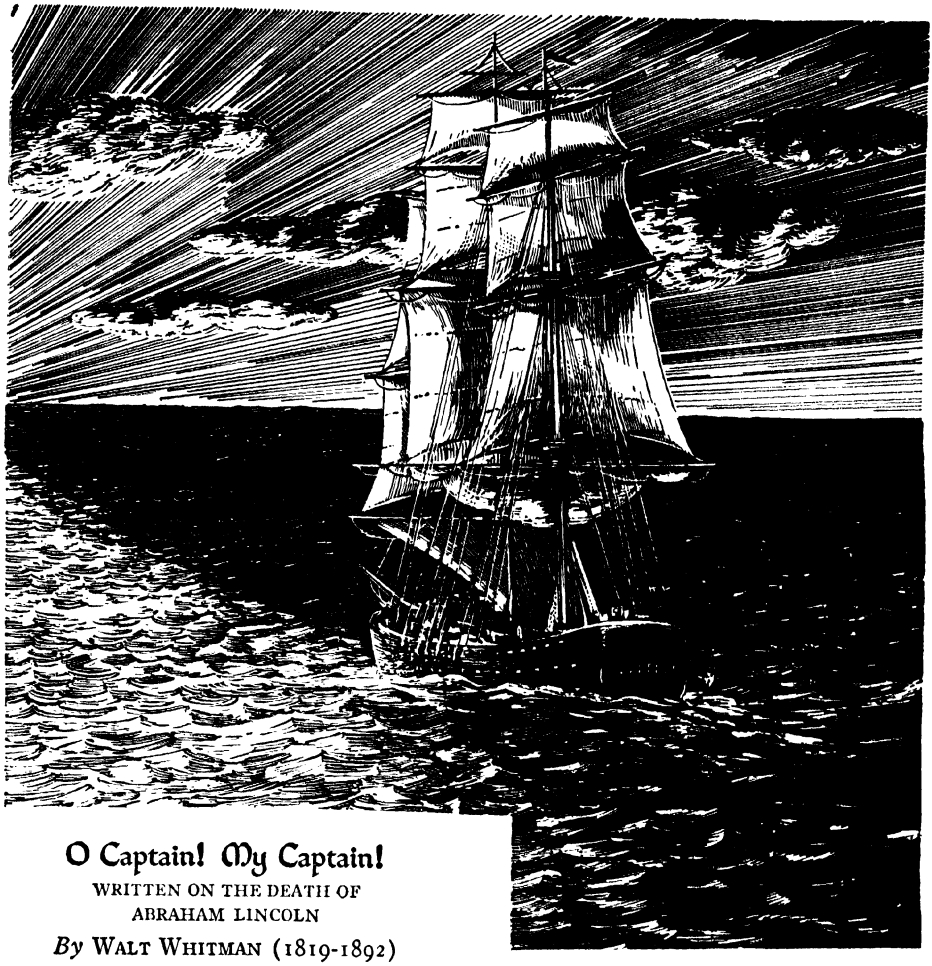
For though from out our bourne of Time and Place
The flood may bear me far,
I hope to see my Pilot face to face
When I have crossed the bar.

Requiem

By ROBERT LOUIS STEVENSON (1850-1894)

UNDER the wide and starry sky
Dig the grave and let me lie.
Glad did I live and gladly die,
And I laid me down with a will.

This be the verse you grave for me:
Here he lies where he longed to be;
Home is the sailor, home from the sea,
And the hunter home from the hill.



O Captain! My Captain!

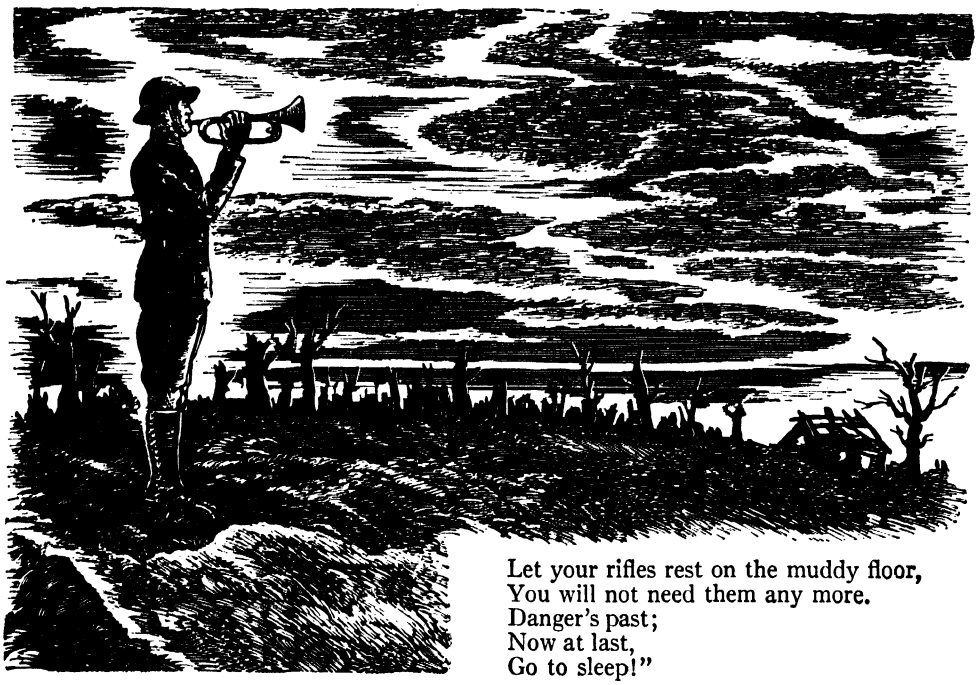
WRITTEN ON THE DEATH OF ABRAHAM LINCOLN

By WALT WHITMAN (1819-1892)

O CAPTAIN! my Captain! our fearful trip is done,
The ship has weathered every rack, the prize we sought is won,
The port is near, the bells I hear, the people all exulting,
While follow eyes the steady keel, the vessel grim and daring;
But O heart! heart! heart!
O the bleeding drops of red,
Where on the deck my Captain lies,
Fallen cold and dead.

O Captain! my Captain! rise up and hear the bells;
Rise up—for you the flag is flung—for you the bugle trills,
For you bouquets and ribboned wreaths—for you the shores a-crowding,
For you they call, the swaying mass, their eager faces turning;
Here Captain! dear father!
This arm beneath your head!
It is some dream that on the deck
You've fallen cold and dead.

My Captain does not answer, his lips are pale and still,
My father does not feel my arm, he has no pulse nor will,
The ship is anchored safe and sound, its voyage closed and done,
From fearful trip the victor ship comes in with object won;
Exult O shores, and ring O bells!
But I with mournful tread,
Walk the deck my Captain lies,
Fallen cold and dead.



Rouge Bouquet*

MARCH 7, 1918

By JOYCE KILMER
(1886-1918)

IN A wood they call the Rouge Bouquet
There is a new-made grave to-day
Built by never a spade nor pick
Yet covered with earth ten metres thick.
There lie many fighting men,
Dead in their youthful prime,
Never to laugh nor love again
Nor taste the summertime.
For Death came flying through the air
And stopped his flight at the dugout stair,
Touched his prey and left them there,
Clay to clay.
He hid their bodies stealthily
In the soil of the land they fought to free
And fled away.
Now over the grave abrupt and clear
Three volleys ring;
And perhaps their brave young spirits hear
The bugle sing:
"Go to sleep!
Go to sleep!
Slumber well where the shell screamed and fell.
Let your rifles rest on the muddy floor,
You will not need them any more.
Danger's past;
Now at last,
Go to sleep!"

There is on earth no worthier grave
To hold the bodies of the brave
Than this place of pain and pride
Where they nobly fought and nobly died.
Never fear but in the skies
Saints and angels stand
Smiling with their holy eyes
On this new-come band.
St. Michael's sword darts through the air
And touches the aureole on his hair
As he sees them stand saluting there,
His stalwart sons:
And Patrick, Brigid, Columkill
Rejoice that in veins of warriors still
The Gael's blood runs.
And up to Heaven's doorway floats,
From the wood called Rouge Bouquet,
A delicate cloud of bugle notes
That softly say:
"Farewell! Farewell.
Comrades true, born anew, peace to you!
Your souls shall be where the heroes are
And your memory shine like the morning-star.
Brave and dear,
Shield us here.
Farewell!"

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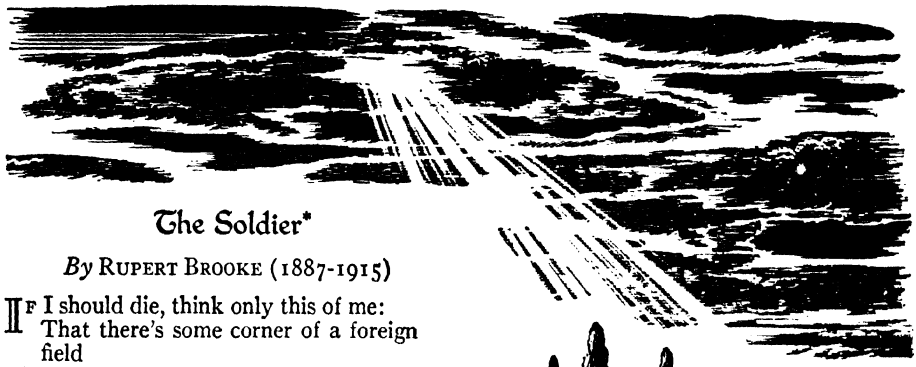
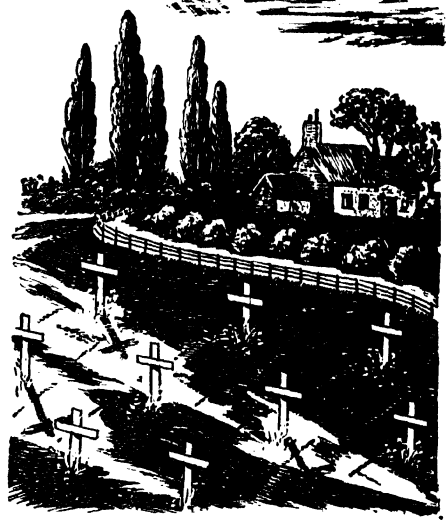


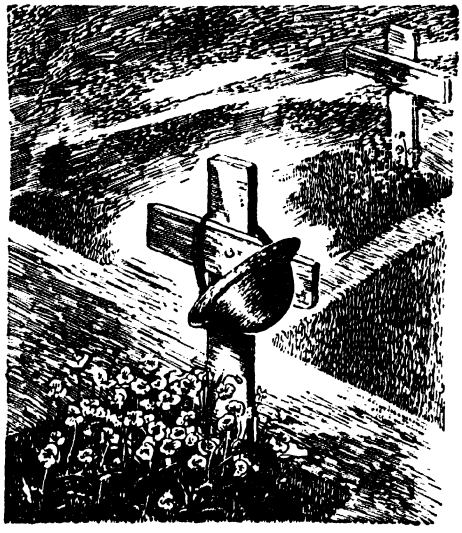
The Soldier*

By RUPERT BROOKE (1887-1915)

IF I should die, think only this of me:
That there's some corner of a foreign field
That is for ever England. There shall be
In that rich earth a richer dust concealed;
A dust whom England bore, shaped, made aware,
Gave, once, her flowers to love, her ways to roam,
A body of England's breathing English air,
Washed by the rivers, blest by suns of home.
And think, this heart, all evil shed away,
A pulse in the eternal mind, no less
Gives somewhere back the thoughts by England given;
Her sights and sounds; dreams happy as her day;
And laughter, learnt of friends; and gentleness,
In hearts at peace, under an English heaven.

*From The Collected Poems of Rupert Brooke, by permission of Dodd, Mead & Co., Inc., and McClelland & Stewart, Ltd.





In Flanders Fields*

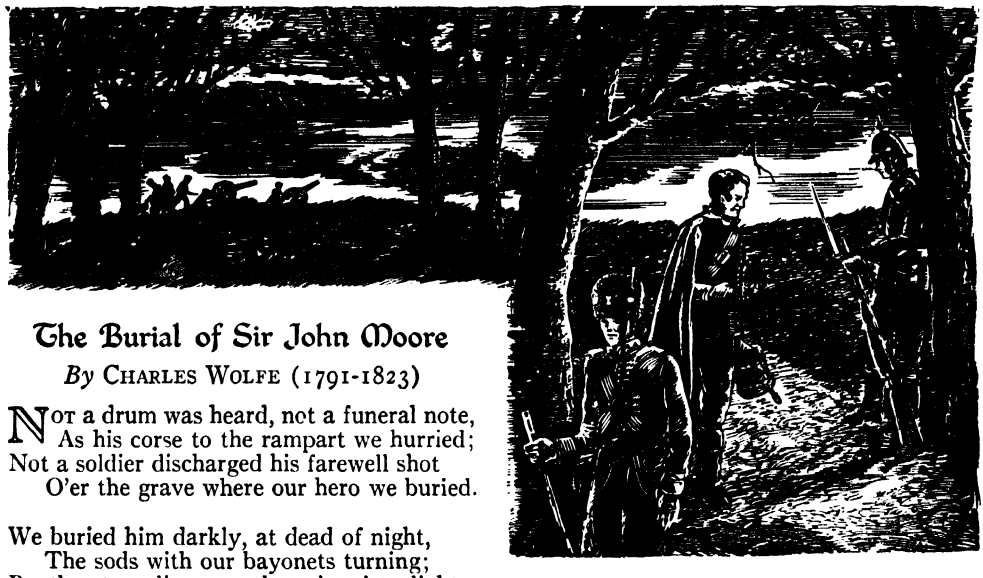
By JOHN MCCRAE (1872-1918)

IN Flanders fields the poppies blow
Between the crosses, row on row,
That mark our place; and in the sky
The larks, still bravely singing, fly
Scarce heard amid the guns below.

