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ANIMAL MANAGEMENT

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CHAPTER I.

ANIMAL STRUCTURE AND FUNCTION.

A KNOWLEDGE of the structure of the various parts of the body (*anatomy*) and the functions they perform (*physiology*) provides a rational foundation on which to base our acquaintance with animals, their requirements and capabilities. So that all may get a clear idea of these complex and technical subjects, necessary references to them are given in as simple language as possible.

Cells.—All animal bodies are composed of cells. *A cell* is a minute round mass of living matter, which may or may not possess the property of moving itself. Though at first all cells appear alike, they soon become specialized to perform one particular duty, *e.g.*, the liver cell makes bile ; the muscle cell acquires the power of contraction. As they increase in number, the pressure of surrounding cells causes them to alter in shape and they may become many sided, flat or spindle-shaped. The entire animal is made up of such minute, specialized bodies, a single cell bearing the same relation to the whole body that a brick does to London. Cells multiply by dividing, each portion attaining to the size of its parent. This power is most marked in youth, *growth*, and declines in age, *decay*.

Bones.—The framework of the body is constructed of *bones*, so arranged that they can be used as rigid supports, or become freely movable when the joints are brought into play. *A joint* is formed wherever two bones meet and move over each other ; it is always surrounded by an air-tight capsule, and in order to prevent any friction the ends of the bones are covered by thick layers of gristle (*cartilage*), which have extremely smooth surfaces. Inside the joint are found special fringes which lie loosely in the capsule and produce "joint oil" (*synovia*), a peculiarly oily, slippery fluid, which bathes the entire joint and ensures the most perfect lubrication. The movement of joints is accomplished by the action of muscles.

Muscles constitute a great part of the body, and are attached to the bones in such fashion as to enable them to move the joints to the greatest advantage when they contract. The power of contraction is the distinguishing feature of muscles : when called into action they shorten and thicken themselves, drawing their points of attachment closer together and so bending the joints.

In addition to the red muscles (*voluntary*) with which all are familiar, and which are moved at will, there is another set not under the control of the will (*involuntary*), which is met with throughout the internal organs, and to which, in particular, the bowels owe their remarkable power of movement. These involuntary muscles, except the heart, are pale in colour and distributed in thin layers instead of thick bunches; but they are as powerful and capable of even more sustained exertion than the voluntary ones. In speaking of muscles generally, it is the red, voluntary ones which are alluded to, but the existence of the others should not be forgotten.

Tendons.—Muscles, though very *elastic* and capable of exerting great force, are quite soft and easily torn; they would be incapable of withstanding the strains to which they are constantly subjected if they were not provided with tendons. *A tendon* is a tough, *inelastic* rope, composed of firm, parallel threads, running throughout its length, one end being securely attached to a bone, whilst the other is spliced into the substance of a muscle. Through the medium of this rigid attachment the muscle exerts the full force of its elasticity without fear of injury and, as a matter of fact, *when sprains of these structures do occur, it is usually the tendon which gives way.*

Ligaments are similar in structure to tendons, but differ in their attachment; they run from bone to bone in the neighbourhood of joints, and are not attached to muscles. They serve to prevent over-extension of joints and, while permitting free movement, knit the component bones firmly together.

The nervous system.—The whole of the above organs of locomotion are set in action and controlled by the will power, which originates in the brain and is transmitted by means of the spinal cord and nerves. *The nervous mechanism* may be aptly compared to a very complete telephonic system which, radiating from the central exchange, the brain, takes orders and conveys messages to and from the entire body. *Nerves* may be divided into two groups, those which give rise to feeling (*sensory*), and those connected with motion (*motor*).

The spinal cord is the continuation of the brain down the backbone, from which many nerves arise, and which acts the part of sub-office to the brain.

Fat is stored in various situations to form cushions, to round off corners, and to serve as a reserve of food if required.

Nourishment is brought to the whole of these structures by the blood constantly circulating through the *blood-vessels*, which are of three varieties, *arteries*, *veins*, and *capillaries*.

Arteries are muscular, thick-walled elastic tubes which, springing from the heart, ramify through the entire body. Gradually diminishing in calibre as their length increases, they reach and supply every organ and structure, finally becoming merged in the capillaries.

Capillaries are, as their name denotes, the finest, thinnest, hair-like tubes imaginable. They permeate every nook and cranny of the system, so that the merest pin prick will draw blood, *i.e.*, wound several of them.

Veins are the continuation of the capillaries on the return journey towards the heart, approaching which they increase in size, receiving fresh tributaries from all parts, till they empty themselves into that organ. Here and there in the course of a vein, slight enlargement of its calibre may be noticed, due to the presence of valves which prevent the blood flowing backwards. *A valve* consists of two or three little skin-like pouches with their openings towards the heart; so long as the blood flows in that direction they lie flat against the side of the vessel and do not obstruct it, but if there is any back-wash it automatically fills them, causing them to bulge into the vein and completely block it. Their action may be well observed by pressing the blood to and fro in the veins on the back of one's own hands. Veins are thinner and are less elastic than arteries, but are capable of containing more blood when distended.

The blood consists of a straw-coloured fluid, in which an infinite number of minute bodies (*corpuscles*) are suspended. During life and when freshly drawn from the body, blood is quite fluid, but rapidly solidifies (*clots*) on exposure to the air. *The blood corpuscles* are of two varieties, red and white. Red corpuscles are very numerous, give the blood its colour, are shaped like a quoit with a solid centre, and measure about $\frac{1}{3000}$ of an inch in diameter. Their peculiar power of absorbing oxygen makes them important factors in questions of ventilation and breathing. White corpuscles are comparatively few in numbers as compared with the red variety, are larger, have the power of moving, and are engaged in the duty of attacking and destroying any harmful germs which attempt to invade the body.

The heart is a hollow, cone-shaped organ, composed entirely of muscle. It is situated in the centre of the chest with its point directed downwards and slightly inclined to the left. Internally it is divided into four compartments, those on the left side being thicker walled and stronger than those on the right. The upper chambers are called *auricles* from their resemblance to the human ear, while the lower, which constitute the bulk of the organ, are termed *ventricles*. At the top of each auricle is the entrance of the large veins of the body and lungs, while below they communicate with their respective ventricles. From the right and left ventricles respectively the big arteries leading to the lungs and body originate. The openings between auricles and ventricles are guarded by strong valves, so arranged that when the ventricle is filled with blood the entrance is completely closed and sealed. In similar fashion the exit from each ventricle is

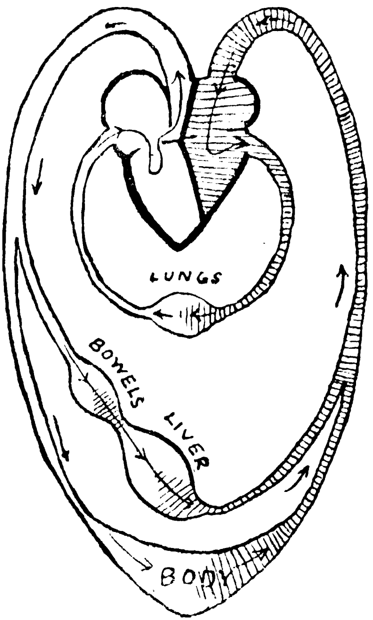

FIG. 1.—Diagram to show the course of the circulation.

closed by other valves to prevent regurgitation of the blood from the large arteries. *The function of the heart* is to keep up the circulation of the blood; it begins to work before birth, does not cease till after death, and in the meantime acts as a perfect, self-regulating automatic pump. *The circulation of the blood* follows the course shown in the accompanying diagram.

Starting from the left auricle the blood flows down into the left ventricle; as it fills, the valves guarding the opening float up on the surface of the blood, till, when they are horizontal, the meeting of their edges closes it. At this moment the heart " contracts."

This contraction is familiar to all as the " beating " of the heart. It violently shortens itself, screws itself slightly round, squeezes all its chambers empty and produces a " lubb-dup " sound at each beat, then relaxes, fills again, and repeats the process. The sounds may be distinctly heard and the " beat " felt by applying the ear to the chest wall. By the contraction the blood in the left ventricle is forced into the main artery of the body (*the aorta*).

This large vessel immediately divides, one branch going to the head, neck and fore limbs; the other, the larger of the two, running along the under surface of the backbone and supplying the liver, stomach, bowels, and hind-quarters. The finest arteries merge into the capillaries, which form a close-meshed network through every part of the body, and it is during this capillary circulation that nourishment slips from the blood to the various structures. Passing successively from the capillaries to the small and the large veins, the blood reaches the right auricle, being reinforced during its passage by the nourishment which has been derived from the food as the result of digestion; it then passes into the right ventricle, from which it is expelled to the lungs. Here it is brought into contact with the air, after admixture with which it is returned to the left auricle again (*see also* Respiration, p. 8).

The lymphatic system.—This is another extensive and important system of vessels, as widely distributed as the blood-vessels, but not nearly so prominent. Its largest vessel flows into the blood stream near the heart, and to it the whole of the body's lymphatics contribute. Lympathics are very thin-walled vessels, and as the lymph they contain is colourless, they are not as a rule apparent to the eye. Their functions are to collect from the bowels the goodness which is digested from the food, and to prevent the accumulation of fluid in any part of the body. The fluid which is thus collected is prepared and filtered by the lymph glands, and ultimately poured into the large veins on the right side of the heart, by the vessel alluded to above. Lymphatics only attract notice as a rule when something goes wrong with them, when they are often prominent, standing out like veins on the skin, while pain and swelling of the limbs and nearest glands is frequently observed. The glands under the jaw, beneath the arm, and inside the thigh, are those most frequently observed to be so affected.

The body, excluding the limbs, is divided into two great cavities—the chest, and the abdomen.

The chest contains the heart, the great blood-vessels and the lungs; while a portion of the gullet passes through it *en route* to the stomach. Its length extends from the point of the breast-bone to the midriff (diaphragm), while on each side the ribs form a strong, sufficiently elastic cage to protect the organs it contains, and permit their free movements during respiration.

The first eight ribs are firmly jointed to the breast-bone, and this makes a rigid protection for the heart, which is situated between them; while the remainder are attached less firmly to each other, and allow greater freedom of movement. The space between the first ribs may be termed the entrance to the chest, and through this the windpipe (trachea) and gullet (œsophagus) make their entry.

Respiration (breathing).—Air is drawn through the nostrils or mouth (in the horse through the nostrils only), passes through the larynx (organ of voice), down the windpipe, and enters the lungs. In the lungs the air and blood mix, and exchange the elements they require; the used, polluted air is then expelled, a slight pause ensues, and the process repeats itself.

The nostrils differ in shape according to the animal's requirements, those of the galloping horse being thin, widely open, and capable of still wider distension, if necessary, to increase the air supply, while oxen and camels, not being required to go such a pace, are provided respectively with a rigid, thick-edged opening and a pendulous slit.

The larynx, the organ which produces the voice, is situated in the throat between the branches of the lower jaw, where it may be readily felt. Its body is made of cartilages, which are jointed together so that the surrounding muscles can narrow or widen its calibre. Food and water pass over its opening on their way down the gullet, and in order to prevent their entrance a lid is provided which closes automatically, and with water-tight accuracy, whenever the animal swallows. Coughing and difficulty in swallowing are immediately experienced if there is anything the matter with the opening (the glottis), or the lid (the epiglottis), *e.g.*, during a sore throat. Inside are two thick elastic cords, so placed as to form a triangular opening with the floor of the organ; when the calibre is varied by the action of the muscles, the edges of the cords are rendered tense or slack, thin or thick according to the strain placed upon them, and as the distance between them is widened or narrowed at the same time, the rush of air through this constantly varying aperture produces the sounds of the voice. If they are stretched to their utmost, and brought close together, a high note results, while relaxation and separation of their edges give a deep tone.

The windpipe extends from the larynx to the lungs; it runs along the lower border of the neck, and can be easily felt as far down as the entrance to the chest. It is composed of rings of cartilage (gristle), the ends of which overlap each other, and, as this arrangement permits it to withstand considerable pressure, it is not often injured. It is lined by microscopic hairs, constantly agitated in an upward direction, by means of which phlegm is brought up from the lungs. At the entrance to the chest the windpipe divides, one branch going to each lung, and from this on, they divide and subdivide until they become very minute, when they lose their gristly rings, and become thin membranous tubes, which continue to divide in the same fashion. The ultimate divisions expand suddenly into little, mulberry shaped balloons (*air vesicles*), the walls of which are so thin that they allow the gases of the air and blood to pass freely from one to the other.

The lungs (*lights*) are two large, elastic organs which, except for the space occupied by the heart, completely fill the chest. They may be described as equally full of air and blood, the entire space, not occupied by the air vesicles just described, being filled with blood-vessels.

The outside of the lungs, and the inside of the chest, is covered by a smooth, shiny, slippery membrane (*pleura*), which prevents friction.

The diaphragm (*midriff*) is a strong, thin curtain of muscle which separates the chest from the belly; it is attached to the inner sides of the ribs, beginning high up under the backbone, just in front of the loins, and slopes downwards and forwards to the breast-bone. It is pierced by the great blood-vessels and the gullet as they pass out of the chest; its front is covered by pleura, and lies in touch with the lungs, whilst the liver and stomach are immediately on its other side.

Changes which take place during respiration.—The blood which is sent out to the body by the arteries (arterial blood) is bright scarlet, and full of oxygen from the fresh air, but after circulating through the various organs, and supplying their needs, it loses some of its oxygen, receives some carbon dioxide in exchange, and in consequence acquires a deeper red colour. In this condition it returns by the veins (venous blood), and is sent to the lungs. Arrived there, it circulates round the walls of the air vesicles, and another interchange of gases takes place, oxygen passing into the blood corpuscles and carbon dioxide into the lungs. Recharged with oxygen, and its vivid scarlet colour restored, the blood is again fit for use, and returns to the heart, while the next expiration discharges the used air from the lungs.

This revivification of the blood by the passage of oxygen into the red corpuscles, and of carbonic acid out of them, is necessary to life; without it the blood becomes dark red, purple, and black successively as this want is felt, and if not supplied, suffocation takes place.

This constant demand for the supply of fresh air makes the necessity for free ventilation apparent.