We are the Dead. Short days ago
We lived, felt dawn, saw sunset glow,
Loved and were loved, and now we lie,
In Flanders Fields.

Take up our quarrel with the foe:
To you from failing hands we throw
The torch; be yours to hold it high.
If ye break faith with us who die
We shall not sleep, though poppies grow
In Flanders Fields.

*Reprinted from IN FLANDERS FIELDS, by John McCrae, by permission of, and arrangement with, the publishers, G. P. Putnam's Sons, New York.



The Burial of Sir John Moore

By CHARLES WOLFE (1791-1823)

NOT a drum was heard, not a funeral note,
As his corse to the rampart we hurried;
Not a soldier discharged his farewell shot
O'er the grave where our hero we buried.

We buried him darkly, at dead of night,
The sods with our bayonets turning;
By the struggling moonbeam's misty light,
And the lantern dimly burning.

No useless coffin enclosed his breast,
Not in sheet or in shroud we wound him;
But he lay like a warrior taking his rest,
With his martial cloak around him.

Few and short were the prayers we said,
And we spoke not a word of sorrow;
But we steadfastly gazed on the face that was dead,
And we bitterly thought of the morrow.

We thought, as we hollowed his narrow bed,
And smoothed down his lonely pillow,
That the foe and the stranger would tread o'er his head,
And we far away on the billow!

Lightly they'll talk of the spirit that's gone,
And o'er his cold ashes upbraid him;
But little he'll reck, if they let him sleep on
In the grave where a Briton has laid him.

But half of our heavy task was done
When the clock struck the hour for retiring;
And we heard the distant and random gun
That the foe was sullenly firing.

Slowly and sadly we laid him down
From the field of his fame fresh and gory;
We carved not a line, and we raised not a stone,
But we left him alone with his glory.

On the Death of Joseph Rodman Drake

By FITZ-GREENE HALLECK (1790-1867)

GREEN be the turf above thee,
Friend of my better days!
None knew thee but to love thee,
Nor named thee but to praise.

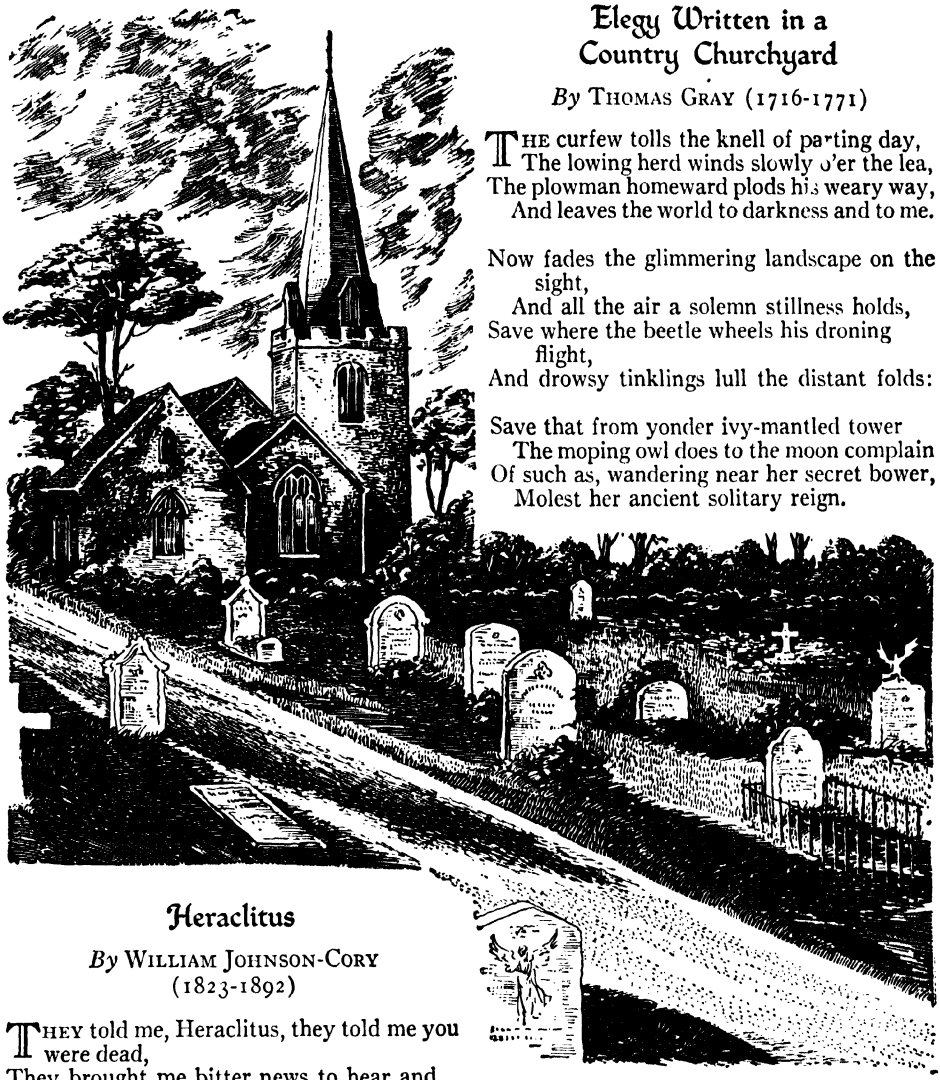
Tears fell, when thou wert dying,
From eyes unused to weep,
And long where thou art lying,
Will tears the cold turf steep.

When hearts, whose truth was proven,
Like thine, are laid in earth,
There should a wreath be woven
To tell the world their worth;

And I, who woke each morrow
To clasp thy hand in mine,
Who shared thy joy and sorrow,
Whose weal and woe were thine:

It should be mine to braid it
Around thy faded brow,
But I've in vain essayed it,
And feel I cannot now.

While memory bids me weep thee,
Nor thoughts nor words are free,
The grief is fixed too deeply
That mourns a man like thee.



Elegy Written in a Country Churchyard

By THOMAS GRAY (1716-1771)

THE curfew tolls the knell of parting day,
The lowing herd winds slowly o'er the lea,
The plowman homeward plods his weary way,
And leaves the world to darkness and to me.

Now fades the glimmering landscape on the sight,
And all the air a solemn stillness holds,
Save where the beetle wheels his droning flight,
And drowsy tinklings lull the distant folds:

Save that from yonder ivy-mantled tower
The moping owl does to the moon complain
Of such as, wandering near her secret bower,
Molest her ancient solitary reign.

Beneath those rugged elms, that yew-tree's shade,
Where heaves the turf in many a mouldering heap,
Each in his narrow cell for ever laid,
The rude forefathers of the hamlet sleep.

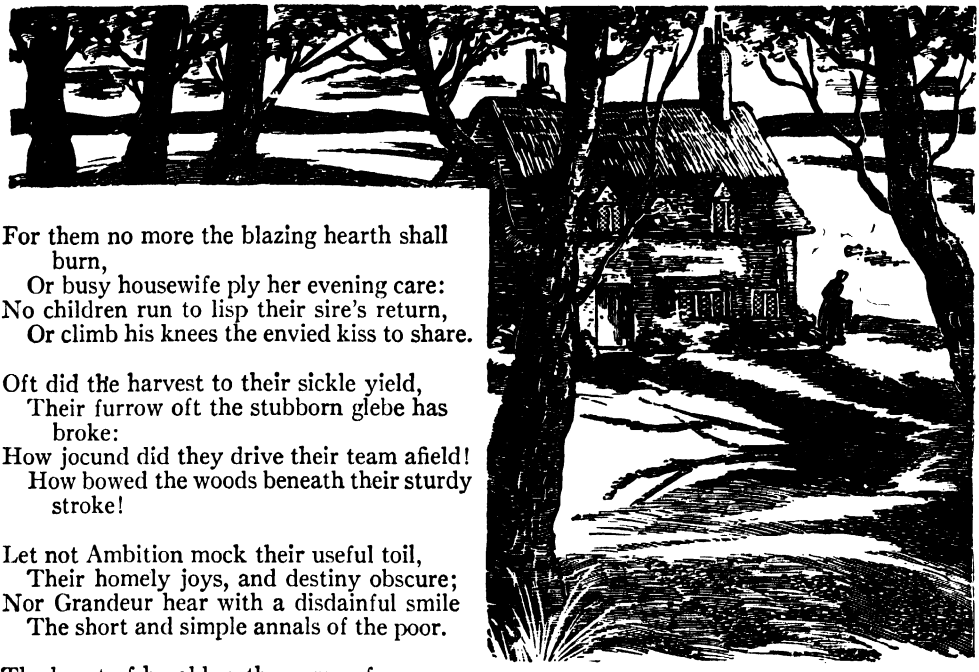
The breezy call of incense-breathing morn,
The swallow twittering from the straw-built shed,
The cock's shrill clarion, or the echoing horn,
No more shall rouse them from their lowly bed.

Heraclitus

By WILLIAM JOHNSON-CORY
(1823-1892)

THEY told me, Heraclitus, they told me you were dead,
They brought me bitter news to hear and bitter tears to shed.
I wept as I remembered how often you and I
Had tired the sun with talking and sent him down the sky.

And now that thou art lying, my dear old Carian guest,
A handful of gray ashes, long, long ago at rest,
Still are thy pleasant voices, thy nightingales, awake;
For Death, he taketh all away, but them he cannot take.



For them no more the blazing hearth shall burn,
Or busy housewife ply her evening care:
No children run to lisp their sire's return,
Or climb his knees the envied kiss to share.

Oft did the harvest to their sickle yield,
Their furrow oft the stubborn glebe has broke:
How jocund did they drive their team afield!
How bowed the woods beneath their sturdy stroke!

Let not Ambition mock their useful toil,
Their homely joys, and destiny obscure;
Nor Grandeur hear with a disdainful smile
The short and simple annals of the poor.

The boast of heraldry, the pomp of power,
And all that beauty, all that wealth e'er gave,
Await alike the inevitable hour:—
The paths of glory lead but to the grave.

Nor you, ye proud, impute to these the fault
If Memory o'er their tomb no trophies raise,
Where through the long-drawn aisle and fretted vault
The pealing anthem swells the note of praise.

Can storied urn or animated bust
Back to its mansion call the fleeting breath?
Can Honor's voice provoke the silent dust,
Or Flattery soothe the dull cold ear of death?

Perhaps in this neglected spot is laid
Some heart once pregnant with celestial fire;
Hands, that the rod of empire might have swayed,
Or waked to ecstasy the living lyre.

But Knowledge to their eyes her ample page
Rich with the spoils of time did ne'er unroll;
Chill Penury repressed their noble rage,
And froze the genial current of the soul.

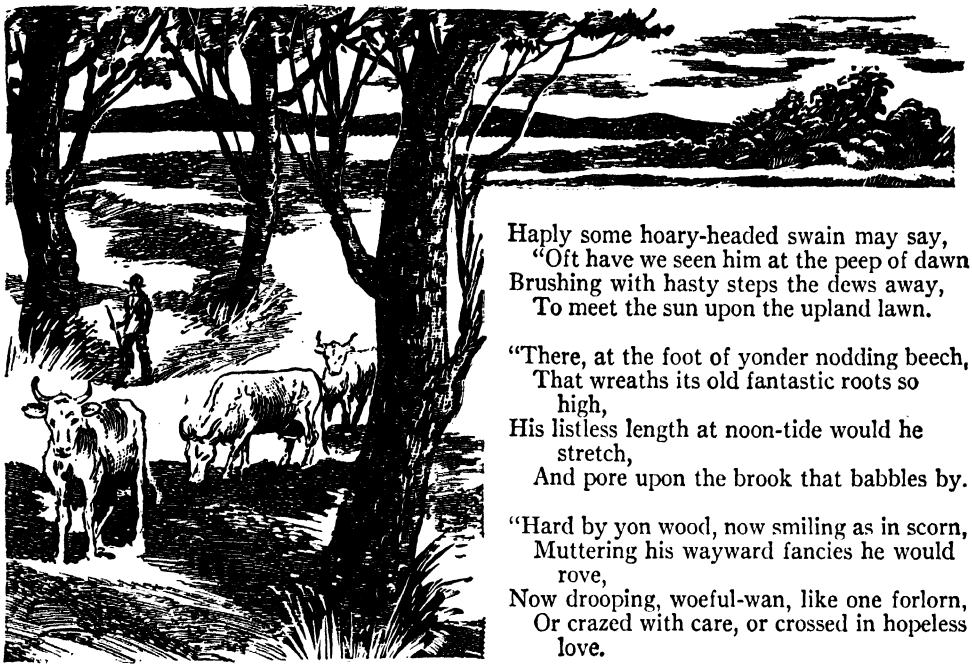
Full many a gem of purest ray serene
The dark unfathomed caves of ocean bear:
Full many a flower is born to blush unseen,
And waste its sweetness on the desert air.

Some village Hampden, that with dauntless breast,
The little tyrant of his fields withstood,
Some mute inglorious Milton here may rest,
Some Cromwell guiltless of his country's blood.

The applause of listening senates to command,
The threats of pain and ruin to despise,
To scatter plenty o'er a smiling land,
And read their history in a nation's eyes,

Their lot forbade: nor circumscribed alone
Their glowing virtues, but their crimes confined;
Forbade to wade through slaughter to a throne,
And shut the gates of mercy on mankind;

The struggling pangs of conscious truth to hide,
To quench the blushes of ingenuous shame,
Or heap the shrine of Luxury and Pride
With incense kindled at the Muse's flame.



Far from the madding crowd's ignoble strife
Their sober wishes never learned to stray;
Along the cool sequestered vale of life
They kept the noiseless tenor of their way.

Yet e'en these bones from insult to protect
Some frail memorial still erected nigh,
With uncouth rimes and shapeless sculpture decked,
Implores the passing tribute of a sigh.

Their name, their years, spelt by the unlettered Muse,
The place of fame and elegy supply:
And many a holy text around she strews,
That teach the rustic moralist to die.

For who, to dumb forgetfulness a prey,
This pleasing anxious being e'er resigned,
Left the warm precincts of the cheerful day,
Nor cast one longing lingering look behind?

On some fond breast the parting soul relies,
Some pious drops the closing eye requires;
E'en from the tomb the voice of Nature cries,
E'en in our ashes live their wonted fires.

For thee, who, mindful of the unhonored dead,
Dost in these lines their artless tale relate;
If chance, by lonely contemplation led,
Some kindred spirit shall inquire thy fate—

Haply some hoary-headed swain may say,
"Oft have we seen him at the peep of dawn
Brushing with hasty steps the dews away,
To meet the sun upon the upland lawn.

"There, at the foot of yonder nodding beech,
That wreaths its old fantastic roots so high,
His listless length at noon-tide would he stretch,
And pore upon the brook that babbles by.

"Hard by yon wood, now smiling as in scorn,
Muttering his wayward fancies he would rove,
Now drooping, woeful-wan, like one forlorn,
Or crazed with care, or crossed in hopeless love.

"One morn I missed him on the 'customed hill,
Along the heath, and near his favorite tree;
Another came; nor yet beside the rill,
Nor up the lawn, nor at the wood was he:

"The next, with dirges due in sad array,
Slow through the church-way path we saw him borne,—
Approach and read (for thou canst read) the lay
Graved on the stone beneath yon aged thorn."

The Epitaph

Here rests his head upon the lap of Earth
A Youth to Fortune and to Fame unknown.
Fair Science frowned not on his humble birth,
And Melancholy marked him for her own.

Large was his bounty, and his soul sincere,
Heaven did a recompense as largely send:
He gave to Misery (all he had) a tear,
He gained from Heaven ('twas all he wished) a friend.

No farther seek his merits to disclose,
Or draw his frailties from their dread abode,
(There they alike in trembling hope repose,)
The bosom of his Father and his God.

THE NEXT POEMS ARE ON PAGE 3927.

A GREAT ROMAN CHARIOT RACE IN THE DAYS OF BEN-HUR

Nothing delighted the people of Rome more than to watch the exciting chariot races that took place in the great arena known as the Circus Maximus. Round and round the chariots went at a tearing pace, as seen here, and often would collide with one another, either by accident or by the design of the drivers, the horses and charioteers being killed, or crippled for life, as was Messala when Ben-Hur deliberately upset his chariot. Ben-Hur carried no whip, but steered his horses to victory by skill and strength.

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A ROMANCE OF LONG AGO

THE famous book whose story we tell here is a work of fiction dealing with the time of Jesus, and was written by an eminent American soldier-author. Probably no tale of Bible times has enjoyed greater popularity than this graphic and thrilling romance of a young Jew who became a convert through the teachings of Jesus. General Lew Wallace, the author, was already well known as a distinguished soldier and a statesman, as well as a story-writer, when in 1880 he published Ben-Hur. But the fame that book brought to him entirely eclipsed all his earlier achievements. He was fifty-three years of age when the story appeared. With the exception of Uncle Tom's Cabin, probably no novel written in recent times has been more widely read. General Wallace died in 1905.

BEN-HUR

THE great city of Jerusalem and all the land of Judea were under the heel of Rome. A Roman official known as the procurator administered the government on behalf of the imperial power, and, supported by the stout blades of the Roman legionaries, kept the people of Jerusalem in subjection.

Such was the state of affairs when, some three years before the birth of Christ, a son named Judah was born to Ithamar, of the house of Hur, a prince of Jerusalem and the richest man of his time. Judah Ben-Hur, though of the Jewish race, was the playmate of Messala, the son of one of the high Roman officials at Jerusalem.

Messala, who had been sent to Rome to finish his education as a soldier, had not been long back in Jerusalem when the new procurator arrived from Rome. His name was Gratus, and his entry into the city was made the occasion of a grand procession. The Romans rejoiced in spectacular display, especially when it conveyed to a subject people some notion of the overwhelming power and glory of Rome.

High up on the flat roof of the house of Hur the young Jewish noble stood to watch the procession pass. Leaning over the parapet, he dislodged by accident one of the heavy tiles. This fell into the road below just as Gratus was riding past, and struck him from his horse. In the confusion that followed, both Jews and Romans were ready to believe that a deliberate attempt had been made to slay the Roman official. Though Gratus suffered but slightly from this accident, Messala denounced Ben-Hur as an assassin. Without the semblance of a trial the youth was condemned to the galleys, while the palace of his fathers was seized in the name of the emperor. No one knew to what fate his mother and his young sister Tirzah had been sent. Subjected to the cruelest treatment, the youth was conveyed to the seacoast. As he passed through the little town of Nazareth a youth, who accompanied an elderly man carrying the tools of a carpenter, came forward with quiet fearlessness to the Jewish prisoner. Looking upon him with infinite pity, he gave him a drink of water before the astonished guards could interfere.

A galley-slave was usually worn to death in a year or so. But Ben-Hur had not abandoned the hope that he might yet live to fight for the Lord of Israel. Even in the awful depression of his new life, chained to a bench in the galley and tugging wearily at a heavy oar, he clung to his hope. His shrewd mind told him that by changing from one side of the galley to the other he would be better able to stand the strain of the toil. This change he contrived to effect, so that he developed the strength and muscles of a giant, and became the best oarsman in the galley. After three years as a slave

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Ben-Hur saved the life of Arrius, the Roman tribune.

Out of gratitude for this service and pity for the youth's wrongs, the tribune adopted the young Jew as his heir. A new life opened out again for the son of Ithamar, and he spent five years learning the art of war at Rome. Arrius died within that time, and Ben-Hur became the possessor of his wealth. A great expedition was being prepared to attack the Parthians in the East. Ben-Hur took service in this so that he might experience real warfare and be the better able to help his countrymen some day to throw off the yoke of Rome.

BEN-HUR FINDS AN OLD FRIEND AT ANTIOCH

It was at the great and populous city of Antioch that the forces were being assembled, and thither Ben-Hur went. Here, to his surprise, he found that the greatest merchant, whose ships crowded the harbor, was one Simonides, who had been his father's steward and slave. According to Jewish law, all that he possessed, including his own person, was the property of the son of Ithamar.

But in the mind of Ben-Hur there was no thought of asserting his power over Simonides. He sought him out solely to discover what had become of his mother and Tirzah. The merchant, an aged man, was broken in body, for he had been subjected to cruel torture by Gratus when that tyrant had sought to make him disclose the sources of Ithamar's wealth. Simonides had defeated the designs of the Roman, and had employed his dead master's capital to such good purpose that he had become the richest merchant in all the world. When convinced that Ben-Hur was indeed the son of his old master, he offered to surrender everything to him, according to the Jewish law.

Ben-Hur, however, resolutely refused to profit by the devotion of Simonides, and would claim no more than that portion of the merchant's wealth which had been the property of his own father.

During a visit to the great circus where the favorite sport of chariot-racing was conducted, Ben-Hur saw various charioteers practicing their four-horse teams in the arena. One of these he recognized as the haughty Messala, his old playmate and false friend. A great meeting was to be held in this vast arena in a week's time, when the chariot races would be the centre of interest. Among the various teams there was one of four beautiful Arab horses. These belonged to the sheik Ilderim, who was in despair because the Roman driver did not seem to know how to drive them. Arabian horses were used to gentle treatment, and Roman drivers were accustomed to the merciless use of the lash. The sheik had changed drivers often, but without success, and he was without hope as the contest approached.

BALTHASAR, THE WISE MAN, TELLS BEN-HUR THE STORY OF THE STAR

So, seeking out the sheik Ilderim, Ben-Hur offered to drive his Arab horses in the chariot race. A trial run convinced the sheik that this young man of the powerful arms knew how to manage the team, and he consented to permit Ben-Hur to drive his Arab four in the great race.

It was at the house of the sheik that Ben-Hur again met an old Egyptian whose life he had saved. Balthasar was his name. He was one of three wise men who had heard a mysterious Voice. Being guided by a star, they had foregathered in the desert and made a pilgrimage to Nazareth to look upon the infant Jesus. From the lips of the old man Ben-Hur heard the thrilling story.

Simonides had also heard the story of Balthasar. He was eager to devote his enormous riches to fitting out an army to support this King of the Jews when he should rally all the nation to the flag of Judah. Messala had meanwhile recognized Ben-Hur, and was busily plotting to remove him from his path.

THE FIERCE EXCITEMENT OF THE CHARIOT RACES IN THE CIRCUS AT ANTIOCH

As the day of the sports came round great excitement was displayed about the chances of the Arab team. Not content with the hope of humiliating Messala by defeating him in the race, Ben-Hur employed a loyal Jew to induce the Roman to stake his entire fortune on the outcome of the great race.

In no city of the Roman world at that time, other than Rome itself, could so vast a gathering of people have been brought together. In the great chariot race there were six contestants. Ben-Hur was the favorite, because he stood for the Jewish people and their hatred of the Romans, and there were many Jews in Antioch. *In the words of Wallace the* description of the race is given.

THE CHARIOT RACE

THE competitors having started each on the shortest line for the position next the wall, yielding would be like giving up the race; and who dared yield? It is not in common nature to change a purpose in mid-career; and the cries of encouragement from the balcony were indistinguishable and indescribable: a roar which had the same effect upon all the drivers.

The fours neared the rope together. Then the trumpeter by the editor's side blew a signal vigorously. Twenty feet away it was not heard. Seeing the action, however, the judges dropped the rope, and not an instant too soon, for the hoof of one of Messala's horses struck it as it fell. Nothing daunted, the Roman shook out his long lash, loosed the reins, leaned forward, and, with a triumphant shout took the wall.

"Jove with us! Jove with us!" yelled all the Roman faction, in a frenzy of delight.

As Messala turned in, the bronze lion's head at the end of his axle caught the fore-leg of the Athenian's right-hand trace-mate, flinging the brute over against its yoke-fellow. Both staggered, struggled, and lost their headway. The ushers had their will at least in part. The thousands held their breath with horror; only up where the consul sat was there shouting.

"Jove with us!" screamed Drusus, frantically.

"He wins! Jove with us!" answered his associates, seeing Messala speed on.

Tablet in hand, Sanballat turned to them; a crash from the course below stopped his speech, and he could not but look that way.

Messala having passed, the Corinthian was the only contestant on the Athenian's right, and to that side the latter tried to turn his broken four; and then, as ill-fortune would have it, the wheel of the Byzantine, who was next on the left, struck the tail-piece of his chariot, knocking his feet from under him. There was a crash, a scream of rage and fear, and the unfortunate Cleanthes fell under the hoofs of his own steeds: a terrible sight, against which Esther covered her eyes.

On swept the Corinthian, on the Byzantine, on the Sidonian.

Sanballat looked for Ben-Hur, and turned again to Drusus and *his coterie.*

"A hundred sestertii on the Jew!" he cried.

"Taken!" answered Drusus.

"Another hundred on the Jew!" shouted Sanballat.

Nobody appeared to hear him. He called again; the situation below was too absorbing, and they were too busy shouting, "Messala! Messala! Jove with us!"

When the Jewess ventured to look again, a party of workmen were removing the horses and broken car; another party were taking off the man himself; and every bench upon which there was a Greek was vocal with execrations and prayers for vengeance. Suddenly she dropped her hands; Ben-Hur, unhurt, was to the front, coursing freely forward along with the Roman! Behind them, in a group, followed the Sidonian, the Corinthian, and the Byzantine.

The race was on; the souls of the racers were in it; over them bent the myriads.

When the dash for position began, Ben-Hur, as we have seen, was on the extreme left of the six. For a moment, like the others, he was half blinded by the light in the arena; yet he managed to catch sight of his antagonists and divine their purpose. At Messala, who was more than an antagonist to him, he gave one searching look. The air of passionless hauteur characteristic of the fine patrician face was there as of old, and so was the Italian beauty, which the helmet rather increased; but more—it may have been a jealous fancy, or the effect of the brassy shadow in which the features were at the moment cast—still the Israelite thought he saw the soul of the man as through a glass, darkly: cruel, cunning, desperate; not so excited as determined—a soul in a tension of watchfulness and fierce resolve.

In a time not longer than was required to turn to his four again, Ben-Hur felt his own resolution harden to a like temper. At whatever cost, at all hazards, he would humble this enemy! Prize, friends, wagers, honor—everything that can be thought of as a possible interest in the race was lost in the one deliberate purpose. Regard for life even should not hold him back. Yet there was no passion, on his part; no blinding rush of heated blood from heart to brain, and back again; *no impulse to fling himself upon Fortune: he did not believe in Fortune;*

far otherwise. He had his plan, and, confiding in himself, he settled to the task never more observant, never more capable. The air about him seemed aglow with a renewed and perfect transparency.

When not half-way across the arena, he saw that Messala's rush would, if there was no collision, and the rope fell, give him the wall; that the rope would fall, he ceased as soon to doubt; and, further, it came to him, a sudden flash-like insight, that Messala knew it was to be let drop at the last moment (prearrangement with the editor could safely reach that point in the contest); and it suggested, what more Roman-like than for the official to lend himself to a countryman who, besides being so popular, had also so much at stake? There could be no other accounting for the confidence with which Messala pushed his four forward the instant his competitors were prudentially checking their fours in front of the obstruction—no other except madness.