The changes of position which actually take place between the various organs during breathing are important when viewed in their relation to feeding and work (Fig. 2). When

1. The Liver.
2. Stomach.
3. Spleen.
4. Diaphragm.
5. Lungs.
6. Ribs.

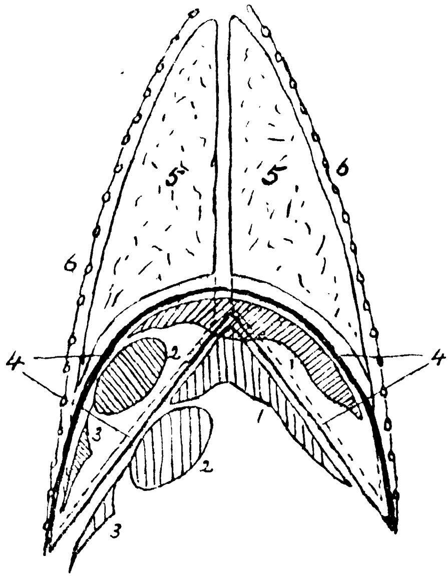

FIG. 2.

the breath is drawn into the lungs (inspiration), these expand; the ribs are drawn outwards to enlarge the chest from side to side, and the diaphragm is drawn back on each side to deepen it. It is evident that this movement of the diaphragm will cause considerable pressure on the liver and stomach, and if the latter is very full of food, the movement will be embarrassed and carried out with difficulty. It is, therefore, easy to understand why a full stomach militates against fast work, which demands rapid, deep, easy respiration, and also why indigestion and colic sometimes follow injudicious feeding during work.

The abdomen or *belly* includes the whole of that portion of the body which lies below the back and between the chest and hind-quarters ; it contains the stomach, bowels, liver and pancreas, *i.e.*, the organs of digestion, and also the spleen or milt, the kidneys and bladder, and the womb of the female.

Digestion.—In the following account the food is traced from the mouth, in order to give a concise and easily understood narrative.

Food having been taken into the mouth by means of the lips, is rolled about by the tongue, chewed by the molars or grinding teeth, and at the same time is mixed with large quantities of saliva, which are poured out from the glands behind, beneath the jaw, and under the tongue. The quantity of saliva produced is very great—in horses or cattle always equal to or greater than the amount of food consumed—and the resulting pasty mixture is carried to the back of the mouth where it enters the gullet after passing over the epiglottis.

The molar teeth of the horse are twenty-four in number, six on each side of each jaw (in advance of the first ones tiny, rudimentary, "wolves" teeth may sometimes be observed, but are of no importance). They present large roughened wearing surfaces, which, when looked at from the front, slope downwards and outwards, leaving a sharp chisel edge on the outside of the upper and on the inside of the lower teeth. The teeth of the lower jaw are narrower than those in the upper, and as they are moved from side to side during mastication they travel over this wider surface and make very effective grindstones. Whilst this movement is perfect, the teeth maintain their respective contours and are worn evenly down as fast as they grow, but if the lateral movement of the lower jaw is not great enough to cover the entire upper surface, the sharp edges will become unduly prolonged, a condition which may interfere with mastication and occasionally requires removal.

Having reached the back of the mouth the food is seized by the muscles at the top of the gullet and forced down it towards the stomach.

The gullet is situated on the left side of the lower portion of the neck and reaches from throat to stomach. Its course may be easily traced from behind the jaw to its entrance into the chest, by watching a horse swallow a mouthful of hay. At the entrance to the chest it passes through the two first ribs, between the lungs, over the heart, through the midriff (diaphragm), and ends at its junction with the stomach, which, except when forced open by the entrance of food, is tightly closed.

The stomach of the horse, a bag-like organ with two openings, one from the gullet and the other to the bowel, is, for the size of the animal, remarkably small. It has, like all the digestive organs, powerful muscular coats for the purpose of kneading and churning the food, and it manufactures a digestive fluid called "gastric juice" in very large quantities. Here the already chewed, saliva-soaked food is thoroughly mixed with the gastric juice and then passed into the bowel, at which stage it is a thick yellowish cream, with finely broken-up portions of the more woody fodder floating in it. *The bowels* (intestines) along which it now passes are divided into small and large. The small bowel is, in the horse, about seventy feet long, and, although freely movable in the belly, is suspended from the underside of the backbone by a thin membrane or caul, which envelops it, and through which its blood-vessels and nerves run. Its inner coat manufactures a special digestive fluid, and about six inches from the stomach the duct from the liver and pancreas opens into it.

The pancreas (which is one of the organs popularly known as the "sweetbread") is situated under the loins in front of the kidneys, and pours into the bowel its particular secretion which, together with the bile, mixes constantly with the partially digested food.

The liver is a large, flat, roughly square chocolate-coloured organ, two to four inches in thickness and several pounds in weight, which lies immediately behind and flat up against the midriff; it is, in fact, squeezed between the latter and the stomach, and from it a small duct passes to the bowel for the passage of bile (gall). The liver secretes bile, which acts as a disinfectant to the bowel; it also takes a large share in preparing the digested result of the food for use by the muscles, which is its most important duty. During its passage along the small bowel—which, it must be remembered, is in constant active motion, churning and dissolving the food mixture—rapid absorption of the now fluid nourishment commences and continues actively throughout its course.

From the small bowel the large bowel is reached, and this, about thirty feet long, and of great capacity, occupies the major portion of the belly. At the junction of the large and small bowel is the "water gut" or "blind gut" (*cæcum*), a cone-shaped bowel capable of containing several gallons, which usually holds a considerable quantity of fluid as opposed to the much more solid contents of the rest of the large bowel; and in addition to taking its part in digestion it appears to be a reservoir where water is stored and from whence it is issued to the body as required. The remaining portion of the large bowel (*the colon*) is doubled twice on itself the entire length of the belly and ends in the rectum. It is in the last part of the colon that the animal's droppings take their characteristic shape before expulsion. The unabsorbed portions of the food pass very slowly along the large bowel, being continually kneaded by the constant worm-like motions of the gut until all the nutriment which the animal is capable of extracting from it has been absorbed.

The main actions of the various digestive fluids are as follows :—

The saliva, by its viscidity and quantity, renders swallowing easy and also helps to convert the starches of the food into sugar, which is a necessary preliminary to their absorption.

The gastric juice, which is acid, converts the flesh-forming (proteid) portions into more easily absorbed substances known as " peptones," assists in breaking up the fibrous portions and converts starches into sugars.

The secretions formed by the cells of the intestines continue the splitting up of these " peptones " and " sugars " into still simpler substances, which are capable of being absorbed through the bowel wall into the lymphatics and blood-vessels.

The bile converts fats into an emulsion and acts as a disinfectant of the general contents of the bowels.

The pancreatic juice may be termed a general digestive fluid ; it further converts starches into sugar, turns flesh-formers (proteids) into peptones and emulsifies fats.

After undergoing these changes a large portion of the nutriment is absorbed, sucked up, by the inner coats of the bowel and poured into the lymphatics of the bowel or the blood-vessels which run from the bowels and stomach to the liver, where, as before mentioned, it is suitably prepared as fuel for the use of the muscles and either issued or stored up as required. Owing to this a temporary congestion of the liver occurs after feeding, and if the organ is not assisted in its functions by judicious exercise it is liable to get out of order.

In the foregoing account the digestive organs of the horse have been described, but there are some differences between them and the organs of ruminants, *e.g.*, the ox and camel, which require note.

The digestive system of ruminants generally is designed to cope with a rough and bulky class of forage and provides for its mastication twice over. The molar teeth are more jagged to grind coarse food ; the tongue is harder, to guard against injury ; and the gullet is more capacious, and admits of easy regurgitation for the purpose of " chewing the cud." While in the horse the stomach is small and the bowels large, the reverse is the case with oxen and camels : the stomach is enormous, and the intestines relatively small. The stomach is divided into four compartments: *the "paunch"* (rumen) is the first and largest division: it occupies the greater part of the belly, into which the whole of the food passes when first chewed and is from there returned to the mouth when the animal has leisure to re-masticate it. The second and third divisions, *the "honeycomb"* (reticulum), and *"many-plies"* or *"fardel"* (omasum), resemble respectively the pattern of a honeycomb and the leaves of a book, but they are smaller and not so important as the first and last. The fourth compartment, the *"rennet"* (abomasum), is the true digestive stomach, which manufactures the gastric juice and leads into the bowel. In all matters relating to the feeding and working of oxen and camels the necessity of good grazing or an ample supply of bulky forage, and leisure for them to re-chew it ("chew the cud"), must be insisted on if they are to retain working condition. Neglect of this will rapidly render either of these animals useless for military purposes.

The spleen or *milt* is a bluish grey colour, shaped like an isosceles triangle, under two pounds in weight, and like straw-berry jam when cut into. Its full uses do not appear to be yet understood, but it seems under certain conditions to be a reservoir for the blood.

The kidneys lie on each side of the backbone, under the loins, and from them a tube for the passage of urine leads to the bladder. In structure they consist of an enormous number of small tubes, which, starting from little knots of capillary blood-vessels, run at first a contorted, and afterwards a straight course, towards the eye of the kidney, where they empty themselves into the tube leading to the bladder. The duty of the kidneys is to filter waste matter from the blood as it circulates through them.

The bladder is merely a reservoir which allows the urine to be collected and discharged occasionally instead of dribbling away continuously.

The reproductive organs differ in the male and female, but in both there is a genital gland, in the male the *testicle*, in the female the *ovary*, which produce the germ cells whose function is to continue the species.

The structure of the reproductive organs in both sexes is such as to permit of sexual embrace (copulation), which brings about the meeting and union of the male germ cell (spermatozoon) and the female germ cell (ovum). These unite and in the womb (uterus) of the female animal the fertilized egg grows, and is nourished until it is fit for independent life when it is born. The period between the fertilization of the egg (conception) and birth is known as the gestation period, and varies in different species of animals.

The skin may be divided into two layers: a deep and sensitive one (the dermis), which contains blood-vessels, nerves, sweat glands, oil glands and hair bulbs or roots; and a superficial, insensitive layer (scurf skin, epidermis) which is constantly being shed (scurf, dandruff). Through the epidermis the hairs, and tubes of the oil and sweat glands, pass to gain the surface, where their openings are collectively called "the pores." The sweat glands are coiled tubes lying deep in the skin and gaining the surface by a thin, spiral duct through which the sweat is discharged. They are constantly in action, and even when the body is at rest there is a very slight perspiration from them, though not sufficient to be visible. The hairs are produced from the hair bulbs, which also are deep in the skin, and they make their exit at such an acute angle with the surface that the coat lies flat and smooth. The coat is shed twice yearly, in spring and autumn, and replaced by a finer or thicker growth suitable to the season, while throughout the year there is a constant slight shedding of old and growth of new hair. Each hair has a muscle, which when in action can pull it into an upright position, and on each side of each hair is attached a small oil gland, the produce of which is exuded at the base of the hair and greases it. The scurf skin (epidermis) acts the part of a protective layer to the too sensitive structures underneath; the sweat helps to regulate the body temperature and get rid of some of the waste products caused by exertion; the coat provides warmth, and the oil glands, by greasing the hairs, give them polish and render the whole surface waterproof. The skin generally is very elastic, varies in thickness according to the amount of protection required by the part covered, and, when handled, should feel "loose" and freely movable over the structures beneath. Over the sides of the body it is capable of considerable muscular movement, which enables the animal to twitch it violently for the removal of flies. In health the coat should lie flat, feel quite smooth and carry a nice gloss; want of condition, exposure, privation, neglect, or ill-health may cause it to "stare," that is, stand on end, look "dull," or feel "harsh"; and under similar circumstances the whole skin may lose its usual mobility, and feel as if glued to the ribs, a condition known as "hidebound."

The routine of the body.—Having taken a survey of the body components and their functions, we can now assemble the whole and view the result of their working as one machine. The routine work of the body is comparable to that of an engine which by the combustion of coal (food) produces heat (work) and ashes (waste).

The complex substances eaten as food are broken up by the digestion into simpler materials which can be absorbed by the intestines, and this nourishment finds its way, *via* the liver and lymphatics, into the blood. By this channel it is carried to the capillary circulation of every organ; here it slips into the muscles and is converted into "energy," "work." Both these operations, viz., the conversion of food into nourishment, and the using of this to do work, are productive of heat. The heat produced is regulated so that it remains practically constant (the temperature), and in this regulation, the skin (sweating) and the lungs (breathing), assisted by the bowels and kidneys, take the leading parts. With such changes constantly occurring, there must of necessity be considerable waste, and this is excreted by the bowels (fæces), and the kidneys (urine), the skin and lungs also assisting to a considerable extent, while the lymphatics take care that no unnecessary fluids collect in the tissues.

In order that these functions may be carried out with as great perfection as possible, the animal should, in all circumstances, be placed under the most suitable conditions, and these are considered in subsequent chapters.

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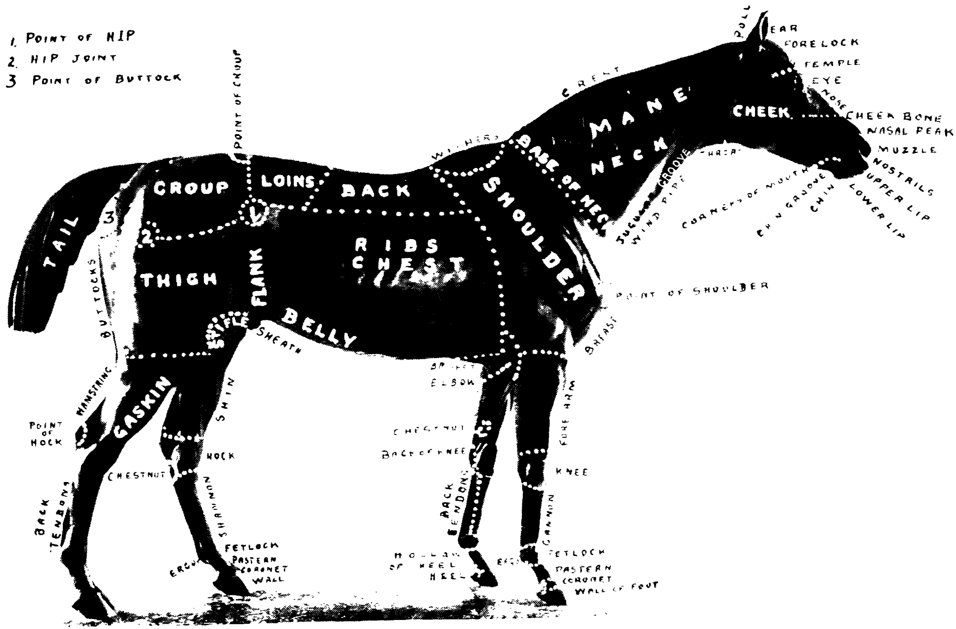

THE POINTS OF THE HORSE.

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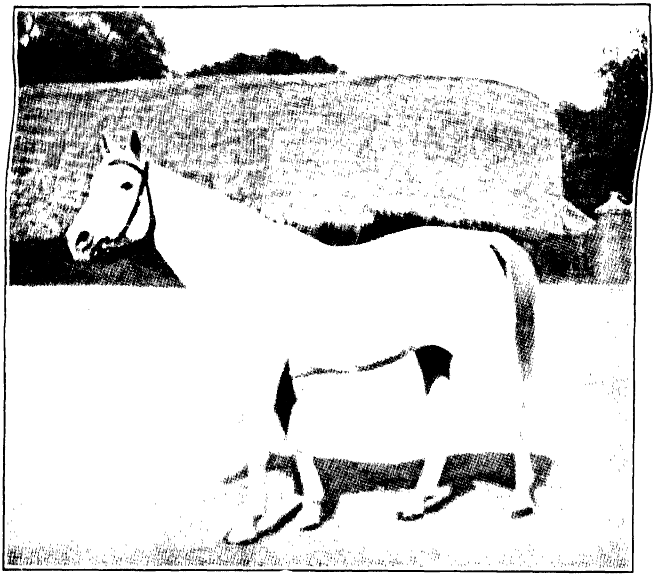


"A good horse is one with many good, few indifferent, and no bad points." The above photograph represents such a one, and the reader's attention is drawn to the following: Arab type of head, long rein, well-placed shoulder, short back, strong loin and well ribbed up middle piece, deepening through the heart. The quarter and thigh are muscular, the arm long, the cannon short, and the back tendons show no tendency to be tied in below the knee. This horse, "Blitz," an Arab, was a wonderful performer in his class, did an immense amount of work, left off sound, and when photographed was nearly twenty years of age.

CHAPTER II.

THE POINTS OF THE HORSE, COLOURS, MARKING AND AGE.

The "*points*" *of the horse* are the terms used to indicate the several regions alluded to.

Commencing at the top of the head, the part immediately between and behind the ears is called the "poll"; the "forehead" is from the poll down to the level of the eyes. From the level of the eyes downwards to the nostrils we have the "face," and the lower part, including nostrils, mouth and chin, is generally termed the "muzzle." By taking hold of the inner side of the nostril, one is able to see some distance up it, to note that it rapidly gets very narrow, and to see on the floor of it, rather towards the inner side, a small hole, which looks as if it had been made with a punch. This opening is the end of a small canal which starts from the inner side of the lower eyelid and allows the tears to be got rid of without running over the face.

If a finger is passed into the nostril at its upper angle, it enters a blind pouch or cul-de-sac, which is known as the "false nostril."

Starting again from the poll: the top of the neck from which the mane springs is called the "crest," and passing the hand down this we come to the "withers." The withers rise slightly from the end of the neck and slope away down to the back; they are situated immediately over the top of the shoulder-blade. Behind the withers lies the "back"; behind the back the "loins," "croup" and "dock." The "back" runs as far from behind the shoulder-blade as a hunting saddle reaches, the "loins" from there to the top of the quarter, and the "croup" from thence on to the root of the tail or "dock." Coming back to the head, the space between the branches of the jaw is called the "jowl," and just behind it is the "throat." Running down the lower part of each side of the neck, from the angle of the jaw to just in front of the shoulder, is a well-marked shallow groove in which the large blood-vessels of the head and neck lie. On the near side the "gullet" also lies in this groove, and its position may be accurately noted whenever the animal swallows a mouthful of food. Beneath these grooves and in the centre line the "windpipe" is found and may be traced from the throat to the base of the neck where it enters the chest, the rings of cartilage of which it is composed being easily felt beneath the skin.

At the lower part of the neck where it joins the body is the "breast," in the centre of which may be felt the point of the breast-bone. This bone runs backwards between the forelegs and terminates in a broad piece of cartilage with a slightly upward curve which is seen just behind the point of the elbow; this is the "girth-place."

The ribs, eighteen in number, springing from the backbone above and attached to the breast-bone below, form a cage for the organs of the chest and belly which extends from between the front of the shoulders to the loins. They may be felt from behind the shoulder backwards, and the space between the last rib and the hind-quarter is termed the "flank." The regions occupied by the "chest" and "belly" respectively may be estimated by drawing a line, curved forward in its length, from the loins above to the girth-place below. The "forehand" includes head, neck and fore-limbs. The "quarters" are the whole of the parts from flank to tail.

Turning one's attention now to the foreleg, the "shoulder-blade" slopes downwards and forwards to the "point of the shoulder," where with the "arm-bone," or humerus, it forms the shoulder-joint; this latter being continued backwards and downwards to the "elbow-joint." The whole of this region from the top of the shoulder-blade down to the elbow and including the large mass of muscle behind the bones constitutes the "shoulder." The "forearm" reaches from the elbow to the knee, the bones being covered with muscles, except on the inside, where they lie close under the skin. The bone forming the "point of the elbow" may be felt projecting prominently at the back of the elbow-joint. On the inner side of the arm may be noted a horny prominence, the "chest-nut" or "castor."

From below the knee to the next joint, the bone running down the front of the leg is termed the "cannon," "shank," or "shin," and the tendons from the bend of the knee down the back of the same area are familiar to all as the "back-tendons." This brings us to the "fetlock" joint, and below this the "pastern" slopes downwards and forwards to the hoof. Behind the fetlock, in a tuft of hair, is a small mass of horn. This is known as the "ergot," and is largest in common bred horses. The region round the top of the hoof is called the "coronet," and usually there is a slight bulging forward of the skin at this point.

Commencing now at the top of the hind-quarter, we find, about a good hand's breadth behind the last rib, a bony prominence just beneath the skin, the " point of the hip " ; the projection of the quarter just below the root of the tail or " dock " is the " point of the quarter " or " buttock," and about midway between the point of the hip and buttock, lying deeply in the muscles, is the " hip-joint." The hip-bone runs from the hip-joint to the " stifle," which is the large joint found behind the lower part of the flank ; from here the " thigh " runs backwards and downwards to the " hock-joint," and the prominent bunch of muscles found over the outside of the lower part of the thigh is often called the " gaskin " or " second thigh." The " hamstring " is the thick, strong tendon running from the muscles at the back of the thigh to the " point of the hock." Below the hock the same terms are used as in the foreleg. The " chestnut " in the hind leg is situated on the inner and lower part of the hock, and is smaller than the corresponding one in front.

The Points in Detail.

The head should not be large in proportion to the animal's size ; big heads are heavy, and although nature provides a strong support in the neck, still every pound tells when the horse is tired. There should be a general appearance of leanness, with width between the eyes, depth through the jaw and fineness about the muzzle ; the lips closed firmly over the teeth, the nostrils fine at the edges and standing well open, the ears alert and carried forward (" pricked "). Breed has a great effect on the head, a high-caste Arab offering perhaps the best type ; but well-bred horses, whether race-horses or cart-horses, generally have good heads of their class.

When the line of the face, viewed from the side, is convex and increasingly so towards the nostrils, it is termed " Roman-nosed " ; the reverse, viz., a concave line from the forehead to the nose being called " stag-faced " or " dished." An abnormally large and long head is sometimes spoken of as " like a coffin," and when viewed from the front the resemblance is not far-fetched.

The ears should, as a rule, be carried upright and forward (" pricked "), though they will naturally move very frequently as the attention is attracted to sounds from various directions. " Lop ears," which flop down sideways, usually denote a lazy disposition and are very ugly, but they may occasionally be seen in well-bred horses. Bad-tempered horses frequently carry their ears flat back against the side of the neck when they are approached or about to kick.

The eye should be set well out at the side of the head so as to command a wide range of vision, and the eye-ball should be neither too prominent nor too deeply placed in the socket.

When the eye is small and sunken it is known as a " pig-eye," and is often associated with a bad-tempered animal.

There should be a sufficient width between the branches of the jaw (the jowl) to give ample room for the top of the windpipe.

A small head is less weight to carry; width between the eyes indicates a good field of vision, and the animal is not so likely to be nervous as one with less ample range of sight; well-opened nostrils and width of jowl give capacity for easy breathing during exertion; while depth of jaw and width between its branches show that the animal is possessed of good masticating power, which has an effect on digestion and consequently on condition.

Although in no point of conformation are there greater differences to be found than in the head and no part in which the influence of blood shows more marked characteristics for good or ill, still in the purchase of a large number of horses it would have to be a very marked and extraordinary fault in the head which alone would cause the rejection of a horse. Generally speaking, the worst fault as regards the head is excessive size and weight, and although the dealer's criticism, " You don't ride his head," is true in a sense, still, with a tired and possibly weak horse on a long journey (common conditions on service), stumbling is likely to be induced by this particular conformation. As an index of disposition and temper, the head has always been the subject of remark, and there is, as a rule, undoubtedly a great deal in its expression and conformation which gives an insight into the general character; the lean, stag-faced head of the nervous thoroughbred, with prominent eyes, constantly moving ears, and nostrils expanding at every sight and sound being a familiar example which most must have seen; whilst the pig-eyed animal with a bump on his forehead is a type commonly associated with a wilfulness and obstinacy which call for equal determination on the rider's part.

The set on of the head to the neck is a matter of importance as regards the ease of control we are able to exercise over the animal, and it is fortunate that the conformation most pleasing to the eye is also the one which gives greatest power to the rider. Just behind the lower jaw there is in a well-set-on head a narrowness and looseness of the part which gives the impression of lightness and free mobility, especially when viewed from the side, though when seen from above (as when riding or driving) it will be noticed that the junction is strong and well clothed with muscles.

The neck.—The set on of the head, however, must be taken in conjunction with *the neck*, which offers several varieties of shape. The upper border from poll to withers from which the mane springs is called the "crest," and it attains a much greater development in entire horses than in mares or geldings, being in some instances so high and heavy as to lop over to one side. For fast-working horses, and especially those which have to travel far, this is a very undesirable conformation, as it adds to the burden carried by the forelegs, which normally support more than half the animal's entire weight, and the neck should therefore be as light as consistent with strength. Length as well as lightness is a point which should be sought for in the neck of any horse intended for fast work, as the muscles which lift and move forward the shoulders lie along it, and length of muscles, generally speaking, means ease and quickness of movement; on the other hand, a short, strong, bulky neck is regarded by some as the ideal for draught horses, and is said to enable the animal to put weight into the collar. A careful inspection of heavy horses, however, shows that many of them have as long necks as other breeds, though their extreme muscularity and bulk may give the appearance of shortness to the eye.

Strength is imperative in this as in all other points of the horse: the neck must be sufficiently strong and muscular not only to lift and pull forward the foreleg, but also to sustain the constant weight of the head. This strength and muscularity is perhaps most fully realized when one is in the saddle, for it may then be seen that the beautifully curved neck which gave such an impression of grace and lightness when looked at from the side is nevertheless sufficiently thick and full of muscle when seen from above; while a weak neck, on the other hand, immediately strikes one as thin and wanting strength when viewed from the same position.

The line of the crest from poll to withers should be firm to the feel, and form a pleasing curve, with a slight dip just in front of the latter, whilst the lower part of the neck which accommodates the windpipe, gullet, and great blood-vessels which convey the blood to and from the head, should be loose and flexible.

The junction of the neck with the shoulder presents a long narrow triangular surface, from the withers down to the point of the shoulder, against which when in draught the body side of the collar rests, and on this account an accentuation of it and consequent width between the points of the shoulders may be a desirable feature in heavy draught horses. In fast-working saddle horses it is not only undesirable but a positive drawback, and in such the junction of the neck and shoulder should be rather a slipping of one into the other than a sharply defined space between the two.

The best type of neck for saddle horses, combining sufficient length and strength with graceful carriage, lightness and good set on of head, is most often seen in the Arab, hunter and racehorse, whilst the typical heavy draught neck may be seen in the Shire and the Clydesdale.

A ewe neck is one in which the curve is the wrong way, the same shape as that of the sheep. With this variety, the head is set on at an angle which is too horizontal, and consequently when going the animal pokes out the muzzle and looks upwards (" a star gazer "), rendering control difficult unless a standing martingale is worn.

A bull neck is short, thick and bulky, very strong but not very flexible, often carried in a more or less horizontal position, and associated with the habit of " boring," *i.e.*, leaning the weight of the head and neck constantly on the bit.

A " cock-throttled " or *" swan-necked "* horse is one which has a neck like a fowl. The set of the head may be good and the commencement of the curve of the neck correct, but towards the lower part it tends to become ewe-necked. With this formation the head is held high ; if accentuated it is a very unpleasant conformation to ride, though in a slight degree only it occasions no inconvenience.

The mane and forelock is not very voluminous in thoroughbred animals. It is composed of perfectly straight hair which lies to one side or other of the neck. In heavy, and especially under-bred heavy horses, it is very plentiful, the hair having a tendency to get wavy or curly, and sometimes it divides down the centre and falls both sides of the neck.

The withers commence from the dip where the neck ends, and rising slightly over the tops of the shoulder-blades, slope away into the back. The rise of the withers is formed by the long spines which, in this situation, project upwards from the bones of the back, and as they are immediately under the skin they are particularly liable to injury by any pressure upon them from above. The truly formed wither for a riding horse should be of medium height only and neither too narrow or fine, nor too thick, a moderate height being essential to afford surface for the attachment of the upward prolongation of the shoulder-blades and their covering muscles. Very high withers are generally too " fine," or narrow, and are not only more liable to injury from the saddle by reason of their actual height, but their narrowness renders this injury more likely, owing to the want of sufficient width to support the saddle, which is a very serious matter in the troop horse. Low, thick withers are undesirable for riding horses, and though some Arabs and ponies must be exempted from the criticism they are usually found in types which are more intended for draught than saddle.

The back is a rather indefinite term, by which is sometimes meant the whole length of the trunk from the withers to the croup, and sometimes that limited region on which a hunting saddle rests. This latter is the part now alluded to, viz., from behind the withers to the front of the loins on each side of the spine. On this comparatively small space the whole, or practically the whole, of the saddle load rests, for the withers in front and the loins behind cannot sustain pressure without injury.

The typical back for all military horses is a short, strong one, level from the dip behind the withers or rising very slightly towards the loins ; a long back is, other things being equal, a weak one, and may often be found in conjunction with shallow back ribs and weak loins, a conformation ill-suited for the rigorous conditions of war. Short, muscular, strong backs, on the other hand, are usually found associated with the good, well-ribbed-up bodies and powerful loins, which denote strength.

When the slope of the withers into the back is deeper than usual, the horse is said to be "dipped" in the back ; a "hollow" back is an exaggeration of this condition carried up to the loins, and a "roach" back is the opposite formation, viz., an upward curve of back and loin. When the animal is as round as an apple and in good hard fettle it will be seen, particularly after work, that the muscles on each side of the centre line of the spine stand up so prominently that there is a slight ditch down the middle of the back, but when from want of flesh the central spines of the backbone are the more prominent they form a sharp ridge or "razor" back. The "razor" back may, of course, be due only to want of muscle which judicious rest, food, and work will produce, but if it is a natural conformation it is a very bad fault and found in conjunction with flat sides, narrow loins, and weak quarters.