It is one thing to see a necessity and another to act upon it. Ben-Hur yielded the wall for the time.

The rope fell, and all the fours but his sprang into the course under urgency of voice and lash. He drew head to the right, and, with all the speed of his Arabs, darted across the trails of his opponents, the angle of movement being such as to lose the least time and gain the greatest possible advance. So, while the spectators were shivering at the Athenian's mishap, and the Sidonian, Byzantine, and Corinthian were striving, with such skill as they possessed, to avoid involvement in the ruin, Ben-Hur swept around and took the course neck and neck with Messala, though on the outside. The marvelous skill shown in making the change thus from the extreme left across to the right without appreciable loss did not fail the sharp eyes upon the benches: the Circus seemed to rock and rock again with prolonged applause. Then Esther clasped her hands in glad surprise; then Sanballat, smiling, offered his hundred sestertii a second time without a taker; and then the Romans began to doubt, thinking Messala might have found an equal, if not a master, and that in an Israelite!

And now, racing together side by side, a narrow interval between them, the two neared the second goal.

The pedestal of the three pillars there, viewed from the west, was a stone wall in the form of a half-circle, around which the course and opposite balcony were bent in exact parallelism. Making this turn was considered in all respects the most telling test of a charioteer; it was, in fact, the very feat in which Orestes failed. As an involuntary admission of interest on the part of the spectators, a hush fell over all the Circus, so that for the first time in the race the rattle and clang of the cars plunging after the tugging steeds were distinctly heard. Then, it would seem, Messala observed Ben-Hur, and recognized him; and at once the audacity of the man flamed out in an astonishing manner.

"Down Eros, up Mars!" he shouted, whirling his lash with practiced hand—"Down Eros, up Mars!" he repeated, and caught the well-doing Arabs of Ben-Hur a cut the like of which they had never known.

The blow was seen in every quarter, and the amazement was universal. The silence deepened; up on the benches behind the consul the boldest held his breath, waiting for the outcome. Only a moment thus: then, involuntarily, down from the balcony, as thunder falls, burst the indignant cry of the people.

The four sprang forward affrighted. No hand had ever been laid upon them except in love; they had been nurtured ever so tenderly; and as they grew, their confidence in man became a lesson to men beautiful to see. What should such dainty natures do under such indignity but leap as from death?

Forward they sprang as with one impulse, and forward leaped the car. Past question, every experience is serviceable to us. Where got Ben-Hur the large hand and mighty grip which helped him now so well? Where but from the oar with which so long he fought the sea? And what was this spring of the floor under his feet to the dizzy eccentric lurch with which in the old time the trembling ship yielded to the beat of staggering billows, drunk with their power? So he kept his place, and gave the four free reign, and called to them in soothing voice, trying merely to guide them round the dangerous turn; and before the fever of the people began to abate, he had back the mastery. Nor that only: on approaching the first goal, he was again side by side with Messala, bearing with him

the sympathy and admiration of every one not a Roman. So clearly was the feeling shown, so vigorous its manifestation, that Messala, with all his boldness, felt it unsafe to trifle further.

As the cars whirled round the goal, Esther caught sight of Ben-Hur's face—a little pale, a little higher raised, otherwise calm, even placid.

Immediately a man climbed on the entablature at the west end of the division wall, and took down one of the conical wooden balls. A dolphin on the east entablature was taken down at the same time.

In like manner, the second ball and second dolphin disappeared.

And then the third ball and third dolphin.

Three rounds concluded: still Messala held the inside position; still Ben-Hur moved with him side by side; still the other competitors followed as before. The contest began to have the appearance of one of the double races which became so popular in Rome during the later Cæsarean period—Messala and Ben-Hur in the first, the Corinthian, Sidonian, and Byzantine in the second. Meantime the ushers succeeded in returning the multitude to their seats, though the clamor continued to run the rounds, keeping, as it were, even pace with the rivals in the course below.

In the fifth round the Sidonian succeeded in getting a place outside Ben-Hur, but lost it directly.

The sixth round was entered upon without change of relative position.

Gradually the speed had been quickened—gradually the blood of the competitors warmed with the work. Men and beasts seemed to know alike that the final crisis was near, bringing the time for the winner to assert himself.

The interest which from the beginning had centred chiefly in the struggle between the Roman and the Jew, with an intense and general sympathy for the latter, was fast changing to anxiety on his account. On all the benches the spectators bent forward motionless, except as their faces turned following the contestants. Ilderim quitted combing his beard, and Esther forgot her fears.

"A hundred sestertii on the Jew!" cried Sanballat to the Romans under the consul's awning.

There was no reply.

"A talent—or five talents, or ten; choose ye!"

He shook his tablets at them defiantly.

"I will take thy sestertii," answered a Roman youth, preparing to write.

"Do not so," interposed a friend.

"Why?"

"Messala hath reached his utmost speed. See him lean over his chariot-rim, the reins loose as flying ribbons. Look then at the Jew."

The first one looked.

"By Hercules!" he replied, his countenance falling. "The dog throws all his weight on the bits. I see, I see! If the gods help not our friend, he will be run away with by the Israelite. No, not yet. Look! Jove with us, Jove with us!"

The cry, swelled by every Latin tongue, shook the *velaria* over the consul's head.

If it were true that Messala had attained his utmost speed, the effort was with effect; slowly but certainly he was beginning to forge ahead. His horses were running with their heads low down; from the balcony their bodies appeared actually to skim the earth; their nostrils showed blood-red in expansion; their eyes seemed straining in their sockets. Certainly the good steeds were doing their best! How long could they keep the pace? It was but the commencement of the sixth round. On they dashed. As they neared the second goal, Ben-Hur turned in behind the Roman's car.

The joy of the Messala faction reached its bound: they screamed and howled, and tossed their colors; and Sanballat filled his tablets with wagers of their tendering.

Malluch, in the lower gallery over the Gate of Triumph, found it hard to keep his cheer. He had cherished the vague hint dropped to him by Ben-Hur of something to happen in the turning of the western pillars. It was the fifth round, yet the something had not come; and he had said to himself, the sixth will bring it; but, lo! Ben-Hur was hardly holding a place at the tail of his enemy's car.

Over in the east end, Simonides' party held their peace. The merchant's head was bent low. Ilderim tugged at his beard, and dropped his brows till there was nothing of his eyes but an occasional sparkle of light. Esther scarcely breathed. Iras alone appeared glad.

Along the home-stretch—sixth round—Messala leading, next him Ben-Hur, and so close it was the old story:

"First flew Eumelus on Pheretian steeds;
With those of Tros bold Diomed succeeds;
Close on Eumelus' back they puff the wind,
And seem just mounting on his car behind;
Full on his neck he feels the sultry breeze,
And, hovering o'er, their stretching shadow sees."

Thus to the first goal, and round it. Messala, fearful of losing his place, hugged the stony wall with perilous clasp; a foot to the left, and he had been dashed to pieces; yet, when the turn was finished, no man, looking at the wheel-tracks of the two cars, could have said, here went Messala, there the Jew. They left but one trace behind them.

As they whirled by, Esther saw Ben-Hur's face again, and it was whiter than before.

Simonides, shrewder than Esther, said to Ilderim, the moment the rivals turned into the course, "I am no judge, good sheik, if Ben-Hur be not about to execute some design. His face hath that look."

To which Ilderim answered, "Saw you how clean they were and fresh? By the splendor of God, friend, they have not been running! But now watch!"

One ball and one dolphin remained on the entablatures; and all the people drew a long breath, for the beginning of the end was at hand.

First, the Sidonian gave the scourge to his four, and, smarting with fear and pain, they dashed desperately forward, promising for a brief time to go to the front. The effort ended in promise. Next, the Byzantine and Corinthian each made the trial with like result, after which they were practically out of the race. Thereupon, with a readiness perfectly explicable, all the factions except the Romans joined hope in Ben-Hur, and openly indulged their feeling.

"Ben-Hur! Ben-Hur!" they shouted, and the blent voices of the many rolled overwhelmingly against the consular stand.

From the benches above him as he passed, the favor descended in fierce injunctions.

"Speed thee, Jew!"

"Take the wall now!"

"On! loose the Arabs! Give them rein and scourge!"

"Let him not have the turn on thee again. Now or never!"

Over the balustrade they stooped low, stretching their hands imploringly to him.

Either he did not hear, or could not do better, for half-way round the course and he was still following; at the second goal even still no change!

And now, to make the turn, Messala began to draw in his left-hand steeds, an act which necessarily slackened their speed. His spirit was high; more than one altar was richer of his vows; the Roman genius was still president. On the three pillars only six hundred feet away were fame, increase of fortune, promotions, and a triumph ineffably sweetened by hate, all in store for him! That moment Malluch, in the gallery, saw Ben-Hur lean forward over his Arabs, and give them the reins. Out flew the many-folded lash in his hand; over the backs of the startled steeds it writhed and hissed, and hissed and writhed again and again; and though it fell not, there were both sting and menace in its quick report; and as the man passed thus from quiet to resistless action, his face suffused, his eyes gleaming, along the reins he seemed to flash his will; and instantly not one, but the four as one, answered with a leap that landed them alongside the Roman's car. Messala, on the perilous edge of the goal, heard, but dared not look to see what the awakening portended. From the people he received no sign. Above the noises of the race there was but one voice, and that was Ben-Hur's. In the old Aramaic, as the sheik himself, he called to the Arabs,

"On, Atair! On, Rigel! What, Antares! dost thou linger now? Good horse—oho, Aldebaran! I hear them singing in the tents. I hear the children singing and the women—singing of the stars, of Atair, Antares, Rigel, Aldebaran, victory! —and the song will never end. Well done! Home to-morrow, under the black tent—home! On, Antares! The tribe is waiting for us, and the master is waiting! 'Tis done! 'tis done! Ha, ha! We have overthrown the proud. The hand that smote us is in the dust. Ours the glory! Ha, ha!—steady! The work is done—soho! Rest!"

There had never been anything of the kind more simple; seldom anything so instantaneous.

At the moment chosen for the dash, Messala was moving in a circle round the goal. To pass him, Ben-Hur had to cross the track, and good strategy required the movement to be in a forward direction; that is, on a like circle limited to the least

possible increase. The thousands on the benches understood it all; they saw the signal given—the magnificent response; the four close outside Messala's outer wheel; Ben-Hur's inner wheel behind the other's car—all this they saw. Then they heard a crash loud enough to send a thrill through the Circus, and, quicker than thought, out over the course a spray of shining white and yellow flinders flew. Down on its right side toppled the bed of the Roman's chariot. There was a rebound as of the axle hitting the hard earth; another and another; then the car went to pieces; and Messala, entangled in the reins, pitched forward headlong.

To increase the horror of the sight by making death certain, the Sidonian, who had the wall next behind, could not stop or turn out. Into the wreck full speed he drove; then over the Roman, and into the latter's four, all mad with fear. Presently, out of the turmoil, the fighting of horses, the resound of blows, the murky cloud of dust and sand, he crawled, in time to see the Corinthian and Byzantine go on down the course after Ben-Hur, who had not been an instant delayed.

The people arose, and leaped upon the benches, and shouted and screamed. Those who looked that way caught glimpses of Messala, now under the trampling of the fours, now under the abandoned cars. He was still; they thought him dead; but far the greater number followed Ben-Hur in his career. They had not seen the cunning touch of the reins by which, turning a little to the left, he caught Messala's wheel with the iron-shod point of his axle, and crushed it; but they had seen the transformation of the man, and themselves felt the heat and glow of his spirit, the heroic resolution, the maddening energy of action with which, by look, word and gesture, he so suddenly inspired his Arabs. And such running! It was rather the long leaping of lions in harness; but for the lumbering chariot, it seemed the four were flying. When the Byzantine and Corinthian were half-way down the course, Ben-Hur turned the first goal.

And the race was WON!

The consul arose; the people shouted themselves hoarse; the editor came down from his seat, and crowned the victors.

The fortunate man among the boxers was a low-browed, yellow-haired Saxon, of such brutalized face as to attract a second look from Ben-Hur, who recognized a teacher with whom he himself had been a favorite at Rome. From him the young Jew looked up and beheld Simonides and his party on the balcony. They waved their hands to him. Esther kept her seat; but Iras arose, and gave him a smile and a wave of her fan—favors not the less intoxicating to him because we know, O reader, they would have fallen to Messala had he been the victor.

The procession was then formed, and, midst the shouting of the multitude which had had its will, passed out of the Gate of Triumph.

And the day was over.

. . . . . .

With the success of Ben-Hur in the magnificent and madly glorious chariot race our quotation from the book ends. The rest of Ben-Hur's story we tell briefly.

Ben-Hur at once withdrew to a place of hiding until he might safely proceed to Jerusalem to search for his mother and sister. But he had little to fear from any vengeance of Gratus. That unjust governor had now been displaced, and a new governor named Pontius Pilate ruled in his stead.

WHAT HAPPENED AT JERUSALEM UNDER THE NEW GOVERNOR

The new governor, in taking over his charge, had discovered that in a subterranean prison, attended by a dumb jailer, were two women, Ben-Hur's mother and sister. They had long been kept there by Gratus, and from the terrible existence they had led, had both been stricken with leprosy. Pilate gave orders that they should be liberated and sent to the hill outside the city. An old servant encountered them and daily took them food.

When Ben-Hur at length had news of the fate of his dear ones, every effort to discover them was vain. Thinking them to be dead, he devoted himself to raising an army to fight for the King of the Jews when He should come.