All horses, especially those which constantly carry heavy weights, tend of course to become more hollow in the back with advancing age, and when the condition is extreme it may be not only a weakness, but a source of considerable inconvenience in saddle fitting ; while the roach back may give similar trouble, though it is in itself a strong formation.

The loin.—Extending from the end of the back as far back as is level with the point of the hip is the "*loin*."

The function of the loin muscles is to raise the weight of the body and its load on the hind-quarters so that the fore-hand can stride away. They should therefore be muscular. Short, broad, fleshy loins are what are required in all classes of horses, and long, narrow, weak ones (" slack loins ") are to be avoided.

The body comprises the chest, belly and flank (the two latter being the " barrel "). Its shape is in accord with the arch and depth of the ribs and the length of the back and loin.

The ribs should be well hooped (" sprung ") and deep, so as to give plenty of room for heart, lungs, stomach and bowels. They should reach well back, so that there is not much space between the last rib and the point of the hip (*i.e.*, " well ribbed up "). At the " *girth-place* " just behind the elbow, there should be a slight upward curve of the breast-bone, which gives the spot its name. From the girth-place to the stifle the lower line of the barrel should carry along with a very slight upward tendency, not running up between the hind legs like a greyhound, or looking " pot-bellied," but it varies somewhat according to the condition of the animal under notice. The hunter or troop horse should be " deep through the heart," *i.e.*, just behind the elbow, have deep back ribs, and be well ribbed up. Shallow bodies, wanting depth through heart and back ribs, and barrels running up light behind, are to be avoided, as they are not shapes likely to stand hardship or give endurance. The same applies to narrow " flat-sided " horses, in which the arch of the ribs is insufficient to give room for large, well-developed lungs and hearts.

Many terms are commonly used to express the appearance of the barrel, " herring gutted," " like a greyhound," " waspy," " tucked up " and " light," all being indicative of smallness from various reasons, while " pot belly," " cow belly," and " grass belly " imply a large or pendulous condition.

The fore-limb—The shoulder.—While all are agreed as to the requirements of a good shoulder, many differences of opinion will be found in actual practice. The typical shoulder should start from a wither of fair height and have a long, well-sloped shoulder-blade. The blade should be muscular, but the muscles should not be lumped on to it either at the top or point; rather they should give the appearance of being neatly slipped into their places and finished off with a plane. The lower part of the shoulder, from point to elbow, should be short and muscular, and the muscles which fill up the angle behind the shoulder-joint should be large and prominent, especially at the lower part near the elbow. The shoulder is said to be " loaded " at the top or point when the muscles of those parts appear too bulky and lumpy. " Upright shoulders " are those in which the slope of the shoulder-blade is considered insufficient, and " short shoulders " are those which are judged to have too little depth from wither to elbow. The shoulder should be set well back on the ribs, and not far forward and up the neck. The placing of the shoulder makes all the difference to the conformation of the forehand, the carriage of the saddle and the distribution of the rider's weight. Upright shoulders, placed far forward, are the worst, owing to the forward position in which such a conformation carries the weight.

The forearm should be long and muscular. Looked at from the side, it should be broad at the elbow with the muscles well outlined, and tapering gradually towards the knee. Regarded from the front, it is narrow with bulging muscles on the outside and a clean, hard line on the inside where the bone is next the skin.

The knee should be, like all joints, big, to afford plenty of room for the attachment of strong muscles. It should be broad and flat, deep from front to back, with a very slight bulge forward in front, and the bony knob at the back large and prominent.

"*Stag knees*," "*calf knees*" or "*back at the knees*" are the terms used to describe joints which, when looked at from the side, show a concave rather than a convex line down the front of the knee.

"*Tied at the knee*" means that the measurement across the cannon and tendons immediately below the knee is small as compared with the same lower down.

The cannon should be short; narrow when viewed from the front, broad and flat looking from the side, with the tendons standing out in clean, hard, straight lines at the back. The line of the tendons from knee to fetlock should be straight, and the leg should look the same width below the knee as it does just above the fetlock. Good measurement below the knee is usually called "plenty of bone," but it includes the tendons as well as the bone, and really means that there is plenty of room for the tendons, and that these are well developed.

"*Gummy legs*" are those in which the clean, hard lines which should mark the course of the tendons are not well defined; but which, owing to general fullness of the leg, or sprain of some particular part, look more rounded than they should.

The pastern should be strong and of medium slope and length. Too long and sloping pasterns may be as faulty as short and upright ones, for although they usually give a pleasant elastic action, they lack strength for hard work and carrying weight. The short, upright pastern means loss of elasticity and extra concussion to both horse and rider, and the mean between these two extremes is best. An exception as regards the slope of the pastern must be made in the case of Arabs, as in some of the best of them the slope is very great.

The foot is considered in Chapter VIII (The Foot and Shoeing).

The forehand, as a whole, deserves special consideration; as it supports more than half the weight of both horse and rider, it should be a prime factor in the selection of saddle horses, and lightness combined with strength in the forehand is of the first importance for riding. The head should be light and well set on, the neck of sufficient length, slightly arched along the crest from poll to withers, light in appearance, but muscular and strong. The shoulders should be deep, well-placed, and the blades set at a sufficient slope. Here, again, the appearance of lightness combined with actual muscular development should be looked for; heavy, lumpy shoulders, especially when upright and placed forward, are the worst type for the saddle. The legs from the arm down should drop straight and true to the foot, the toes being turned neither in nor out, and with plenty of bone below the knee. This last is important, as the strain on the tendons is, in any case, great; and if they are "tied," *i.e.*, thrown out of the straight line, and given insufficient room at the knee, the tension on them at a fast pace is so much increased that they are more likely to be sprained, and this extra risk rightly causes great attention to be paid to this part. If the toes are turned out from the fetlock, "brushing" is likely to occur, and the liability is greatest when the horse is fatigued. The fetlock of a horse which turns his toe out is bent inwards as well as backwards when the weight is passing over the leg, and is thus brought nearer the other leg, the foot of which may strike it in passing.

The quarters should be muscular and full of flesh, but their shape may vary considerably. "*Straight*" *quarters*, which run nearly level from the croup to the dock, are seen chiefly in thoroughbreds, but a "*drooping quarter*" which slants downwards from croup to dock is also seen in many well-bred horses. When the slant is very pronounced it is termed a "*goose rump*." "*Round*" quarters are seen in cobs, ponies, and many Arabs. When the points of the hips are wide apart, so that they are very prominent when looked at from behind, they are often termed "*ragged hips*." The actual shape is not a matter of so much consequence for general work, provided the parts are sufficiently large, strong, and full of muscle.

The thighs from the stifle to the hock should be long and well clothed with muscle. The prominent bunch of muscles at the lower and outer part of the thigh is termed the "*gaskin*" or "*second thigh*," and should be well developed. The strong tendon running from the muscles at the back to the point of the hock is the "*hamstring*."

The hock should be a large joint with a prominent point. From the point, the tendons of the hind limb should drop straight to the fetlock, and if there is any bulging over the seat of curb, about five or six inches below the point, it should be due to the prominence of the bone in this neighbourhood and not to an enlargement of the tendons. The inside (best viewed from a point just outside the foreleg) should present a marked knob where the thigh bone terminates and from there slide gradually to the cannon without any very marked prominence over the seat of spavin. When the points of the hocks approach each other, instead of being in the perpendicular, they are termed "*cow hocks*." "*Sickle hocks*" are those which are too much bent, so that the line from the point of the hock to the ground slopes forwards. "*Curby hock*" is an indefinite term used by some to denote the presence of curb, and by others to describe either a hock which they think likely to get a curb, or one which, owing to the prominence of the bone, looks as if it had a curb. When the thighs slope markedly backwards and the hock is further behind the animal than usual, the formation is termed "*cat hammed*."

The hind-quarters, providing as they do the propelling force for the body, must be muscular and of a size proportioned to the rest of the frame. For speed, length and depth of the quarter, with long, straight-dropped thighs and hocks ("hocks well let down"), are required; for strength, bulk is essential. In speedy horses width of the quarter is not so noticeable as length and depth, but it is a prominent feature in heavy breeds. Narrow, short quarters wanting muscle between the thighs ("*split up*") with cow hocks and cat hams are the worst types.

The class of horses required for the Army may be generally described as follows :—

Colours.—Whites and greys are only required for special purposes, and are always specially ordered. Other very light, or washy coloured horses are not accepted.

Entire, unmanageable or vicious horses, crib-biters, wind-suckers, parrot-mouthed or undershot horses, or horses with capped elbows, damaged knees or injured or deficient teeth are not admissible.

Horses with short docks will not be accepted.

Soundness in eyes, wind and limb essential; no stale, upright, or overshot joints, and no curby hocks will be passed.

The class required is a deep, short legged, short backed, good barrelled horse, of the hunter stamp, with substance and quality, true action, and going quite clear of the joints.

The same description generally applies to cobs.

For artillery and engineers good quality draught horses are required.

Ages.—For peace, four off to six years; for war, six to ten years.

Colours and Markings.

It is necessary to note colours and markings exactly as they are recorded for the purpose of identification.

The colour of horses is markedly influenced by breed, and is also to some extent an index of character, though to this latter there are numerous exceptions. Breed, however, has a very general effect on colour, which is, of course, the more marked where selection is practised with a view to maintaining a peculiarity. The Cleveland bay is a well-known example, and also there may be cited the whole colour chestnut of the Suffolk punch, the black Belgian horse, the cream-coloured Hanoverian, and the dun Kathiawar of India. Whatever the horse's colour it should be good of its sort and not "*washy*." This term is used to indicate the faded or washed-out appearance of the coats of some horses, and it may be generally noted that the hair on the legs of such gets lighter towards the extremities—*mealy legs*. When a choice is possible such colours should not be selected as they indicate a general want of hardiness. There is truth in the saying, "A good horse is never a bad colour," whichever way it is applied.

The colours usually purchased for the service are bay, brown, black, and chestnut; others which are not so commonly seen in the ranks are dun, grey, roan, piebald, skewbald and odd coloured.

Bay horses vary from a light, golden or yellowish, which might almost be called a dun, to a very dark rich shade which merges into brown, and midway between these extremes we have the bright, blood bay with a coat the colour of polished mahogany. If it is a question as to whether the animal is bay or brown, the fine hair on the muzzle will show most distinctly which is correct.

Whatever the shade, whether light, bright or dark, it should not be "washy," and where there is a change of colour towards the feet it should become deeper than that of the body or black. Bay with black points is universally esteemed as a hardy colour, and usually associated with good working qualities. White markings are extremely common both on the faces and legs, but they do not as a rule become so exaggerated as is often the case with chestnuts, and occasionally a leg with a pepper and salt mixture of black and white hair from below the knee or hock downwards may be noted.

Brown, though usually a sufficiently distinctive colour to admit of ready description, may sometimes be difficult to distinguish from bay or black, and recourse must again be had to the hair of the muzzle to determine which is correct. As with bay, brown, to be a good colour, should tend to become black towards the feet.

Black, though a particularly attractive colour when it carries a sheen and the animal is in condition, is not, perhaps, so much esteemed as bay or brown. It is not now so common among our own horses as imported ones, and this together with the fact that a rusty black or one out of condition always catches the eye at once, may account for the want of appreciation. It is uncommon among thoroughbreds and Arabs, and extremely common in Belgium.

Chestnuts may vary in colour from a dark liver which approaches brown, to a light washy, which is to be avoided. It is not usually found as a whole colour except in the Suffolk punch, and there is often a tendency for the white markings of the face and legs to become exaggerated. The colour is also very generally believed to be associated with a tear-away, headstrong disposition, and there is no doubt that some, especially those with much white about them, are impetuous and excitable; on the other hand, very many of the best horses are chestnuts, and so, perhaps, it may be only when the colour is conspicuous that it attracts attention.

Dun, varying from a mouse colour to a golden dun, is considered good for hard work and sound constitution, especially when found with black points. Zebra markings are generally well marked on animals of this colour. It is not common in English horses, but is frequently met with in India.

Greys are not usually purchased for remounts, as they are conspicuous against almost any background, but before rejecting a good horse for immediate service one should remember that they only get white with age, many being so dark when young as to look almost black, and yearly becoming whiter. It is common among the draught-horses of France, and is a favourite colour among Arabs, particularly the variety known as "flea-bitten."

Roans are of two classes, the "*red*," or "*strawberry*," and the "*blue*"; and the appearance of the coat is produced by the intermingling of red, white, and yellow, or black, white, and yellow hairs respectively. They tend to get whiter with age in the same way as greys, but not in so marked a degree. The red roan is sometimes called "sorrel," and occasionally a chestnut roan may be met.

"*Piebalds*" are black and white, and "*skewbalds*" any other colour and white, the colours being laid on in large patches all over the body.

Odd coloured resemble piebalds and skewbalds, except that the patches are of more than two colours.

The marks usually noted are as follows :—

On the head.

"*Star*," a white mark generally more or less rounded in the centre of the forehead ; it is further described as "large," or "small."

"*Stripe*," a narrow white marking down the face. It may or may not be a continuation of a star. It may be further described as "short," "irregular," "broad," or "narrow," according to its appearance.

"*Blaze*," a white marking covering almost the whole of the forehead between the eyes, and extending down the front of the face, involving the whole width of the nasal bones.

"*White face*," where the white covers the whole of the forehead, front of the face, and extends laterally to the mouth. Really an exaggerated blaze.

"*Snip*," a white mark between the nostrils ; may be centrally placed or may extend into one or both nostrils, and must be so described.

"*Upperlip*" and "*underlip*" are the names used to denote white skin at the edges of the lips.

"*White muzzle*," where the white embraces both lips and extends to the region of the nostrils.

"*Wall eye*," where, owing to a lack of colouring matter, the eye has a greyish-white or bluish-white appearance.

On the body.

"*List*" and "*Ray*" are terms used for the dark lines seen along the back of some horses, all donkeys, and many mules.

"*Zebra marks*," where there is a striping on the limbs, neck, withers or quarters. They are not very common in horses, but are usually seen in donkeys and mules.

In describing horses the above terms are sometimes called *mule marks* or *donkey marks*.

There are many marks, not congenital ones which are permanent, *e.g.*, saddle, bridle, collar, girth and other harness

[*To face p.* 30.

Star.

Stripe.
With snip into off nostril

Blaze.
With snip into near nostril.

White coronet.

To face p. 31.]

White pastern.
Showing ermine marks.

White fetlocks.

Sock.

White leg.

marks, bandage marks, firing and branding marks, scars, tattoo marks. These should be described. Horses which have been "docked" should be so described.

White hairs in the coat, mane and tail, and patches of white or dark hair on any part of the body are also noted.

When the coloured hairs of grey horses are arranged in small tufts over the entire body they are said to be *flea-bitten.*

As the result of tick bites, some horses, particularly South African, of colours other than grey, have small white patches scattered over the entire body.

On some horses, particularly Australian, fine lines of white hair producing a sort of wide-meshed network are seen on the loins and quarters; they are termed *salmon marks.*

"*Flesh marks.*"—Patches of skin with no colouring matter.

On the legs.

White feet, white coronet, white heel, white pastern, white fetlock, and *white leg* are all noted. As all these marks are one colour the word "*white*" is often omitted, and the name of the part only is mentioned. If the white hair does not completely cover the place mentioned the word "partly" is inserted, and when black spots are seen on the white, it is called "*with spots*" or *ermine* when it bears a resemblance to that fur. As the above may not at first be clear to those unfamiliar with the terms a sample description is given.—*Off fore and near hind legs; near fore fetlock partly; off hind coronet with spots.*

Horses without any white marks on them are said to be *whole coloured,* and when the hair towards the lower part of the leg and hoof is black, the term "*black points*" is used to describe it.

In general conversation the word "horse" is often used to describe the whole species without reference to sex, but in setting forth an accurate description it is only employed to designate the uncastrated male as synonymous with *Stallion* or *Entire.*

Gelding means a castrated male of any age.

Colt is somewhat loosely employed to describe any young and usually unbroken male, but when applied to racehorses is only used to mean a young stallion usually not more than three years old.

Foal is applied to either sex under one year old, after which the term "yearling" is used. If it is wished to describe the sex, the terms colt foal, filly foal, yearling colt and yearling filly are used.

Filly means a young female, usually up to three years old, after which she is spoken of as a "mare."

Rig means a male from which only one testicle has been removed, the other not having descended into the scrotum.

It may be noted in passing that stallions and rigs should not be employed as soldiers' horses as there must always be a risk of their screaming or misbehaving at some critical moment.

HEIGHT.

Horses are measured by *hands*; a hand being four inches. The height is taken by a special measuring standard from the ground to the highest point of the withers.

A *pony* usually means an animal not more than fourteen hands, but the special conditions of polo and pony racing have resulted in the term being used to describe many larger animals.

Cobs and *galloways* are horses not exceeding fifteen hands and the former term generally implies a thick-set animal as well.

The average height of English horses is usually considered to be 15·2; but the variations are from about 9 hands in the Shetland to 17 hands in the Shire.

WEIGHT.

The average weight of a cavalry horse is 9 cwt., and that of a light draught horse 10½ cwt.

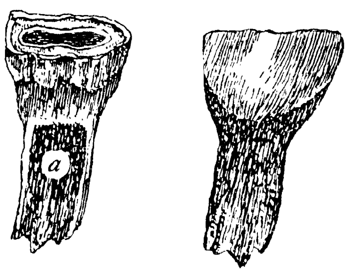


FIG. 3.—Back and front view of milk tooth, showing on back, at *a*, the hollow caused by the pressure of the growing permanent tooth, beneath, which ultimately pushed the milk tooth out.

AGEING.

The age of the horse may be told with practical accuracy by the appearances of the incisor teeth. There are two complete sets of these, *temporary, milk,* or *foal* teeth, and *permanent,* or *horse* teeth.

The differences between temporary and permanent teeth are as follows :—

The temporary tooth is small and white, has a distinct *neck,* and a short fang, which practically disappears as the tooth gets older from the pressure of the growing permanent tooth beneath, until its remnant is pushed out of the jaw (Fig. 3).

The permanent tooth is larger, stronger, and browner in colour, has no marked *neck* and a long, stout fang (Fig. 4).

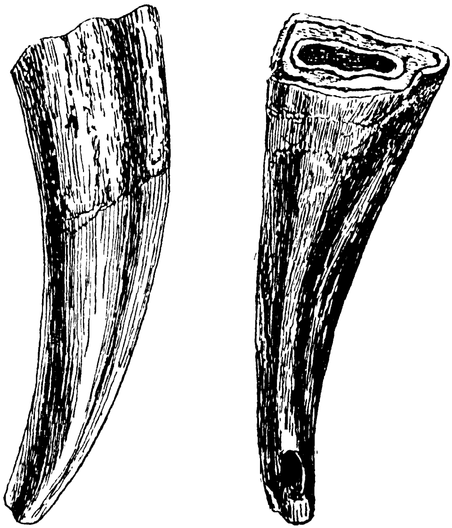


FIG. 4.—Front and back views of permanent incisor.

The parts of the teeth.—The surface which bites on the food or its fellow in the opposite jaw is the *table,* or *wearing surface. The mark* is the blackened depression which is seen on the table. It is lined by a distinct, narrow, pearly-white ring of enamel. This latter is easily seen and felt, as it stands up a little above the level of the rest of the surface. In the new tooth the mark is very broad and deep, but with age and wear it becomes shallower and smaller, till finally it disappears altogether. The blackening of the mark is due to discoloration from the food during mastication, and is not present in the new tooth.

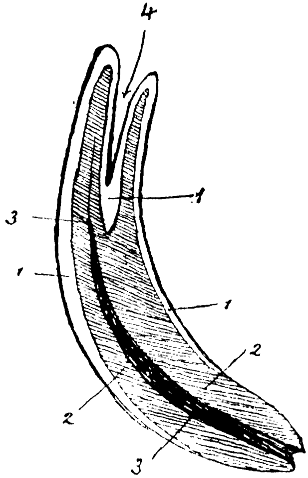


FIG. 5.—Diagram to show the different parts of a tooth and their relative positions.

1. Enamel.
2. Ivory (tooth substance).
3. Fang-hole.
4. The mark.

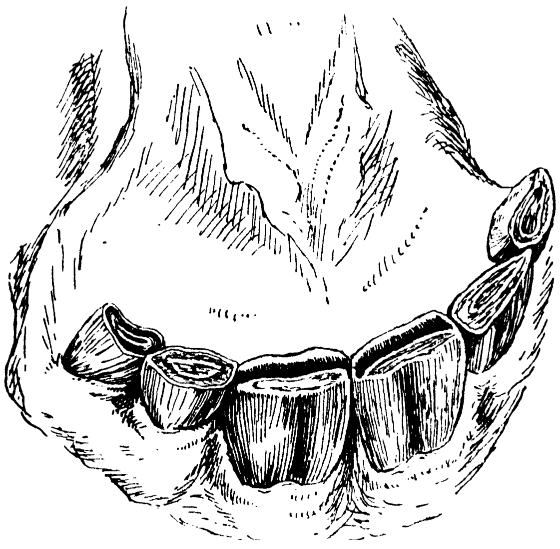


FIG. 6.—Three years old. Central teeth well up but not worn much.

The crown of the tooth is that part which is above the gum, and the point where the gum and tooth meet is the *neck*.

The fang is the part within the jaw. It is hollow and its cavity (fang-hole) contains the blood-vessels and nerves which nourish and sensitize the tooth. As the tooth grows up, the fang-hole becomes filled in with tooth substance of a lighter colour than the remainder, and when the wear reaches this level, it appears on the table of the tooth as a small white

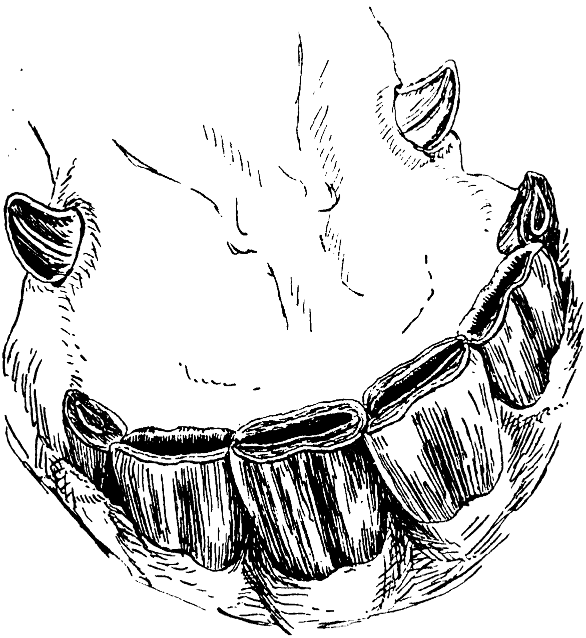


FIG. 7.—Four years old.

spot in the centre, or in front of the mark, if that has not already disappeared.

The horse's teeth, unlike those of man or the dog, do not grow to a certain length and remain so. On the contrary they continue to grow and be worn away until old age. As they get older definite changes are observed in their shape and appearance, and it is owing to these that they form such a good guide to the animal's age.

The age of thoroughbred horses is calculated from 1st January, others from 1st May. Army horses at home are aged as from 1st April. Abroad there are arbitrary dates fixed from which the age of animals is assessed, for example :—

In India:	Country-breds	1st January.
,,	Walers	1st October.
,,	Arabs	1st April.

The terms "rising" and "off" are frequently used in ageing horses; *e.g.*, "rising six" means "nearly six"; "six off" means "past six, but not yet rising seven."

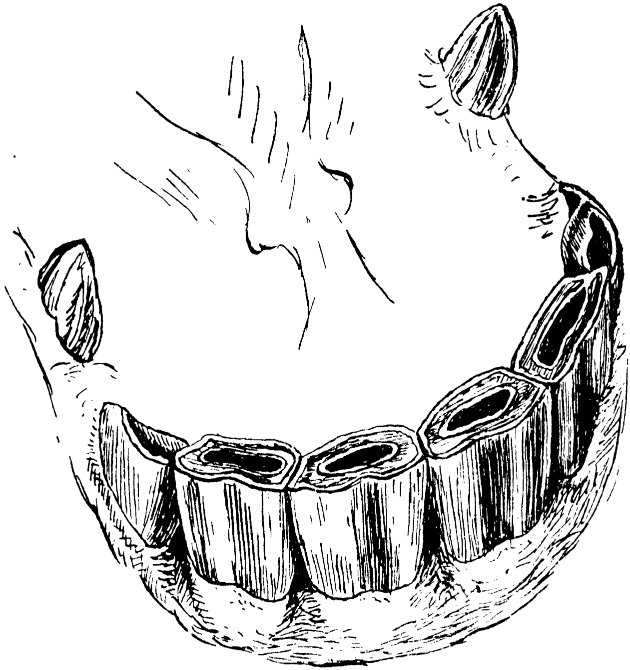


FIG. 8.—Five years old.

Number of teeth.—There are six incisors, at first milk teeth, and later on replaced by permanent teeth, in each jaw. The two in the centre of the jaw are called "centrals," the next tooth on either side is known as a "lateral" and the outermost one on each side of the jaw is the "corner" tooth.

In the male, a *tush* appears behind the corner tooth on each side of each jaw when the horse is reaching maturity. This is a permanent tooth only.

The *molar teeth* are six on each side of each jaw. The 1st, 2nd, and 3rd are first temporary and then permanent, but the 4th, 5th, and 6th only appear as permanent teeth. Practically, they may be left out of consideration for our purpose.

At birth the foal has two central temporary incisor teeth in each jaw. *At about two months* the lateral temporary teeth are cut, and at six to eight months the corner temporary incisors are through the gum.

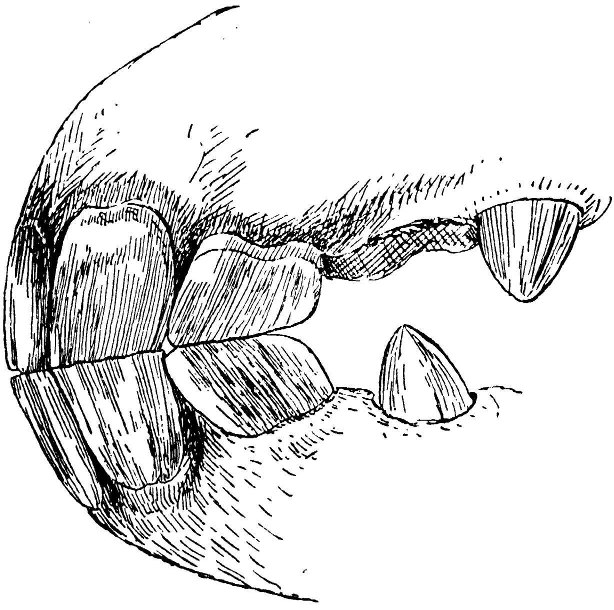


FIG. 9.—Five years old.

At one year the whole of the temporary incisors are in wear, the corner tooth being little worn and looking "shelly," *i.e.*, the inner side of the tooth not yet grown up level with the front.

At two years to two years and three months there may be some sign of the centrals giving place to the permanent teeth which are to succeed them. The gum may be red and swollen and the teeth loose.

Care should be taken against mistaking a two-year-old for a six-year-old mouth. This has frequently been done, but will not occur if one is familiar with the difference between the temporary and permanent teeth in appearance.

At two years and six months the central permanent incisors appear and at *three years* they are in wear.

At three years and six months the lateral permanent incisors are cut and at *four years* are in wear.

At four years and six months the corner permanent teeth are cut and at *five years* are in wear, but not fully.

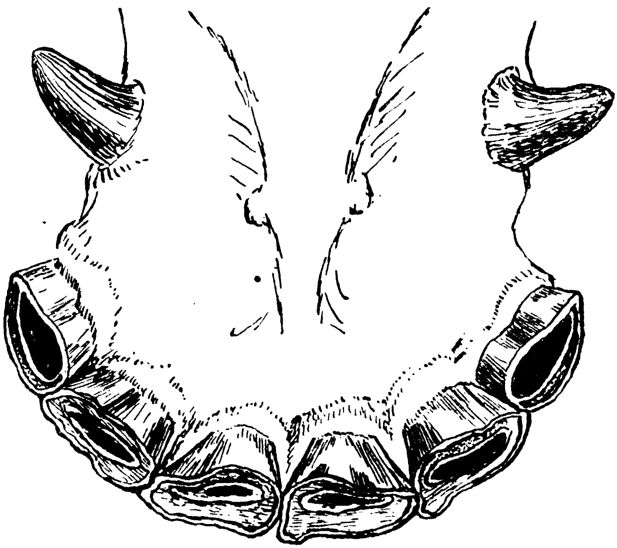


FIG. 10.—Six years old.

Between four and five years the tush is cut; at first it has a sharp point and edges, but these gradually become rounded with age.

At six years the corner teeth are in full wear over their whole surface, the marks are broad, but those of the central teeth are smaller, and show more wear than those of the laterals and the laterals more than the corners. The wearing surfaces of the teeth are broad ones, the centrals showing perhaps a tendency to become triangular.

With the mouth closed (*see* Fig. 11) and looked at from the side the teeth are upright and meet each other squarely, the upper corner tooth projecting slightly beyond that of the lower jaw, at the posterior corner.