Now, at this time, the infant whom Balthasar had journeyed to Nazareth to look upon had grown into manhood. He had been going about throughout Judea, teaching the common people to practice gentleness and mercy, to worship God in holiness, and to believe in Him and His Son Jesus if they would be saved.

Among these believers was Balthasar, whom Ben-Hur met again on his way to look upon the Teacher he had worshiped as a babe. The young Jew accompanied the old man on his journey. When he saw the Nazarene he recognized in Him the gentle face and pitying eyes that belonged to the little carpenter who had given him water to drink when the Roman guards were taking him to the galleys. Thrilled and fascinated though he was by this gentlest of teachers, he was not without a feeling of disappointment. All his preparations to raise an army that would fight with mortal weapons for the King of the Jews were useless.

BEN-HUR BECOMES A FOLLOWER OF JESUS OF NAZARETH

From place to place Ben-Hur followed Jesus, observing Him closely, witnessing the miracles that He wrought, believing in Him. He still hoped that he might be called upon to fight for Him as an earthly prince, for he could not understand why the kingdom of Jesus was not of this world. So it came about that Ben-Hur was one of the multitude that went up to Jerusalem with Jesus.

As they were passing the hill of the lepers two women ran down, and throwing themselves at the feet of the Master, besought Him to make them clean. He saw Jesus bless them and tell them that their faith had made them clean. Curious, and still a little doubting, Ben-Hur lingered behind to see if it was as the Master had said. Behold, his mother and sister stood before him restored to health.

It was required by the law that persons who had been cured of leprosy should tarry without the walls of Jerusalem for nine days before being allowed to return to their homes. Ben-Hur would not desert his mother and Tirzah during these nine days which they had to wait outside the city. So he was not present at those world-moving scenes when the Jewish multitude had turned against the gentle teacher of humility and holiness. In that short time the rabble and the priests had hounded Him to death and drawn from the reluctant Pontius Pilate consent to His execution.

THE LAST THAT BEN-HUR SAW OF HIS LORD AND MASTER

When Jesus was crucified on the hill of Calvary, Ben-Hur stood, in company with Simonides and Balthasar, believing that the figure on the central cross was that of the true Messiah. So affected by the dreadful scene was Balthasar that, before the earthquake had come to strike terror through all that multitude, his spirit had taken flight to be with Him who died on the Cross.

Not many years after this greatest event in the history of the world, Ben-Hur, who had married the daughter of Simonides, determined to use his riches in the cause of Christianity. To the construction of the Roman catacombs the fortunes of Ben-Hur and Simonides were devoted.

The Christ, as Ben-Hur saw him, had "a form slightly above the average in stature, and slender, even delicate. His action was calm and deliberate, like that habitual to men much given to serious thought upon grave subjects; and it well became his costume, which was an undergarment, full sleeved and reaching to the ankles, and an outer robe called the talith; on his left arm he carried the usual handkerchief for the head, the red fillet swinging loose down his side. Except the fillet and a narrow border of blue at the lower edge of the talith, his attire was of linen yellowed with dust and road-stains. Possibly the exception should be extended to the tassels, which were blue and white, as prescribed by law for rabbis.

"The head was open to the cloudless light, except as it was draped with hair long and slightly waved, and parted in the middle, and auburn in tint, with a tendency to reddish golden where most strongly touched by the sun. Under a broad, low forehead, under black well-arched brows, beamed eyes dark-blue and large, and softened to exceeding tenderness by lashes of the great length sometimes seen on children, but seldom, if ever, on men. The delicacy of the nostrils and mouth was unusual; and when it was taken into account with the gentleness of the eyes, the pallor of the complexion, the fine texture of the hair, and the softness of the beard, which fell in waves over his throat to his breast, never a soldier but would have laughed at him in encounter, never a woman who would not have confided in him at sight, never a child that would not, with quick instinct, have given him its hand and whole artless trust; nor might any one have said he was not beautiful."

THE NEXT STORY OF FAMOUS BOOKS IS ON PAGE 3861.

THE DAY BIRDS OF PREY

WE enter now the presence of the regal birds, the sovereigns of the air. We have spoken of cuckoos and sparrows, of larks and crows, of the parrots, starlings and warblers. Now we come to the day birds of prey—the bold, fierce hunters of the air corresponding to the lions and tigers and the other great flesh-eating mammals that prowl the earth.

Ornithologists (students of bird life) have given the name *Falconiformes,* from the Latin word meaning sickle, to this Order of birds. Look at the pictures in this article. You can see the sharp hooked upper part of the bill (like a sickle) on all the birds. Their claws are also sharp and curved.

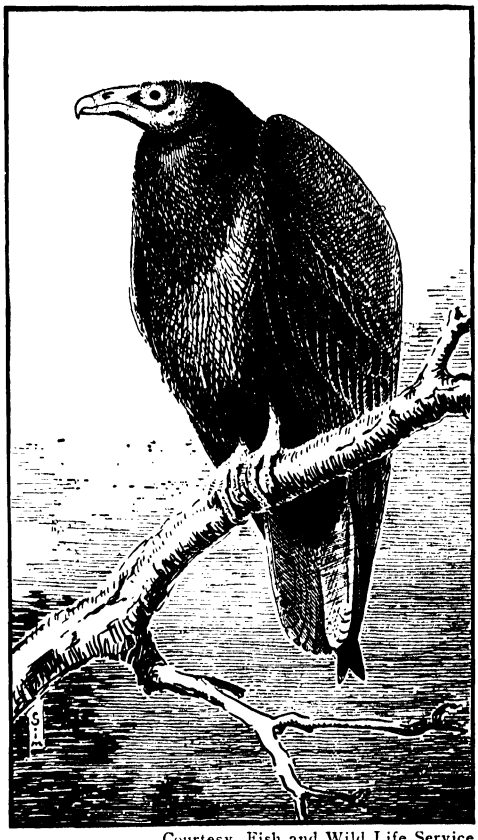
Among the *falconiformes* there are several sub-orders and families, the vultures of the New and Old Worlds, the secretary-bird of Africa, the hawks, harriers and ospreys, the falcons and caracaras and buzzards and the eagles. They are swift, powerful fliers, all of them, seizing their prey boldly in the daylight, living by their speed and courage.

The animal race must have its check and brake, and the day birds of prey have helped to fulfil the purpose of killing the unnecessary members of families that might otherwise be too numerous. They, together with the night birds of prey, have been the natural controllers of the rodents that destroy our crops, of the herb-eaters that consume our pastures, of the birds that ravage our orchards, of the reptiles whose bite is swift death to man and beast.

It is not only as destroyers that the birds of prey are notable; we rely enormously on their efforts to rid the earth of dead flesh and other rotting matter which would disgust our senses and poison our health.

Some of the *falconiformes* are inland birds, others stay near the sea and get their living from the water. In this chapter we shall range over the world. More is told about our American day birds of prey in the articles on Birds of North America.

The first of the day birds of prey which we shall consider is the osprey. Another



Courtesy, Fish and Wild Life Service
U. S. Department of the Interior

The turkey vulture, wrongly called turkey buzzard.

name for this bird is fish-hawk, and a good fisher it is. In many ways it resembles the fishing owl, especially in habits, though they are not closely related. Both fish-hawk and fishing owl have sharp, deadly talons with tiny spikes on the bottom for holding the slippery fish firmly. The owl, however, hunts, or rather fishes, by night, while the osprey is a day bird.

To us the osprey is harmless, except when we try to rob its nest of young or eggs. Then it acts like a feathered fury, fiercely defending its home. The eggs are of good size and very brilliantly colored with markings of purple, lilac, orange, red and black. Its nest is a huge mass of sticks, placed on a ledge of rocks or along low shores, in trees, and occupied over and over again for years.

The fish-hawk flies with the grace and beauty which are gifts of this whole order,

but ends its flight with such a plunge into sea or river that an onlooker might fancy it shot dead. It goes down swiftly, coming up with its prey, not in its beak, but in its talons. There we have a capital difference in the methods of land warriors and aerial hunters. The lion and tiger hold with the claws to kill, and carry with the mouth. The birds of prey kill with the terrible beak, but carry with the claws.

The osprey is found in nearly every part of the world where there is water. It is two feet long, brown in color, for the most part, and the wings are long and strong. It builds its enormous nest of sticks on cliffs or trees near the water, and returns to the same nest year after year. Frequently he is robbed of his prey by one of the eagles. It is believed that there is only one species.

THE WILD HOMES OF THE FALCONS OF THE NORTH LANDS

The falcons are wonderful creatures, whether the Greenland falcons or the Iceland falcons, or the larger Norwegian Falcon, or Gyrfalcon, which ranges from the old home of the Norsemen through all Northern Europe, right away to the dim, cold lands of Northern America and Alaska, and makes a prosperous living in adversity.

It is curious that men have been able to call into servitude birds from this fierce line. In the Middle Ages, and earlier, falconry was a favorite sport in Europe. Falcons were trained to bring down birds from the sky and then return to the owner's wrist. The three large falcons we have mentioned were used and also some of the smaller species.

To-day, in Palestine and India, the Saker Falcon is employed to hunt birds and animals. Hawks will not peck out a hawk's eyes, the saying runs, but sakers will hawk kites, chasing and grappling them in midair, to bring them dead to the ground, as eagerly as a kestrel strikes down a sparrow.

The Peregrine Falcon is the typical species. There is hardly a country in the world where it has not been found. It is the bird we often call the Duck Hawk. For its bulk it is the most powerful of all the birds of prey, and also the swiftest. As is general in the birds of prey, the male is the smaller of the species, fifteen inches long as against the seventeen inches or more of the female. Nesting sometimes in tall trees, the peregrines love better the cliff and headland, fit home for a creature in which flight seems to have reached perfection.

THE FALCON'S AMAZING FLIGHT WHICH MAN CANNOT EQUAL

Generally the food of the peregrine is birds. Its long pointed wings carry it through the air with the speed of an airplane. As a fact, we have no man-made engine of locomotion to compare with it. The peregrine is so fast, so enduring, so swift to turn and double, to rise and to descend, that we can scarcely hope to match it.

True, our airplanes can race it in a straight line, but they have engines with energy amounting to hundreds of horse-power; the peregrine is but one bird-power, and it does things in the air which, one fears, our aircraft can never rival—rising like a lark, soaring in the wind, speeding straight like a rushing swift, dropping sheer out of the skies to the earth in one grand plunge like a falling meteor, but safe, unjarred, unfailing.

Few birds are too swift or courageous for the bold peregrine to engage. It will strike at quarry bigger than itself, as a wild goose, but a pigeon-breeder hates the bird. We must tell the truth. This wonderful hawk is a terror to pigeons and other birds.

A climber in the summer of 1920 was horrified to find in a peregrine's nest the rings that had once encircled the legs of twenty-two homing pigeons. Worse was to follow in the summer of 1923. It happened that a fisherman saw a falcon seize a pigeon in the air. He followed its line of flight; then, climbing down to the marauder's nest, saw an overwhelming spectacle. There were the unpalatable remains of many dinners, the parts of birds which the hawks do not eat. The feet of hundreds of pigeons were there, many of them bearing the numbered rings which owners attach to the legs of valuable birds. The tyrants had snapped up these adventurers as they crossed their line, engaged on races which had begun in various parts of the country.

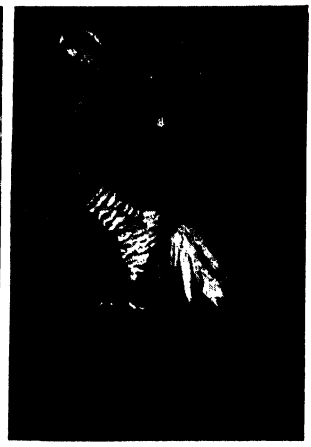
OTHER FALCONS, BOTH EUROPEAN AND AMERICAN

Several other true falcons belong to North America. The Prairie Falcon is a bird of the plains, and is seldom seen east of the Mississippi. The Pigeon

BIRDS OF PREY THAT HUNT BY DAY

The Indian kite.

The Chilean sea-eagle.



The goshawk.

The European sparrow hawk makes a raid on a flock of chaffinches.

The hobby.

The osprey alighting.

The king condor.

Hawk, sometimes called the American Merlin, is a small slaty blue falcon which breeds chiefly in Canada and winters in the United States. Richardson's Merlin is another western falcon, and the Sparrow Hawk is usually placed with them.

The European Hobby is rarer than the peregrine. They haunt Southern Europe in pairs, and should be welcomed as devourers of hosts of insects as well as their due measure of small birds. The hobby hen measures thirteen inches, but the wings seem very long.

THE MERLIN THAT FOLLOWS ITS QUARRY WHEREVER IT MAY GO

Like the peregrines, the European Merlins have long been trained to hunt for man. They are more pertinacious than the larger bird, which, like a great cheetah, adds dignity to speed, and abandons the obviously difficult, as when a bird goes to refuge in a tree or cavity. Not so the merlin. It follows in after the quarry, like a fiery little terrier into a fox-hole, and there, in the bird's own hiding-place completes its deadly mission. Only an expert can detect any difference between this bird and our own pigeon hawk.

There is some doubt whether the European Kestrel is a true falcon. It is the commonest European bird of prey. Together with swiftness it has an ability which we are spending thousands of dollars to impart to airplanes. It can hang apparently motionless in the air while searching for prey on the ground, like a little living statue suspended on high by invisible agency. It is called the "wind-hoverer" because of this gift. There is no prettier sight than a kestrel stationary up in the sunlight, its wings vibrating so rapidly as to be invisible, its keen, handsome little head turning from side to side to show that the thing is real, alive, and not a happy fancy of the mind. It is practically identical with our sparrow hawk.