From six years onwards the changes are as follows :—

The marks get smaller, rounder, and may disappear from the central teeth at about ten years. In some teeth, however, they persist for much longer periods, the variation being due to the depth of the mark and the thickness of its enamel lining, and also the manner in which the upper and lower incisors make contact with each other. In an "undershot" mouth the "marks" may persist for a long time.

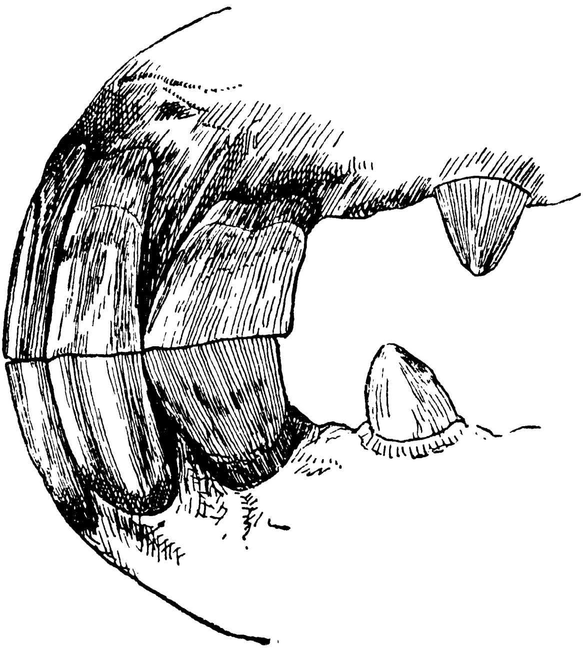


FIG. 11.—Six years old.

The fang-hole makes its appearance on the wearing surface of the central teeth at about eight years, as a transverse line, in front of the mark. With increasing age it becomes a "spot" rather than a line, and as the mark disappears it occupies the centre of the table.

The shape of the wearing surface becomes changed from the broad oval to triangular, the back of the tooth forming the apex of the triangle.

The teeth become longer and project forwards with age, instead of meeting each other in the perpendicular or nearly so.

At and after seven years there is a distinct notch on the upper corner incisor, where it overlaps its fellow in the lower jaw (Fig. 12). It is frequently broken off and sometimes removed by unscrupulous persons.

At ten years " Galvayne's mark," a depression on the outer side of the upper corner incisor, appears ; it reaches half-way

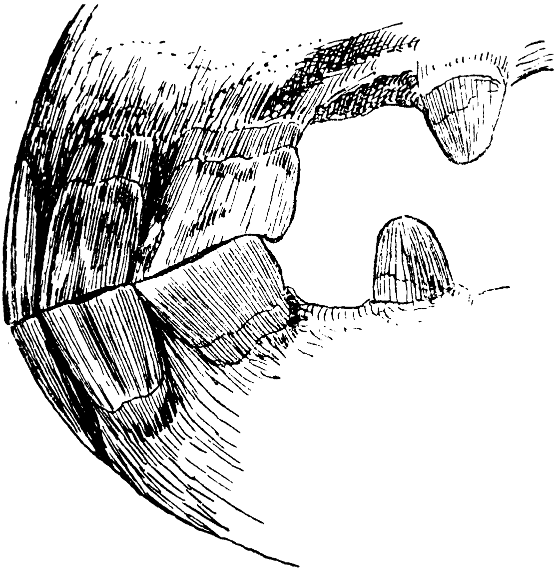


FIG. 12.—Seven years old.

down the tooth at fifteen, to the bottom at twenty, is half grown out at twenty-five, and disappears at thirty.

All changes appearing in the tables of the central teeth are seen in the laterals the following year and in the corners a year later.

The changes are given here for precise dates, but variations are considerable and can be learned by practice only.

The whole of the points already mentioned should be taken into consideration when determining the age of an animal, and too much reliance should not be placed on a single tooth without taking into consideration the whole mouth.

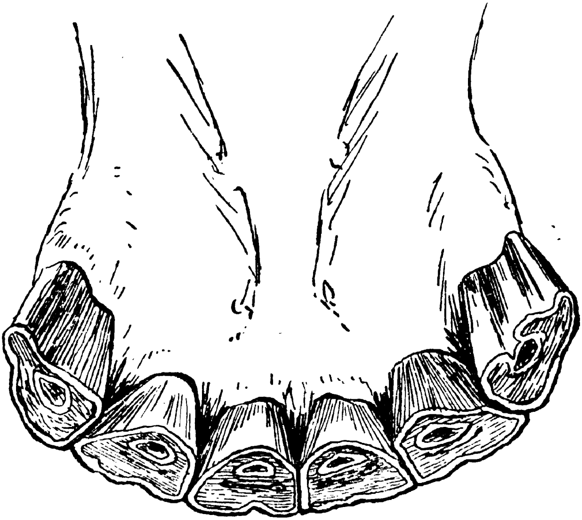


FIG. 13.—Ten years old.

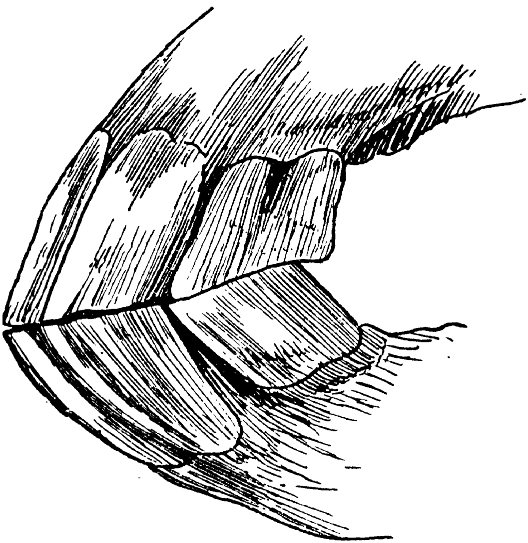


FIG. 14.—Fifteen years old.

In case of doubt the following points (apart from the teeth) are often present in old horses: sunken eyes, a sunken cavity above the eye, grey hairs in coat, and sunken anus.

Bishoping is attempting to make an old mouth look younger, as follows:—The teeth are filed short and level, a false "mark" is gouged out of the centre of the table and blackened with caustic.

The trick may be detected by: (1) closing the mouth, when the teeth will not meet naturally; (2) by observing the absence of the enamel rim to the false mark and errors of its shape due to slips of the gouge; (3) occasionally the traces of the rasp or file used to shorten the teeth are in evidence.

When ageing a horse one should always look at the same time for signs of crib-biting, in which case the front teeth will be unusually worn, sometimes down to the gums.

CHAPTER III.

STABLE CONSTRUCTION AND FITTINGS.

WHILE it is not essential that officers should possess a detailed knowledge of stable construction, they should undoubtedly have such acquaintance with the main points as will make their opinion of value when, as is the rule, a board is assembled to decide on a site or whether newly completed stables are fit for occupation.

Site.—The chief considerations in selecting a site for stables are :—pure air ; good light ; dry foundation ; a good water supply ; facilities for free drainage. Prevailing winds, and the position of surrounding buildings are also points to be taken into account. The position of a stable site must frequently be a matter of necessity rather than choice, but, as it will depend on the location of barracks for men, it will undoubtedly be a healthy one.

The nature of the soil is of the first importance—a sub-soil of gravel or deep sand offering the best prospect for a firm base, with free drainage and consequent dryness. Next to these self-draining soils, any rocky formation, such as limestone, chalk or granite, is suitable ; but stiff clay, deep loam, peaty and marshy soils are not naturally favourable and should it become necessary to occupy them, sub-soil drainage must be extensively adopted.

Dryness suggests a well-aerated soil and ready drainage ; *dampness* a rapid decomposition of animal and vegetable matter, a sub-soil water near the surface, and no drainage in case of wet.

Foundations are artificial bases to give stability, wider than the intended structure, and deep in inverse proportion to the solidity of the natural formation. Where the sub-soil water is near the surface, they require draining, and in very damp localities the buildings may have to be raised on arches or piles. Concrete and brick jelly are the usual materials of which they are made.

Aspect.—The buildings should be sheltered from the severest winds prevailing in the district, and not overshadowed by other structures to such an extent as to interfere with a full supply of pure air and sunlight.

Arrangement.—Echelon lines are the ideal arrangement, but the site at disposal rarely allows the extensive frontage this requires, and parallel lines are almost as good. Either of these plans admits of each stable or row of stables getting a free supply of air and light, which is the point desired. Small squares or enclosures are the worst models, as offering less perfect air supply, and greater chance of contagion when any form of sickness is prevalent.

Walls should be at least 12 ft. high to the spring of the roof, $1\frac{1}{2}$ to 2 bricks thick, and damp proof. This latter condition is fulfilled by (1) a water-proof course of asphalt, or layer of vitrified brick, introduced in the wall a little above the ground level, or (2) by double walls with a space between. This space is liable to become a refuge for vermin, but affords good protection against damp from rain beating on exposed faces. Bricks measure 9 in. $\times$ $4\frac{1}{2}$ in. $\times$ $2\frac{1}{2}$ in., are extremely porous, and will hold nearly a pint of water.

Roofs are flat or sloping. Flat roofs are found only when living rooms or lofts are built overhead. They must be air-tight, to prevent the escape of heated, foul air from the stable into the rooms above, and they offer no means of natural roof ventilation.

Sloping roofs without overhead rooms are by far the best, as their construction secures air space and light, besides admitting of ample natural roof ventilation.

Materials for roofs :—

(1) Tiles, either flat or pantiles, maintain an equal temperature and afford roof ventilation, but are easily broken or loosened and become untidy and leaky.

(2) Slates are fixed to the woodwork of the roof by two nails driven through each, and are not easily displaced, but they are as liable to breakage as tiles. Both tiles and slates make excellent roofs if kept in good repair and they should have an under roofing of boards.

(3) Stone flakes are substituted for slates in some districts where stone is abundant, but are very heavy, clumsy, and not to be recommended.

(4) Thatched and tarred felt roofs are to be rejected on account of their liability to fire, which is a fatal objection, though they have the advantage of being noiseless, and warm in cold climates.

(5) Galvanized iron is of baking heat in hot weather and of freezing temperature in cold ; it is also excessively noisy when vibrated, but it is cheap, no trouble, and easily transported, so that it is in general use in recently developed countries or localities, where, in spite of its drawbacks, it is

very acceptable. It should in any case have a wooden inner roofing.

Open roofs, i.e., without ceilings, may be closed along the ridge or have louvre-board ventilation. Louvres consist of two or more overlapping boards, separated from each other by a few inches, and set at such an angle that rain and snow cannot beat inwards.

The pitch or slope of the roof which is necessary varies somewhat with the material employed, tiles which are thick requiring more than slate; but an angle of forty-five degrees with the horizon may be regarded as a maximum.

It is not possible to get all the qualities required in an ideal roof out of any one material at present in use, the desiderata being: *an equable temperature in both hot and cold weather, noiselessness, non-inflammability, and durability.*

Floors should be laid on a solid foundation, raised above the outside ground; should slope from front to rear only so much as will admit of drainage to the back of the stall; should be absolutely impervious to wet; smooth, but not at all slippery, and durable. In the endeavour to comply with these requirements, a bed of concrete 4 to 6 in. thick should be first laid and the slope from the front to the rear of the stall made about one in sixty, *i.e.*, a slope of not more than 2 in. in 10 ft. Any floor not laid on concrete will sink in places, and harbour pools of urine.

Materials for paving:—

(1) *Cobblestones*, set in cement, are uneven and never give the animal a good or level standing; they are rarely laid on a concrete foundation and consequently sink in parts; the supporting cement cracks and urine finds its way between. They are a bad flooring in every way.

(2) *Bricks* are only suitable if thoroughly vitrified. Ordinary bricks are very porous, rapidly absorb moisture, wear quickly and unevenly, but are not slippery. They should be laid on their sides as they last longer.

Vitrified bricks, of which there are many kinds, are impervious to wet, but some of them wear very slippery. There are, however, others which do not become too glassy, and these make excellent paving: "Candy," "blue Stafford," "Dutch," and "adamantine clinkers" being the names of familiar varieties. All such bricks are grooved on the upper surface with one or more lines and the edges chamfered, to give better foothold and facilitate stall drainage. Such patterns are very various, but two crossed lines on a brick which has chamfered edges appears to answer as well as any other device, and the multiplication of grooves makes cleaning difficult. There is *probably no vitrified brick which does not wear somewhat slippery, but on the whole they make the* best paving.

(3) *Stone slabs* wear smooth and require constant re-chipping ; they are liable to crack a good deal and cannot be called a good flooring.

(4) *Granite setts* wear for a very long time, but want re-chipping frequently as they get smooth, and they never give a quite level standing.

(5) *Concrete* is laid in several varieties, some of which are good, durable, and non-slipping : but other samples are the reverse and require continual chipping or grooving to make them at all safe.

(6) *Asphalt* is too easily affected by heat, and gets too slippery when wet to make a satisfactory stable paving, and especially is this the case when calkins are worn.

(7) *Wood blocks* or any other materials, as wooden sleepers, which will absorb wet are quite unsuitable, although, when treated with creosote the former may be very usefully employed in forges and outbuildings.

Dimensions of stalls.—The dimensions laid down for the construction of stable blocks are : —Normal breadth of block, with one row of stalls, 18 ft., with two rows, 31 ft. *Height sufficient to give not less than* 1,200 *cu. ft. for each horse*, after subtracting the total dimensions of the fittings. All stalls against external walls. Stalls 5 ft. 6 in. wide, centre to centre, and 11 ft. long from wall to centre of heel post. Crib-biter stalls 6 ft. in the clear between walls.

VENTILATION.

The subject of ventilation is best studied here so that its bearing on the cubic space necessary may be fully appreciated. The object of ventilation is to change the air of a building frequently enough to keep it pure without allowing a draught to strike the occupants. Fresh air is approximately composed of—

Oxygen	2,099
Nitrogen	7,899
Carbonic acid..	2

per 10,000 volumes.

The amount of carbonic acid is very minute, but if it rises from 2 to 6 volumes per 10,000 the air is "very stuffy," while 6 to 8 volumes per 10,000 makes it "very offensive."

The bearing of the quality of the air on the condition of the blood has been already noted (Respiration, p. 8), and unless a full supply of pure air is constantly afforded, the body is not so well able to perform hard work, or to resist the attack of disease as it otherwise would be. Unfortunately, this fact is not at once supported by the appearance of animals which are kept under the most insanitary conditions; rather is the reverse the case. The horse which lives in a stuffy, ill-ventilated stable may look fatter and sleeker than the occupant of a cold, fresh one, and this is sufficient to make the fresh air stable unpopular with a large section of those whose credit to a varying extent may depend on the appearance of the animal. It is only when called on to undergo hardship, or when some epizootic disease is prevalent, that the difference in health and strength is noticeable, and these are the very conditions under which the soldier has most need of a really hardy mount. A practical and reliable test for the purity of the air in a stable is the effect produced on the sense of smell when entering it. If there is no apparent difference from the air outside it is satisfactory; but if there is any stuffiness the ventilation is defective, and the air of the stable requires to be changed more frequently.

Draught and chill.—A draught is a current of air passing through a confined space, like a building, at such a pace that it produces a feeling of cold when it strikes the skin. The effect of such a draught on a warm skin full of blood is to drive the blood into the internal organs and produce chill and shivering. The hotter the skin at the moment when the animal is exposed to the draught the greater is the danger of a chill. If the air has to be changed very often, its constant inrush will keep the animals in a perpetual draught, and as it is one of the chief objects of ventilation to avoid this, a considerable cubic space is necessary in order to keep the atmosphere pure without having to change it too frequently. Careful experiments have shown that although men can only bear three changes an hour, eight or ten in the same time is not too often for the horse's comfort or health, and a calculation based on that shows 1,200 *cu. ft. for each horse is sufficient, and is a convenient space in all respects.*

It may be objected that a stable ventilated to such a degree that it does not differ from the open air, will be extremely cold in winter, but this is really no objection; the health of animals does not suffer from cold to anything like the same extent as that of men; they stand varying temperatures remarkably well, and chills from standing in a draught, particularly when heated and tired, are really the only changes of temperature which are at all likely to produce sickness. In cold weather the heat and condition of the body should, if necessary, be maintained by extra food, bedding, or clothing and not by allowing the occupants of a stable to breathe an atmosphere heated by the emanations from their own bodies and the exclusion of fresh air.

Means of Ventilation.

Inlets.—Doors, windows, air bricks, tubes.

Outlets.—Louvre-boards, cowls, shafts.

Doors.—Stable doors are valuable additions to, but can hardly be regarded as permanent means of, ventilation, since the tendency is always to keep them shut. They should be kept open as much as possible, especially when the stable is empty, so that the floors may be well aerated. When there are doors at each end of the building, one may usually be kept open throughout the day, or, where half-doors are fitted, the top half certainly can.

Windows.—These are the main inlets for fresh air, and to get the full benefit from them they should be arranged along both outer walls of the stable, one over each stall. Stable windows should be hinged from the lower edge, or centre, so that they may be opened with an inward slant. The "Sheringham," hinged at the lower edge, is the most suitable pattern, and is fitted to all modern troop stables. With windows on each side of the stable, those to the leeward should always be kept open, and in calm weather those on both sides. The amount of inlet space required for each horse is not less than 1 sq. ft.

The direction taken by a current of air entering a stable is determined by the slant of the inlet through which it comes, so that with a window sloping inwards it will be thrown up, well over the animals standing immediately underneath; and since it is somewhat cooler, and therefore heavier than the rest of the stable air, it will descend and be spread among those on the opposite side. The advantage of this is that the air is well diffused and slightly warmed before it reaches the animals, and risk of draught is avoided. Where air bricks are placed under each manger about 1 ft. from the ground, care should be taken that they are not blocked up.

Louvre-boards are fitted under the ridge of the roof, and act as outlets for the heated foul air. They should be sufficiently broad and overlapping, and set at an angle acute enough to prevent rain beating in. They should be permanently fixed open; if movable they will always be shut.

Ventilation cowls and tubes.—With overhead rooms, or where louvre-boards are not fitted to open roofs, the foul air can be extracted by means of various cowls and tubes, which are so constructed that the wind passes over an upward slant or through a narrow slit and creates a continual vacuum below, thus drawing up the foul air. Any patterns which permit birds to nest in them, or which do not act equally well from whatever direction the wind blows, are useless. The pattern adopted in the Service, viz., Boyle's, is very good.

Where there is only a single row of windows, or if for any other reason the inlets for fresh air are insufficient, inlet cowls may be utilized for the introduction of an extra supply. The openings of the cowls are so arranged that the oncoming wind strikes a surface with a downward slope, and so is led to the interior of the stable. A double tube, the inner an extractor and the outer an inlet, is sometimes employed, but tubes of all descriptions are inferior to windows and louvre-boards properly arranged, and should only be found in troop stables when the latter means are lacking; at the best they are not so efficient, and there is always the chance of vermin or dust blocking the openings. Tobin's tube is another means of adding to the inlets. The outer opening is low down on the exterior of the stable wall, and from it the tube passes through the wall and upwards, opening on the inside at a height considerably above its entry; by this the temperature of the air is somewhat raised before it reaches the horse, and by a slight variation of the detail, heel posts and stall partitions are sometimes converted into ventilating shafts.

DRAINAGE.

The requirements for efficient stable drainage are quite simple: viz., a stall level from side to side, but sloping sufficiently (1–60) from front to rear, to admit of urine flowing to the back of the standing; a shallow, open, surface drain behind the stalls to convey the collected fluid to the outside drain or sewer.

In order that the standing may be as level as possible, the stalls should not slope more than will allow the urine to run off, and the drain at the back should be quite open and as shallow as the quantity of fluid to be carried will allow. If it is a very long stable this drain may be made to slope from the centre towards both ends—a hog-backed drain. Closed and underground drains, although very usual in good-class private stables, are not good; their contents cannot be seen, it is true, but they have no other recommendations, and as they hide the drainage from view it is frequently forgotten, with the result that they become foul and choked from neglect.

A drain in the centre of the stall is also a mistake, as, in addition to the faults just enumerated, it necessitates a standing which slopes to the centre, instead of a level one. Private owners, for the sake of appearance, will have covered and stall drains, but they are more trouble and less useful and effective than open ones. Where they are in use they should have removable covers and be freely accessible. All

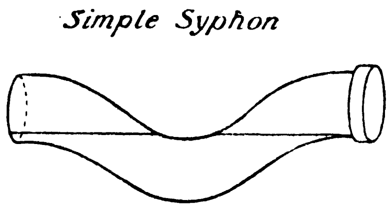


FIG. 15.

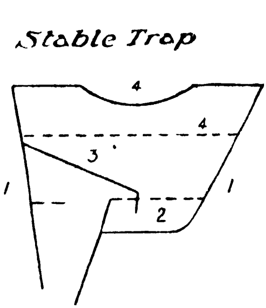


FIG. 16.

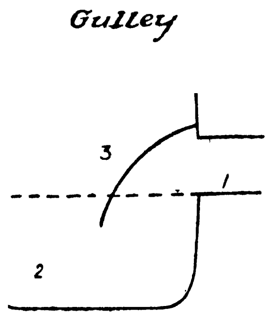


FIG. 17.

1. Water level.
2. Receptacle to catch sediment.
3. Flap reaching below water level.
4. Gratings to catch solids.

drains should be free of sharp angles, any change of direction being made by curved pipes or "bends."

Where the stable drainage runs into the outside drain or sewer, a "trap" is placed to prevent the return of sewer gases. The principle on which traps are constructed is to place a body of water between the stable air and the sewer air and so prevent the return of the latter. There are many varieties of traps, but the principle is the same in all, and the diagrams appended will help to explain it.

Whatever pattern of trap is adopted, it is imperative that the water seal, *i.e.*, the body of water interposed between the stable and sewer, is of sufficient volume to prevent any slight gas pressure overcoming it. Further, to prevent any risk of sewer air entering a building, all drains should be ventilated on the sewer side, and the outlet of the ventilator carried upwards above the roof of the building; a disconnecting syphon should be interposed between the stable drain and the sewer.

Solid matter should be removed from the traps, and the drains flushed with water daily; it is not necessary to use disinfectants under ordinary conditions.

Stable Fittings.

Stable doors should be 8 ft. high, and 4 or 8 ft. wide, according to whether the men have to lead single horses or pairs through them. Too narrow a door has been the cause of many accidents, both to horses and men, the former striking and frequently breaking their hips, and the latter getting trodden on or squeezed against the door-posts. Too low a door has probably been responsible for more casualties in the past than it is likely to give rise to in the future, as there is a noticeable improvement in this respect in recently constructed stables, and 8 ft. is not too high to prevent the chance of a startled horse throwing up and striking its head. The door may be hinged or made to traverse on rollers; hinged doors should open outwards to permit free entrance if the animal stands in the doorway, and also to guard against accidents from striking the half-closed door. The hinges should be |—- shaped, the horizontal arm reaching well across the door to support its weight, and a suitable swing-back stop should be fitted to prevent it banging to.

Half-doors, the top and bottom portions opening separately, are excellent for stables. The top half can usually be left open—on the lee side at any rate—for ventilation; and when fitted to loose boxes, the occupant can look out. In this latter case the lower part should be high enough to exclude the possibility of jumping over. Traversing doors should be hung on rollers from above and fitted with large smooth handles, on which a loose horse cannot get hung up.

Latches should be strong, easily turned and with large flush handles, which offer no projections for loose horses to get hung upon.

Windows have been to some extent described under the heading of ventilation. They should be on the Sheringham principle, *i.e.*, hinged along their lower border so that they open with an inward slant. There cannot be too much light in a stable, and if possible each animal should have a window over its stall, the lower edge 8 ft. from the floor and fastened by some method which leaves no rope or projection for the horse to play with or get entangled in. Sash windows are unsuitable for stables.

Partitions and bails.—In military stables partitions exist as a rule only where stalls and loose boxes join; in front they should prevent horses seeing or touching each other, and be high enough behind absolutely to stop all chance of an animal kicking over the top. Bails are the usual fittings for the separation of stalls in large stables of all descriptions, and they may range in design from a simple wood or iron pole to a deep, heavy boarding, occupying the rear half of the stall. The bail is either suspended from the manger in front and the stall post behind, or hung from the roof. With heavy patterns the former is the stronger method, but either is suitable for poles.

A simple pole, of wood or iron, is a sufficient stall division as long as the horses are quiet, but however it is arranged it can be but little protection against kickers. The most suitable height is the level of the hock, which will give as much protection as possible to the animal attacked, and if the aggressor kicks over it, will injure him as little as may be. A quick release hook should be fitted to all bails, but springs which act automatically, when extra weight is placed on them, are to be avoided; they become weak, and ultimately drop the bail on the least touch.

Deep, heavy bails of boarding, swinging about 2 in. clear of the floor, and reaching half-way up the stall, are much better protection against kickers: they must be strong and solid so that they do not swing too much when struck or break from the force of the blow. In fitting heavy bails care must be taken that they are close enough to the ground to prevent a hoof being entrapped beneath them.

Kicking boards may be attached to pole bails, to afford extra protection. These are simply a single or double depth of boards, preferably double, which are hinged to the under surface of the rear half of the bail: they do not prevent all kicking accidents, but are a very desirable addition to the ordinary bail, easily attached and moved when necessary. Of whatever pattern the bails are, they should be of the strongest materials; the wood employed must be of a tough grain, and at least a double thickness of board is desirable. Horses kick very hard, and if the wood breaks the offender is not only encouraged, but the chance of more serious accidents is incurred, if a leg gets through the gap made.

Mangers are now made entirely of iron. They should be large, broad, with a perfectly smooth surface, and all corners well rounded. An overhanging lip to prevent food being wasted when the horse scatters it by blowing or nuzzling in it, is sometimes found, but it lends itself to accumulating dirt unless well attended to. Broad mangers are to be preferred to narrow ones, as the greedy horse cannot plunge his mouth deeply into the food and seize large mouthfuls, and deliberate mastication is more likely to be obtained. The rim of the manger should be sufficiently broad to prevent it being seized by the teeth, as this encourages crib-biting.

The height of the manger for a full-sized horse should be about 3 ft. 6 in. from the ground.

Hayracks should be on the same level as the mangers, and not as may be seen in many old-fashioned stables, above the horse's head. In this latter position, the animal was constantly exposed to the risk of getting dust and fragments of hay in his eyes, and in addition an undue proportion of the ration was wasted by his pulling it down, when it was trampled underfoot and soiled as he reached for more. Where all the hay is fed as chop, a hayrack is of course unnecessary, and a manger running the entire breadth of the stall serves the double purpose. Open racks of all patterns are of necessity wasteful, as quantities get pulled out between the bars, trampled and soiled; and for this reason a deep receptacle without open bars in front, and which can only be entered from the top is a more economical pattern.

The importance of all the fittings, such as latches, window fastenings, etc., in a stable being flush with the walls or woodwork, or at any rate not offering any projections on which a chance loose horse can tear himself, cannot be overestimated, and for the same reason no nails should be driven into the walls. Horses which get loose during the night always appear to have the faculty of finding and wounding themselves on any rough or sharp projection in the stable.

Gas or electric light fittings should be well out of reach, and protected from accidental interference.

CHAPTER IV.

STABLE MANAGEMENT.

Grooming.

The objects of grooming are cleanliness, prevention of disease, and improvement of the animal's condition and appearance, the whole of which results may be sufficiently attained for the troop horse by a good brushing and wisping once a day. The necessity for and the amount of grooming required varies with the conditions under which animals are placed; the better they are fed and the faster the pace expected of them when at work the greater should be the amount of care expended on getting the skin into perfect condition. Grooming may therefore be limited to the amount necessary for cleanliness and health, or it may be prolonged and amplified with the object of increasing the power of the skin to work at high pressure, and this latter is the benefit which is derived from hand-rubbing and wisping, *i.e.*, massage.

The importance of grooming as a preventive of disease must not be underrated; whilst it is quite true that mange and many other diseases are not produced by dirt, it is nevertheless equally true that they are most frequently met with, spread with greater rapidity, and are much more difficult to eradicate where dirty conditions prevail, and the regular brushing and cleansing of the coat is an undoubted preventive.

The relation of regular exercise to the amount of grooming required is another matter which should be kept in mind. It is a well-known fact that an idle horse is always more difficult to clean than one which is at work; indeed, it is almost impossible to keep some skins free from scurf and grease when the horse is idle, and this tendency to accumulate skin dirt is found to be greater with corn-fed horses than those at grass. *The idle horse therefore requires even more attention and thoroughness as regards grooming than his fellow at work,* whilst regular exercise is, in addition to its other benefits, a labour-saving procedure.