The falcons have their pigmies, like other birds, and they have also their resplendent crested members, but we pass on to the sub-family of the buzzards. In North America the name is often incorrectly applied to one of the vultures of which we shall speak presently. In fact the buzzards are hawks, and there are more than thirty of them. Among American buzzards may be named the Red-tailed Hawk, often called the Hen Hawk and also the Red-shouldered Hawk. Swainson's Hawk, or Buzzard, common in the western half of North America, is almost the same bird as the Common Buzzard of Europe. The breast has a large cinnamon-red patch. The Rough-legged Hawk, another buzzard, has legs feathered to the toes. In spite of their names none of these is very dangerous to poultry.

Now we pass to another group, the Kites. There are about thirty species, nearly all belonging to the tropics. Formerly some were common in Europe, but they are now becoming rare. The Common Kite is reddish brown, and in former days was the scavenger in European cities. Four species are found in southern United States. The Swallow-tailed and the White-tailed occasionally wander into Canada, but the Mississippi Kite and the Everglades Kite are strictly southern birds.

The White-tailed Kite seems guiltless of offense against us. Its flight is easy and powerful. The Swallow-tail Kite is mainly a snake-eater, and those who have most closely studied it uphold this kite even against the swift for its tireless, graceful flight, beginning before the sun is up, and ending when the sun has been long below the horizon.

THE KINGS OF THE AIR THAT LIVE TO BE A HUNDRED

Now we pass on to the true kings of the air. The eagles await our coming. These are the most majestic creatures that wing the air. They have not the swift-turning flight of the hawks, they cannot rise straight up from the ground like the larks; they are like airplanes, and must have a long sweep of open land, or preferably a height, from which to take off. But in the air, here is dignity, power and splendor. The birds live to a great age, perhaps as much as a century. They occupy one dwelling-place for generation after generation. Haunting the wildest country, they seem, as they rise screaming into the skies, the very spirit of a scene in which mystery and something of terror mingle with rugged loveliness.

THE EIGHT KINDS OF SEA-EAGLE THAT INHABIT THE EARTH

At least eight species of sea-eagles are distributed about the earth. South America has the misfortune to lack a species, and this fact is one of the curi-

osities of animal distribution, for the Bald Eagle is found in North America and is the national emblem of the United States. An alternative and more correct name for this bird is the White-headed Sea-eagle.

This bird was formerly common all over North America, and is still to be found near the coast and the Great Lakes, and sometimes along large rivers. After it reaches the age of three years its head, neck and tail are white. They seem to mate for life and occupy the same nest year after year. They eat fish thrown upon the shore, or fish which they have compelled the osprey to drop, and sometimes catch them for themselves. They sometimes kill game birds, or small mammals and are known to eat carrion.

THE WHITE-TAILED ERNE, THE EUROPEAN SEA-EAGLE

The European example is the White-tailed Sea-eagle, of which the female measures thirty-four inches, the male six inches less. They build on craggy peaks remote from the haunts of man; but in the forest lands of Northern Europe they are at home in high trees. If not disturbed, they nest in the same spot and the same nursery annually, adding a little each year to their furniture, so that in the end their rough nest of twigs and sticks becomes a structure six feet and more in height.

Shepherds tell stories of the experiences of lambs with them. And there are tales of game birds caught by them. But in general it is birds of the shore and of the sea which these giants snap up, and these are far fewer than their catches in the water itself.

The sea-eagle has not his name for nothing. He has an eye like a telescope, which sees into the mysteries of the deep; at the sight of a prize he hurls himself at the water, dips like a flash with those terrible talons, and up comes the wriggling prize—big fish, small fish. It may be a herring; it is more likely to be of mackerel size; and on occasion the salmon is the reward of enterprise.

A THRILLING FIGHT IN AIR AND SEA BETWEEN A FISH AND AN EAGLE

But salmon vary in size, and sometimes are heavy, and one eagle has been known to grasp more than he could either raise or release. This bird had his talons firmly fixed in the plump back of a salmon, whose bulk would have graced the table of an alderman. Lift it into the air the bird could not; draw out its talons it either could not or would not. So there was a desperate struggle. First the eagle would lift the fish a little way out of the water and drop back with it; then the salmon would play the submarine and violently submerge, taking down the eagle with it. How the matter would have ended—perhaps in the death of both—we are unable to say, for an onlooker finished the contest by capturing both pursuer and pursued—surely a unique haul.

In Asia there is a sea-eagle greater than either of these. Steller's Sea-eagle, found in Siberia and occasionally in the Aleutian Islands, has white thighs and also shows white in the wings. It is the largest of all. There are African species also.

A BIRD OF THE AFRICAN HEIGHTS THAT FOLLOWS THE JUNGLE FIRE

We must have a word on the Bateleur Eagle, an African bird of the heights, which preys on the young of deer, antelopes and sheep, and distinguishes itself in action against snakes and other reptiles, of which its unflagging appetite demands unending supplies.

Fires in the jungle and grassy karoo, instead of frightening off the bateleur, are a summons to a feast. It follows the line of the fire, and snaps up the reptiles which emerge from it, even dashing with furious haste into the smoke to snatch up something it might otherwise miss. What a choice of fates for a living creature—death by fierce flame or by the beak of this feathered emblem of destruction! Its color is a strange mixture of maroon, black and gray.

The supreme sovereign of the Order is the superb Golden Eagle. The size is large. The wings of a female frequently measure seven feet from tip to tip—she is always larger than the male. The color is deep brown, in parts almost black, but the feathers on the head and neck are tawny or reddish brown. The base of the beak and the legs are bright yellow.

These birds do not disdain the union of art with power. Two will beat over ground together, so that as one puts up a hare or a rabbit by the strokes of its wings, the second will catch the animal as it flees in panic from the original

assailant. That is one of the cleverest things the king of birds is known to do. But it is not the most audacious, for a golden eagle has been seen to make its lightning plunge down through the air to snatch a grouse wounded by a shot, and carry it away before it can touch the ground. And another has been seen to stoop before panting hounds, clutch up the hare they were pursuing, and sail away with it.

There is not much that one would doubt of the golden eagle's daring, though here and there, as with ourselves and as with lions and bears and dogs, among the courageous may be found cowardly exceptions. In general, however, the king of birds, a splendid savage measuring a yard, lives up to the tradition which has been woven around it.

The nest of the golden eagle is perched high among mountains, or high hills, or on the shelves of inaccessible cliffs. It ranges the whole northern hemisphere. It was never common, for so great is its appetite and that of its young that usually only one pair lives in a considerable territory. Its food comprises birds, rabbits, hares, fawns, lambs and the foulest carrion. It is like the lordly lion; it will kill with dignity anything that opposes it, or it will batten like a jackal on fetid garbage.

There are legends that golden eagles carry off children and devour them, and in Scotland we find ancient inns bearing the name The Eagle and Child. But there seems no truth in the tradition. Admittedly eagles carry away fawns as heavy as babies, but not up through the air to their homes. They will seize a fawn on a height and fly downhill with it to a lower level, and devour it there, or carry away portions to their nestlings. That is quite a different matter from rising sheer into the heights with such a burden.

THE FEARFUL WORK OF THE BEAK AND TALONS OF THE GOLDEN EAGLE

Yet they perform wonders of daring and skill up in the wilds where the deer run free. An eagle will swoop on a herd feeding near a cliff, and, attacking one, will beat it with its wings, assail it with its great cutting beak, gripe it with its talons, and drive it headlong over the chasm, flying down then to feed at leisure.

There is nothing stranger recounted in the fables about these eagles than some of the stories which are undoubtedly true. Outside a forest a solitary roebuck was feeding. A golden eagle swooped down on it and drove its talons into the animal's back. Instinct came to the aid of the deer, and it turned and dashed for the safety of the wood, the great bird riding it. The first tree they met nearly achieved the object of the roebuck in striking its enemy from its back. The eagle took a deeper grip with its talons, but, as a second tree was neared, retaining its hold with one claw, it grasped the stem of the tree with the other.

So great, however, was the force with which the buck was moving, and so tenacious the hold of the eagle, that the bird was rent asunder, one half remaining firmly clinging to the tree, the other attached to the body of the deer.

It is curious that the handsome Imperial Eagle, numerous in South and Central Europe, and away to India and China, differs, according to country, in the character it betrays. In Europe it is regarded as second in dignity and courage only to the golden eagle; in India naturalists look upon it with disfavor as nothing more than a great kite. Has climate anything to do with it?

Does climate affect even the golden eagle? Here we either kill it or confine it to menageries. In Central Asia it is tamed to work for man as the hawks are elsewhere. But there is something stirring in the thought that the game of the golden eagle which hunts at the behest of a master is—the wolf!

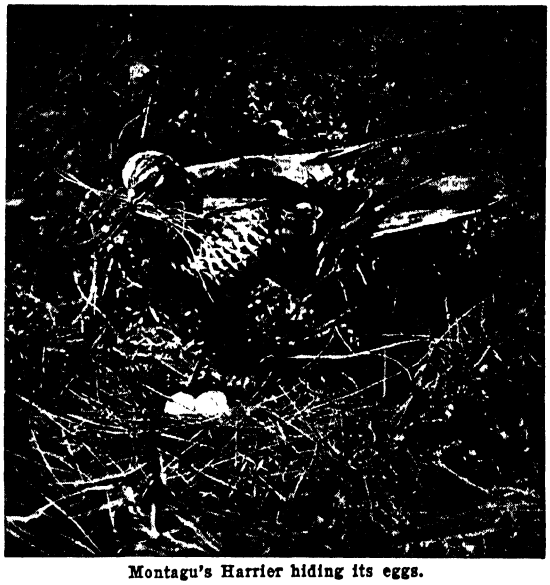
Spotted eagles, tawny eagles, wedge-tailed eagles, eagles which exist chiefly on the flesh of monkeys; eagles so forbidding of aspect as to be named harpy eagles—harpy being one of the fabulous monsters of old belief, which pictured a ravening bird with the features of a cruel woman—so the list runs on.

In the next group, that of the true hawks, we are upon difficult ground, for it is difficult to define a hawk. Apparently a hawk is a day bird of prey which is neither an eagle, a vulture, a falcon, a buzzard, a harrier nor a kite. Even with all these omitted there are about a hundred species.

Generally it may be said that a hawk has a short stout bill, a long square tail, long bare legs, and that its wings do not

extend to the end of the tail. The cutting edge of its upper bill is never notched. Hawks are scattered over the world, but the number of species of true hawks in Europe and North America is small, though many birds are called hawks.

The most common European species is the Sparrow Hawk. Here looks match performance, for these birds have the very carriage and countenance of battle. The female is nearly fourteen inches long, and the species is beautifully fitted for its life. A grand flier, it prefers to get its prey by stealth. It haunts wooded country, whence it dashes out on the bird which is to form its dinner, suddenly, to take its victim by surprise.



Montagu's Harrier hiding its eggs.

It seems always keeping its strength in reserve for flight in turn. And when man and gun are near, that is often enough what happens. The sparrow hawk really earns his keep nobly by killing birds where birds are too many. But men who breed birds to be shot in thousands each year prefer to be their own slaughterers. They hate this child of Nature, the sparrow hawk, which, for its sustenance, weeds out the weakliest of the covey.

We have two hawks closely akin to the European sparrow hawk. They are Cooper's Hawk and the Sharp-shinned Hawk. Both are common over North America. Both live mainly on birds and do not object to poultry. The American Goshawk is a larger bird, sometimes two feet long. The name means "goose hawk," and the European species was trained to kill the wild goose.

The next group is the Harriers. They are ground-loving birds which catch small birds, mammals and reptiles, but, in the case of the Marsh Harriers, find frogs and fish pleasant fare. Montagu's Harrier was once common in Europe, but is now rare. Our species is called the Marsh Hawk or the Marsh Harrier.

THE CARACARA OF SOUTH AMERICA THAT RUNS AS WELL AS IT FLIES

Near allies of the harriers are those South American hawks, the Caracaras, hawk-like in build and appearance, but not in habit. They are flesh-eaters, but they run as well as they fly. Flocking in numbers like wolves in a pack, they hunt in company, and, in the manner of the jackal following in the wake of the lion, the caracaras keep pace with human hunters to eat the offal and the carrion which they may furnish. One species, Audubon's Caracara, ranges into the southern part of the United States.

Where exactly to end the line of hawks and begin the line of vultures is a difficult matter, seeing that the great Lammergeiers, or Bearded Vultures, are closely related to both. The lammergeier is more vulture than hawk, yet it has the head and neck feathered, as no vulture should. The lammergeier is a magnificent bird, forty-two and more inches long. It lives in the mountain ranges of Southern Europe and of Asia, but descends to the plains to feed, chiefly on carrion, but sometimes on animals killed by itself. The name means "lamb vulture."

Sad stories of the practices of the lammergeier are told in some of the story-books. A mother working in a field leaves her baby at the edge, and the great bird swoops down and carries it away, never to be seen again. Some of these stories may be true, for the lammergeier is quite powerful enough to carry the weight of a baby or a lamb.

The vultures themselves are of hideous aspect and habit, bareheaded or bare-necked, sometimes both; they are weak of feet, so that they can not carry their prey, but must gorge on the ground where they find it. The sea-eagles have their feet and legs bare of feathers so that they may not be impeded by clogging their limbs when plunging them into the water; the vultures have their heads and necks bare because they plunge both into the decaying flesh that constitutes their meals.

THE GOOD WORK THE HIDEOUS VULTURES DO FOR MANKIND

They are the jackals and hyenas of their Order, living chiefly on filth, yet they are of value to us. They clear the earth of reeking impurity and are highly valuable servants. In many cities of the Eastern World disease would be even more common but for these creatures. But it is impossible, even granting that they are superb creatures on the wing, to take delight in their form or functions.

The Secretary-bird of Africa, however, is a vulture which is not repulsive. In fact, in a freakish fashion he is not unhandsome in appearance. The feathers at the back of the head are supposed to look like a quill pen stuck behind the ear. Hence we have the name. The secretary-bird plays the part of a watch-dog about the farms of South Africa.

His long legs make a football of the deadliest snake, and his knobbed wings beat the reptile to death, whereupon the poisonous reptile makes him a satisfactory meal. Tortoises, lizards, mice, birds and even baby deer help to fill his larder.

All the vultures mentioned except the caracara belong to the Old World. The New World vultures are an entirely distinct family. The most important members are the Condors of South America, birds whose wings might have startled even Sindbad after his adventure with the roc. They have a span of full eleven feet. Condors, indeed, are the largest of all flying birds. They are mountaineers by birth and residence, but they float down to the plains below, carrion-seeking, or to act the part of slaughterer to aged, enfeebled horses, to sheep and lambs and calves, and even to snap up unwary dogs incapable of self-defense.

They build no nests, but lay two white eggs upon the bare rock. The young are covered with whitish down and cannot fly until two years old. Their appetites are enormous. One has been known to eat eighteen pounds of meat in a single day. Often they gorge themselves until they cannot fly. The King Vulture and the California Vulture are closely related, but are smaller.

THE WIDE RANGE OF THE DAY BIRDS OF PREY

Related to these are the Turkey Vultures, lordly fliers which have beaks so weak that they cannot tear open the dead body of an animal until time has done its work, and decay has set in. They will perch near by for days, perhaps, waiting for the meal to be ready; then they flock down and feed with a greediness that is disgusting to human beings. These vultures have no voices. They hiss like reptiles when disturbed.

They are common in the southern part of the United States and occasionally may be seen as far north as Canada. In some southern cities they pick up their living in the streets around slaughterhouses and large markets. Here they do valuable work as scavengers, and, for their services, receive protection. Like other vultures, they fly well and can hang suspended in the sky, apparently without moving their wings.

There has been much dispute as to whether the turkey buzzards find food by sight or smell, but most observers think they rely upon their keen eyes. They lay one or two eggs on the ground, on rocks, or in a hollow stump in thick woods. The turkey vulture is known as the turkey buzzard in some places. This is not a correct name. The bird is not a buzzard, but is one of the family of vultures. Its bare red head and throat resemble the red-throated turkey gobbler.

A near relative, the Black Vulture, is smaller, stouter and blacker. This vulture is seldom seen in the North, but it is found in large numbers in all of tropical America. In the country a large dead animal may be absolutely covered by dozens of these repulsive creatures. In a southern city one old fellow was easily recognized because of the loss of a foot. For twenty years he was accustomed to frequent slaughterhouses to claim his living. Many black vultures probably live to a great age. They often sleep on a roof, snuggled against a chimney. These birds rarely attack living animals.

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 3881.

EAGLES AND THEIR RELATIONS

PONDICHERRY VULTURE

RUPPELL'S VULTURE

BLACK VULTURE

MONKEY-EATING EAGLE

JARDINE'S HARRIER OF AUSTRALIA

IMPERIAL EAGLE

BRAZILIAN CARACARA

PEREGRINE FALCON

THE LAMMERGEIER

THE BALD EAGLE

SHORT-TOED EAGLE

HARPY EAGLE

AFRICAN SEA-EAGLE

THE EUROPEAN BUZZARD ON GUARD OVER ITS YOUNG

THE SECRETARY BIRD

THE CROWNED HAWK EAGLE

THE EGYPTIAN VULTURE

KOLBE'S VULTURE

THE CONDOR

THE GRIFFON VULTURE

THE MERLIN PREPARES A MEAL FOR ITS YOUNG

THE WHITE-TAILED EAGLE

THE HARRIER HAWK

THE BLACK KITE

SOUTH AFRICAN KESTREL

THE GREENLAND FALCON

THE KOREAN SEA-EAGLE

THE GOLDEN EAGLE

THE SPARROW HAWK

A YOUNG SPARROW HAWK

THE MARTIAL HAWK EAGLE

THE CINEREOUS VULTURE

COMMON, OR RED, KITE

A YOUNG CONDOR

BLACK-CRESTED EAGLE

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A class in arithmetic taking moving pictures of a unit in a school arithmetic project.

MOVIE MAKING IN SCHOOL

ALMOST every American boy and girl loves to go to the movies. Many of them do so as a part of their school work in order to learn about the customs and people of long ago as shown in historical films. Movies made especially for showing in schools are becoming more widely used and they show us what takes place in many different fields. Pictures of animals are used in biology classes, scenes of commerce by rail and water bring new interest to geography classes, and many other subjects are presented more vividly through the medium of the moving picture. Although many of these are sound films, there are still hundreds of good silent films available and probably will be for many years to come.

Have you ever wanted to make a movie or to be in a movie? A great deal of glamour and excitement is built up around our popular stars, and this is kept alive by the pictures and stories featured in magazines and newspapers. All of these things tend to make the movies a mysterious business and create a desire with most of us to see what goes on behind the scenes. Why not gratify that desire by making your own movies? After all; the best way to learn things is to do them.

It will not be possible for you to make pictures exactly like those which come from the great studios of the professional movie industry. It is quite possible, however, for you to make simple yet interesting movies which will give you a great deal of fun and perhaps bring you a little money. It does not take much capital, provided you can borrow or rent the simple equipment you will need for the purpose of making really satisfactory moving pictures.

The easiest way to approach the problem is to enlist the help of other boys and girls. This is best done in school where a regular meeting time and place is easy to arrange. If you would like to start a movie club, it is a good plan to talk with one of your teachers about the idea. Perhaps your school already has such a group, and if that is the case you will want to make application for membership.

If you have to start the club yourself, then ask your faculty adviser about the procedure and get ideas about the correct method of writing the rules and by-laws. It is very probable that your school has regulations governing all sorts of organizations and you will desire to follow them closely. You will

wish to talk about it to a few of your friends who might be interested so that you can start with a small group who really intend to do something worthwhile.

CAMERA AND OTHER EQUIPMENT

One of the first things to be decided is the means of getting your camera and other equipment. Sometimes the father of one of the club members will be willing to lend a camera. In some cases the school will own one and in a great many cases it will also own a projector. If no other means of getting a camera can be found perhaps you can persuade a local photographic dealer to rent you a second-hand camera. A good used camera suitable for outdoor movie making could be purchased for about twenty-five dollars.

In addition to the camera there are two other essentials, the tripod and the exposure meter. The former is necessary because it is out of the question to make good steady pictures with the camera held in the hand. Hand holding is satisfactory for ordinary amateur use but for more serious efforts, such as you will want to make, rock-like steadiness is important. The exposure meter can save a great deal of film for you because it will measure the light and tell you just how to set your lens. Film cost is low and you have your choice between black-and-white and natural color films. It is easy to make titles, and you can purchase them already made if you so desire.

When the club idea has really been worked out and the officers elected, it is a good plan to ask the members just what they would like most to do. Some will have to work on the scenario, others do the camera work, one person will have to be script clerk, and you will also need a film editor and a title writer. There is sure to be enough work for everybody.

BOOKS ON MOVIE MAKING

After the formation of the club and the appointment of people to undertake various duties, the next step should be to secure information about the actual work of shooting film. There are several good books available. One of these is published by an organization called the Amateur Cinema League, 420 Lexington Avenue, New York, N. Y. The ACL also furnishes a helpful service to its members which enables them to have their films criticized by experts. In addition, they supply booklets and other interesting material to their members.

It is important for you to get all the material obtainable for your group and then pass it out to those who will be concerned with the actual work of production. For example, it will be very valuable to have your script writers read a good book on scenario writing. Cameramen must study the more technical material. If there are some good amateur movie makers among the parents of your club members you might get them to give you short lectures at your meetings. Take advantage of every opportunity to learn about what you are to undertake.

MAKING YOUR FIRST PICTURE

When the members have learned a little about what is ahead of them it will be time to discuss the subject of the first picture to be made. There are dozens of possibilities. For example, a group in a Greenwich, Connecticut, high school decided to make a film on the water supply system. They showed what happens to the water in their community from the time it leaves the brooks until it runs from the faucets in their own homes. The local water-supply company helped them a great deal because it was interested in telling people just what it did to insure a plentiful and pure water supply. Sometimes a company of this type will help pay for the film used, considering it a worthy contribution to education and civic activity. Films on various departments of a city government are always interesting. The fire department, the police department and the public works department all have stories behind them that are waiting to be filmed. Behind the scenes in the post office, and traffic safety are other subjects that can be interesting.

After you have decided upon a subject, the next move is to work out a general plan for the film. If you intend to film the fire department you must decide just what phase you wish to picture. Shall it be the correct method of turning in a fire alarm? Shall it be fire prevention in the home? Or shall it show the modern fire fighting equipment and how it is used? In any event, it is important to take a rather simple idea and follow it through. Do not try to show too much or the film will seem complicated and pointless.

When the general theme has been decided upon set your research committee to work. Let them visit the officials of the department and ask about the work. A visit to the

firehouse may be necessary. By talking with the men it will be possible to fill in your outline with many details needed to round out the story. Much of this material may be eliminated when the script is finally ready for shooting, but it is important to cover every bit of the ground in the preparatory stages.

The scenario writers must then take the material and work it into script form. In doing this they must carefully follow the directions to be found in reference books. The most important part of all movie making lies in the preparation of the script. Seek plenty of advice on this part of the work and do not rush to complete it. A well-written script will make the actual shooting much easier.

A properly written scenario is just as important to a film as a plot is to a book. It is a working plan or blueprint of the film which describes each scene in the order in which it should come, giving, in each case, all the information and details that must be known to the actors, scene-builders, director and camera man. For example, scene number four of a film may be played by two characters in a dining room. The scenario will describe the room, its furniture and where this must be placed. It tells what clothes are to be worn by the actors who appear in the scene, and what food and dishes, if any, must be on the table. Then it describes the action that must take place, and the various changes in distance and angle.

While the lighting must always be adequate for good clear photography, the scenario will sometimes require special lighting effects or shadows. These and other technical matters are always worked out by the director, lighting director, and camera man, but they must be recorded in the proper place in the scenario. If all these things are carefully planned in advance and clearly indicated in the scenario, then great confusion and expense will be saved during the actual rehearsal and filming of each scene, and the shooting can go along smoothly.

More important still, the completed movie will tell its story smoothly and understandably, without the loose threads and distracting "jerkiness" that is soon painful in a film which has been done in an unplanned hodge-podge fashion. In short, a carefully planned scenario, carefully followed, will give the movie what is known as good continuity. In the professional movies high salaried continuity experts are employed just to see that all the elements in the filming process are smoothly co-ordinated in the manner here described. It will be a fascinating problem for your group to work out—and lots of fun.

Wm. Spies, © Movie Makers

Titles with a moveable background. One girl holds a frame containing the title; another spins a disk.

As soon as the script has been finished and approved by the club and the faculty adviser you are ready to start shooting. This is the most exciting part of the whole project. Take your time and follow the rules you will find in good books about movie making. If you come to a situation that is not clear to you refer to the best book you have for instructions.

In order to help make the work easier it is well to break the scenario up into what is called a shooting script. This is simply a

rearranged list of all the scenes which are grouped so that all shots of one subject or in one locality can be made at one time. This saves a great deal of moving about. In the shooting script as well as in the scenario, camera directions always specify whether the shot is to be a "close up," a "medium shot" or a "long shot." Any special placement of the camera, such as on the ground or on top of a car, etc., which may be necessary in order to get a desired composition, angle, or effect, is also indicated in the camera instructions. The script clerk will have these lists at all times and check to make sure that the required scenes are taken.

After the shooting period is over it is necessary to do the editing and titling. Here again your film editors will have to follow directions and put into practice what they may have learned from reading reference material. This is one of the most interesting and skilled jobs in movie-making. A bad job in any of the different departments of movie-making can easily spoil the result—whether in the scenario planning, the acting, the directing, lighting, or camera-work. But even if all of these things have been done to perfection—the film can still be dull or amateurish if the film editing and titling are bad.

A film editor and his assistants must look carefully at all the film that has been shot and remove any of it that is poorly photographed. The scenes involved must then be gone through again and rephotographed with the faults of the rejected film corrected. These faults may arise either from bad lighting or from incorrect focusing or exposure on the part of the camera man. Still other scenes may have to be refilmed because of poor or awkward acting and directing.

It will be realized how unnecessary much of this cutting and refilming can be if the scenario is perfected prior to the filming, and the scenes carefully rehearsed before any film is shot.

The matter of writing good titles, and the selection of the proper places for inserting them in the film, is of the greatest importance, and should be planned and reviewed several times before the ultimate selections are made up and filmed. Writing the titles is sometimes done in the script but in case changes have been made it may be necessary to rewrite them somewhat. One group can shoot the titles or if they are to be purchased ready-made there will be some ordering to do and a choice of type and background decided upon.

It may seem a long, hard job fom the time the idea is conceived to the finished film but you will find the work to be fun. The great day for the first screening will arrive and you will want the entire club to see the finished production. After it has been approved you will plan to show it to others in your school. Perhaps it can be projected in assembly or you may show it after school hours and charge a small amount for admission to help pay for the film you have used. In any event, you will wish to have it seen by as many people as possible. If it has turned out well there may be requests for showing it to local clubs of various kinds. It will be a fitting reward for your efforts.

Suggested reading:

ACL Movie Book, Amateur Cinema League, Inc., New York, N. Y..

How to Write a Movie, Arthur L. Gale, Brick Row Book Shop, New York, N. Y.

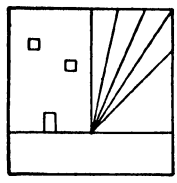
Make Your Own Movies for Fun and Profit, Gale-Pessels, Coward-McCann, New York, N. Y.

How to Make Good Movies, Eastman Kodak Company, Rochester, N. Y.

Article prepared by Frederick G. Beach, Supervisor, Motion Picture Bureau, N. Y. Central System.

A WINDMILL FROM A SQUARE OF PAPER

TO make this windmill, we buy at any stationery store paper which has one side black and the other white. We place it upon a table with the white side uppermost and we rule pencil lines upon it like those shown in the picture. Then, with a sharp scissors or a penknife, we cut up the paper into ten pieces, as marked. Finally we paste these pieces down, with the black side uppermost, on a sheet of white cardboard.



1. HOW THE PAPER IS MARKED, READY FOR CUTTING.

2. THE COMPLETED MILL.

End of a foot race, at one of the ancient Olympic games. From a painting by Otto Knille.

What Were the Ancient Olympic Games?

THE ancient Olympic games were celebrated every four years at Olympia on the bank of the river Alpheus in Greece. From very early times this was a sacred place to the Greeks. Temples of the gods were built, and festivals in their honor were held here. Just when the games began and who founded them we do not know, but we have a list of winners beginning with 776 B.C. and ending in 394 A.D., a period of 1,170 years. Here all the best athletes of Greece met, and the winner in any event was taken home in triumph, and was sometimes supported by the public for the remainder of his life.

Only Greeks of good character might contend, and they were required to train faithfully for ten months before the games. There were foot races, short and long, jumping, throwing the javelin and the discus (a bronze plate), wrestling and boxing. Later chariot racing and races on horseback were added. There were special contests for boys in running, wrestling and boxing. There was also a contest of heralds, and the victor in this was allowed to announce the winners to the great crowds. The prizes were crowns of wild olive from the sacred tree.

The Greeks considered the games so important that a sacred truce was declared, if any states were at war, so that both athletes and spectators from all the states might travel in safety. The four years between the games was called an Olympiad, and time was reckoned by them. For example, an event might be said to occur in the second year of the one hundred and seventy-second Olympiad. Sometimes the Olympiad was named for the winner of the foot race.

WHAT ARE THE MODERN OLYMPIC GAMES?

The revival of the Olympic games in modern times is due chiefly to the efforts of a high-minded Frenchman, Baron Pierre de Coubertin. His efforts appealed to many lovers of the high ideals of clean sport, and the first Olympic meeting in over 1,500 years was fittingly held at Athens, Greece, in 1896.

The meetings did not become truly representative until 1908 and had hardly taken root when they were interrupted by the first World War. They were resumed in 1920 and from 1924 onward they have been the most important international sports meetings in the world. By 1932 fifty nations were sending 2,000 contestants to the games. The 1932 games were witnessed by 1,750,000 people. Competitions in the following events are held in the modern Olympics:

Track and field sports (running, jumping,

Wide World

Greek villagers start the 1948 Olympic flame on its way.

throwing discus, hammer and javelin, putting the shot, etc.)

Swimming	Polo	Basketball
Rowing	Boxing	Soccer
Canoeing	Riding	Field Hockey
Yachting	Cycling	Field Handball
Gymnastics	Gliding	Lacrosse
Weight Lifting	Shooting	Wrestling
Fencing	Baseball	Fine Arts

The winter sports contests (skiing, skating, bobsleighing, ice hockey) are now held separately at a time and place more suited to them than to ordinary sports.

Though the Olympic games do not yet mean as much to us as they did to the ancient Greeks, still they arouse much interest and bring the winners much fame. The United States has carried off many Olympic honors.

These are the dates and places of the modern Olympics: Athens (1896); Paris (1900); St. Louis (1904); Athens (special, 1906); London (1908); Stockholm (1912); Antwerp (1920); Paris (1924); Amsterdam (1928); Los Angeles (1932); Berlin (1936). World War II then interrupted the games until 1948, held that year in London.

WHAT DOES THE ORCHESTRA CONDUCTOR DO WITH HIS STICK?

He may be said to collect on the tip of his baton the musical powers of the singers and instrumentalists who have placed themselves under his command. Watch the first raising of the little wand by a good conductor as he is about to launch the performance of some great work. Try to imagine the musical force he is privileged to wield. For the time being every one of those trained musicians is waiting to translate into musical sound his slightest gesture.

The conductor's part, then, is much more than that of beating out the time. The composer sets down the notes to be played or sung. The musicians produce the corresponding musical sounds. The conductor takes these scattered efforts and with them weaves the enthralling story which holds his audience spellbound. Yet there is an important mechanical side to his work. Notice that kettledrum player standing at the back. See how keenly he watches the conductor. He is not playing, but is busy counting the seventy-four bars' rest allotted to him. Now watch the conductor. He gives a quick glance at the player, to be sure he is prepared for his entry. Then the baton gathers in the brass. The excitement is growing. Suddenly the conductor's left hand shoots out, and the kettledrums crash in confidently.

So the conductor shepherds the members of his flock—showing them, not only when, but how, to play. Usually it is only the conductor who must know thoroughly all the various parts for, say, a symphony.

WHAT WAS THE FIRST STRINGED INSTRUMENT?

Back through the ages we must go, centuries before the birth of Jesus, back to the very earliest records that exist of man's life on earth. There we find proof of the existence of instruments that must have taken more centuries still to reach that stage in development. In the wall-paintings of the Egyptians, belonging to a period of possibly 3000 B.C., we find pictures of harps shaped not unlike the instruments of today. They were handsome instruments, richly ornamented and standing more than six feet high, but differing from our modern harp in having no supporting pillar.

Nowadays by strings we mean the bowed instruments of the violin family. In the lyre, which the ancient Greeks borrowed from the Egyptians, we have a forerunner of our fiddle. From the lyre we get the common

name applied to all the members of the violin family; we also get the idea of a number of strings. But the principal parts, the sound box, fingerboard and movable bridge, come from the monochord. This consisted of a single stretched string. The Greeks in the time of Pythagoras could make the notes of the scale by cutting off portions of the string with a movable bridge.

From the lyre and the monochord it was a small step to the productions of an instrument conforming in its essentials to the fiddle. We know that in the third century B.C. an instrument which was a combination of the lyre and monochord was in use among the Greeks.

The first bow that was used was probably the player's finger! You have probably heard music played by rubbing the rims of tumblers that have varying amounts of water in them. Such a set of tumblers is often called a glass harmonica. The glass harmonica is a good example of what can be done, with the aid of a little resin, by using the finger as a bow.

WHY IS IT GOOD TO BOIL POTATOES IN THEIR JACKETS?

It is good to boil potatoes in their jackets because most of their potassium and other salts are to be found chiefly in the cells under the skin, and so are thrown away when the potato is peeled. It seems probable that most of the potato's vitamins also are just under the skin. So it is better to boil the potatoes and then skin them.

WHY DO WE RISE TO THE SURFACE WHEN WE DIVE?

This is not a very easy question to answer. For one thing, it is possible to dive and not rise again. This may very easily happen when a man dives from a height into shallow water and does not do the right thing when he gets under. He may then strike the mud at the bottom and stay there. That is the danger of diving from too great a height into shallow water. In such a case the diver's body would naturally go deeper than the water before it came up again. The secret of the diver's success is that he turns his hands after he enters the water, and so changes his course. Apart from this, the reason why the diver comes up again is to be found partly in the elastic rebound of the water after he has struck it. We must also remember that the pressure of the water gets greater with every descending foot. The diver's body, filled as his lungs are with air, is scarcely, if at all, heavier than the water itself. The case becomes different if he is injured, or if he is a drowning person unaccustomed to water, who breathes out the air of his lungs, and breathes water in. Then his body is heavier than water, and he sinks.

WHY DOES WOOD WARP IN DAMP WEATHER?

As long as a piece of wood is alive it contains a certain amount of moisture, in the fibers. We may think of the fibers as small tubes packed side by side. These fibers shrink or swell according to the amount of moisture they contain. When the tree is cut down and made into timber, a great deal of moisture is let out and evaporated, and the wood will retain its shape as long as it is dry.

One of the difficulties in drying planks is to get both sides equally dry; and we have noticed that if we place a piece of damp wood near the fire, or if we wet one side of a piece of dry wood and hold it near the fire, the wood very soon begins to curl. That is because one side is contracting and drawing the other side round with it. The shrinking and swelling, according to the amount of moisture present, takes place only across the grain of the wood, leaving its length unaffected by the moisture.

WHAT CAUSES WOOD EXPOSED TO DAMPNESS TO ROT AWAY?

There are kinds of wood that will not rot away, even though they are kept in water. The city of Venice is built on wooden piles buried in the shallow sea, and these have lasted for many centuries.

We shall guess what it is that makes wood rot when we learn what is done to protect wood that must be exposed to wet, for instance, the wood of which railway ties are made. These are often soaked with a chemical substance called creosote; and the particular property of creosote that makes it so valuable is that it is poisonous to microbes. So the answer to the question, in one word, is Microbes. Wood will not rot if it is charged with something that kills microbes, or if, as in the case of Venice, it is protected from microbe enemies by being kept in salt water.

If you live in the southern United States, or have visited there, you have seen swamps with bald cypress trees growing in them. Cypress wood is remarkably hard and resists attacks of insects and microbes. The wood of the bald cypress, which grows in

the swamps, is used for railway ties, fence posts, telegraph poles, piles for docks and other purposes for which a water-resistant wood is needed. From pine wood, which contains much creosote, we get wood tar that is applied to other woods to protect them.

WHY DOES SALT MAKE US THIRSTY?

There is a certain amount of salt in all our food, and one of the properties of salt is to draw water from the tissues toward the kidneys where the waste liquids are filtered. Normally the amount of water drawn is not great enough to be noticeable, but if the food we eat is very salty, the amount of water drawn out of the tissues by the salt will be abnormal and the tissues will then be lacking in water.

Now whenever a certain part of the body is in distress, it can convey its need to us, as when the gnawing sensation in our stomachs warns us that we are hungry. In a similar way the tissues, whenever they lack water, can signal their need to the tongue and the throat which themselves begin to feel parched and dry. From this we know not only that our mouths are dry but that our whole bodies are in need of water. Nothing else seems to quench thirst so well as water does.

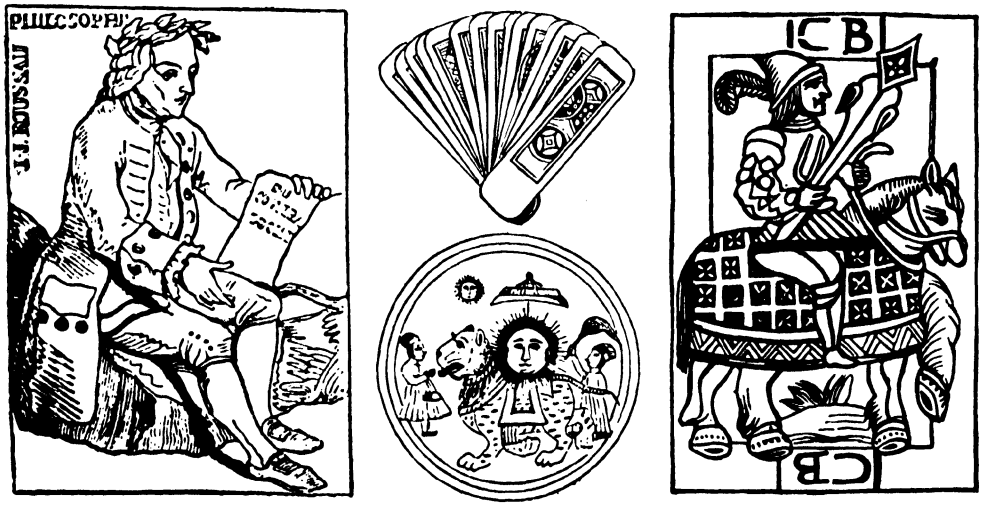
WHEN WERE PLAYING CARDS FIRST USED?

Playing cards have been traced back as far as 800 A.D., when they were popular in Hindustan, and from there they seem to have spread both east and west. They are said to have come into Europe when the Crusaders learned about them from the Saracens. The ancient packs of cards varied widely in different countries. Some of them had as many as ten suits, as in Hindustan, where the suits symbolized ten incarnations of their god Vishnu. Our four suits, clubs, diamonds, hearts and spades, were meant to portray a three-foil leaf, diamonds, hearts and swords. The spade comes from the Italian word for sword. The court cards, or face cards, at first consisted of only masculine figureheads, as the early card games were supposed to be a sort of play warfare, in which women had no part. The double-headed court cards came into use in about the thirteenth century, to avoid the risk of revealing information about one's hand by turning the face cards.

The pack as we know it, with four suits of thirteen cards, is thought to symbolize the year of fifty-two weeks divided into lunar months, or perhaps to symbolize a pack of hounds, which also consists of fifty-two members. At one time the four kings were supposed to represent Charlemagne, David, Alexander and Julius Caesar. In fact, the symbolism attached to playing cards has been extensive.

The history of card playing has a dark side; for centuries cards have been employed in gambling games. To most people, however, they furnish pleasant and harmless entertainment, and there are endless variations of games that may be played with them.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3791.



Old playing cards of: left, the French Revolution; top center, China; lower center, India; right, Portugal.

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