Extra grooming, especially massage of any variety, has a great effect in improving the general condition, and is a point which has always received the greatest attention from those who train animals for any form of severe and prolonged exertion. It must be borne in mind that all working horses are kept under purely artificial conditions. They receive an amount of food which is very far in excess of their bodily requirements and which is converted into the extra energy which enables them to produce the work required; whereas in a natural state they eat no more than sustains them, take little more exercise than enables them to change pasture and only carry their body weight. The extra food consumed and work done produce greater and more rapid changes throughout the body than would otherwise result. The digestion is called on to perform much more work in the same time, and the blood has an increased quantity of nourishment poured into it; at the same time the work, which is rendered possible by the increased nutriment, creates a large amount of extra waste, which is got rid of by the lungs breathing more rapidly, the kidneys and bowels working at increased pressure and the skin throwing off more material in the sweat and dandruff. The amount got rid of by the skin is very considerable and increases enormously when exertion is severe and sustained, so that when the condition required is for the production of fast work it is essential that the skin should be in as good fettle and as well trained as the rest of the body. Grooming, therefore, is one of the means which help to make and keep the body fit as well as clean.

Grooming tools.—The grooming tools supplied in the service are body brushes, curry combs, and rubbers. Wisps are to be made by the men as required, and every man should be taught how to make them. Dandy brushes are occasionally supplied, but are not usually issued: their use, however, is so general, that a description of them and their employment is included, as well as other articles usually found in stables with which all horsemen should be familiar.

Body brushes are made of stout bristles or vegetable fibre and have a broad hand-loop of webbing across the back to prevent the brush slipping from the grasp. The use of the body brush is to remove scurf and dirt from the coat, and for this purpose the bristle brushes are far superior to those made of fibre. Fibre, however stiff at first, ultimately flattens down from the continued pressure on the brush and is then useless; bristles, on the other hand, though more expensive, do not bend, but simply wear shorter, and retain their upright position till worn down to the back. It is well to remember that as bristles get shorter they become less pliant and stiffer, so that a half-worn brush is a very prickly article to bring down hard on a tender, ticklish skin, and should be used with consideration. In England all body brushes are made of bristles, though fibre brushes are sometimes issued at stations abroad.

Curry combs.—The service pattern of curry comb consists of several straight, blunt toothed blades in a metal back, with a broad loop of webbing for the purpose of securing it on the back of the hand. It is essential that the teeth should be smooth and blunt, and in the service pattern they are rounded at the top and bottom. This prevents the bristles being unduly worn away when the comb is used to clean the body brush, and also guards against injury to the skin when used for the removal of dirt. Other patterns have wooden handles, and some have a series of curved springy blades, instead of the straight rigid ones usually met with. At the sides small projections of the blades are seen on many patterns for the purpose of knocking on the ground when dislodging dirt from the back.

Use of the curry comb.—In the service the use of the curry comb on the skin is generally prohibited, and its utility is confined to cleansing the body brush of scurf. To effect this, only an occasional rub on the brush is necessary, but its use is much abused by lazy men, who make a great show of cleaning the brush and do little work with it on the skin, the result being that the brush is quickly worn out. The dirt should be dislodged by knocking the side of the comb on the floor behind the horse, where it can be seen and swept up, and is evidence of the man's diligence. Blowing the scurf out of the comb is a dirty plan which is not to be practised; it results in the dust being inhaled by the horses or settling again on the coats from which it has just been removed.

Outside the service the curry comb is a recognized instrument of grooming. With light horses its use is as a rule limited to the removal of caked dirt and mud, but with vanners and in commercial stables generally the animals are groomed all over with it, and subsequently brushed with a dandy brush.

The method has a good deal to recommend it where time is an object; it is quick, effective, does not in any way injure the skin, and seeing that this is the case, some discretion may be allowed in its employment.

Water brushes are made of longer, finer, and softer bristles than body brushes. They are intended for damping the mane and tail, and washing the feet and legs; but they are often used dry for grooming fine-coated, ticklish horses, and are certainly very useful for grooming the head and face. When employed for washing feet, their use should be confined to the hoof only, wetting of the legs being prohibited as a routine.

Dandy brushes are made of stiff whisk fibre. Outside the service they are in general use as a grooming brush, and, as a matter of fact, are most useful in any stable. On light horses their use is as a rule limited to the removal of hard caked dirt, the rest of the grooming being performed with the body brush, but in commercial stables they are often the only brush used, and are employed in conjunction with a free use of the curry comb. Their use saves time and labour and they are most efficient instruments of grooming.

Mane or *tail combs* are made of horn or metal, with deep, broad teeth; though convenient, they are not actually necessary and, if they are not very carefully used, tear out and break the hair considerably.

Sweat scrapers are long flexible blades of smooth metal, with a handle at each end by means of which the lather of a sweating horse may be conveniently and quickly removed. Another variety has a central handle with a rigid curved blade, but the pattern is not so good as the flexible one, since the rigid blade does not adapt itself to the curves of the body so well; they are not necessary in troop stables.

Sponges are commonly used during grooming for the eyes, lips, nostrils, and dock. Though the convenience of sponges for this purpose is undoubted, they should invariably be prohibited on the appearance of any contagious disease, as they are one of the commonest channels by which infection is spread.

Rubbers are generally used to give the coat a final polish after the rest of grooming is completed, and a damp rubber may, with advantage, take the place of a sponge whenever possible, since it can be easily disinfected and cleaned by boiling, a process which ruins sponges.

A wisp is a pad of hay or straw, made by twisting the material into a rope and doubling it into a convenient-sized pad as described below. Its proper use, which is really a form of massage, is a most valuable method for improving the condition of the skin and coat. To make a wisp, soft hay or straw should be twisted into a convenient-sized rope about 8 to 10 ft. long; two loops are then formed at one end, one being very slightly longer than the other. Each of these loops in turn, is then twisted beneath the remainder of the rope until the end is reached, when it is passed through the extremity of each loop, and tucked under one of the twists. A really good wisp should be no wider than can be conveniently grasped by the hand, about a foot long and 2 or 3 in. thick; some little practice is necessary to make one really well.

Rough coir gloves and leather pads stuffed with hair are sometimes used for the same purpose, the latter (tappees) being in common use as a grooming tool in India.

Time for grooming.—As a matter of appearance and cleanliness, horses should be "quartered" (lightly groomed) before going to exercise, but the "strapping," *i.e., thorough grooming* *is best carried out on return from work, unless this has been of a very exhausting nature, when horses are better left alone until recovered from fatigue.* As a practice it is advisable to pick out and inspect the feet before commencing to groom the horse, in order that the feet are not overlooked (*see* p. 62).

Method of grooming to be adopted.—The horse must be cool and dry. Commencing at one side of the neck immediately

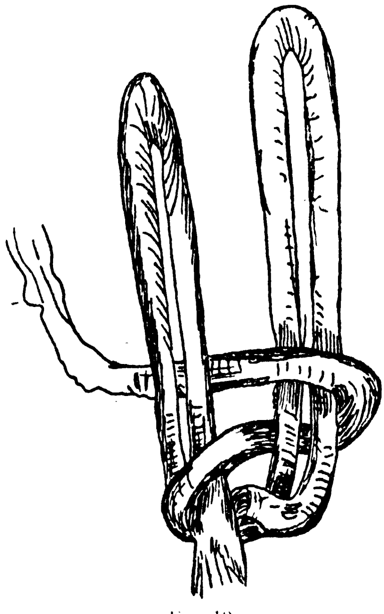


Fig. 18.

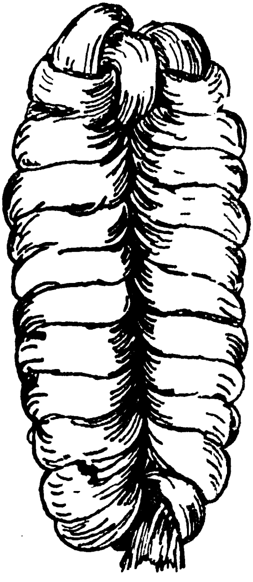


Fig. 19.

"A Wisp."

Commencement, showing two loops formed from one end of rope, and method of twisting the other around them.

Completed (semi-diagrammatic).

behind the ear, the coat should be thoroughly brushed out, the brush moving the way the hair lies as a rule, though in order to get out hard dirt or scurf it is sometimes necessary to brush in a circular direction. To use the brush with the best effect, the man should stand well away, keep his arm stiff, and lean the weight of his body on the brush, which should be placed gently on the skin and not brought down with a bang, especially on a thin-skinned, ticklish horse. If the man stands close, with a bent elbow, and brushes with his arm only, he does not force the bristles or fibres through the coat so well, or remove the scurf so effectually ; he should use the brush in the left hand for most part in grooming the near side, and in the right hand for the offside. When grooming inside the hind leg he should grasp the hamstring with his free hand. Having completed one side, the other is gone over in the same manner, starting from the neck. The legs should be done after the body is completed. The horse is now turned round in the stall, the head and mane brushed and eyes, nostrils, and the dock cleaned. Finally, he is put about again, the tail is brushed out and the whole coat wisped and given a final polish with a rubber.

In grooming the head it is well to use a soft brush if one is obtainable, and for this purpose a dry water brush is frequently requisitioned ; it is further to be noted that a good groom is careful not to knock the skin with the wooden edge of the brush when going over the bony projections of the head and legs.

Wisping, as previously stated, is a form of massage. It stimulates the skin generally, bringing plenty of blood into it, and producing a vigorous circulation. In particular it has a great effect on the oil glands of the hair, increasing their output, and thereby giving a marked gloss to the coat. The wisp should be brought down with a bang on the skin, in the direction of the hair, and the process repeated all over the body, care being taken to avoid delicate parts.

Hand-rubbing is another excellent form of massage, and is specially useful for removing the loose hair of the coat as well as stimulating the skin. The hands are slapped down smartly on the coat one after the other, and the weight of the body leant upon them and the forearms, whilst both are moved over the skin with firm pressure. It is a method not much employed in England, but is much practised in the East, and is of such undoubted value that it should be generally adopted when time permits. Hand-rubbing the legs and " stripping " the ears, *i.e.*, pulling them gently through the hand from base to apex, are both details which should not be neglected, and, in the case of the legs, brisk but gentle rubbing with the fingers and palms in the direction of the hair is an excellent stimulant to the circulation of the limbs. For the removal of loose hairs by rubbing, the hands and arms should be kept slightly damp. Given a clean horse in the first instance and brought in cool, a hearty man will complete his toilet thoroughly with brush, wisp, and hand-rubbing well under an hour, and do both himself and the horse credit. Length of time occupied is no criterion of the quality of work done, and quick, hard grooming should be encouraged in every way.

Brushing the mane.—If the hair is at all damp, matted or kinked, it should be brushed till well separated, and then, commencing at the highest point of the withers and keeping the horse's head low, so as not to dirty the part already cleaned, it should be taken a lock at a time and brushed out from the roots.

To thin the mane.—This should only be done when the hair is so thick as to be intractable, and is accomplished by taking a few hairs at a time from the under surface, freeing them from the rest, and pulling them out quickly. The hairs on the upper surface should not be touched. When sufficiently thinned, the mane should be brushed out and the ends made level by simply plucking them with the fingers. On no account should they be cut with scissors, or the appearance will be spoiled.

To lay the mane.—As a rule, water-brushing the mane when cleaned and tying a rubber cornerwise over it is all that is requisite to make it lie tidily; but when this is insufficient it may be wetted, plaited in locks, and small weights tied along the ends of the plaits. Very intractable manes can be made to lie by plastering down with wet clay, which easily brushes off when dry, and, after a few repetitions, leaves the hair in the desired position; or a mane layer may be used for the same purpose. A mane layer may be made as follows:—A round stick about the diameter of a broom stick is cut into lengths of 6 in.; these are sawn down the centre and a thumb screw fitted through each end to form a clamp; the flat surfaces are lined with a piece of thin corrugated rubber and the lengths are then clamped on the mane, their weight causing it to lie as required.

Hogging the mane.—When "hogging" is practised, the hair should be cut from each side and carefully edged off to avoid a sharp clipping line against the hair of the neck. A well-developed forelock is a protection against flies, and if it is removed an eye fringe should be worn whenever necessary. If a mounting lock is required it should be a large one, or it will rapidly pull out and look untidy.

Grooming the tail.—The hair of the tail should be treated like the mane, brushed out from the roots lock by lock for cleanliness, and finally straight down for appearance.

To bang the tail.—Place the hand under the dock to raise it into the position in which it is carried when the animal is moving, and having determined the right length, an assistant should gather the hair firmly together with a double grasp, holding it quite straight, with the spot to be cut showing between his hands. The cut should then be made with the shears inclined a trifle upwards, so that the outer hairs of the tail may be a little longer than those nearest the legs. Troop horses' tails should be banged such a length that they reach within 6 in. of the points of the hocks when moving, and if the dock is too short to admit of this, they should be left as long as possible consistent with neatness. Tails should not be combed unless a " swish " is required, as it breaks and pulls out the hair. Pulling and trimming horses' tails should be left to a trained man ; like the mane, the under hair should be pulled out.

Wet and sweating horses should be dried before being groomed or left. If they are wet from rain, wisping with handfuls of loose straw and brisk friction with the rubber subsequently, is a good method of making them warm and dry.

A sweating horse should be led about till dry, scraped and wisped as above, or allowed to roll in a sand bath (p. 75), and, if the weather permits, he should not be brought into the stable till he is quite cool. With troops, the return of horses from work wet with sweat can generally be avoided by walking the last part of the return journey. Sweat patches under the saddlery should be dried immediately the saddle is removed, or have some covering left on the back till they are cool.

" Breaking out," that is, sweating in patches, is occasionally observed after drying or grooming in hot weather ; the patches should be again dried, and if they recur, the animal may be led out into the open for a little while. The condition occurs most frequently in horses which are not fit, but some animals constantly exhibit it ; a good practice is to place a layer of straw lengthways along the horse's back under a rug.

To judge the cleanliness of a horse the hand may be passed the reverse way of the hair, to get a view of the skin, and the points of the fingers run firmly against the set of the coat, when lines of grey are left on a dirty skin and the points of the fingers are likewise covered with scurf. Between the branches of the under jaw, under the crown piece of the head collar, the bends of the knees and hocks, under the belly, between the forelegs and thighs and the tail are the places usually scamped when the work is not thorough, and should be looked at when the horse is being passed.

Other stable details which may be included under " grooming " are washing of the mane, tail, and sheath, and picking out the feet.

The mane and tail may be washed with soap and water when necessary to remove greasy dirt. Rubbing the tail is not uncommon, and is generally due to its dirty condition, the irritability being in such cases removed by a good washing and subsequent brushing.

The sheath should be washed occasionally, and some horses require it oftener than others, especially those that stale without drawing the penis, a habit which is generally induced by the accumulation of dirt. At certain seasons of the year, and in hot climates particularly, the prevalence of maggots from the attacks of flies renders a close attention to this detail very desirable. Soft soap should not be used for washing the sheath.

The feet should be picked out thoroughly at every stable hour, and on return from work. It is a detail which does not always receive the care it should, as, apart from the necessity of cleanliness, the sole of the hoof is so liable to injury, from accidents at work, that very frequent inspection of it should be made. The most convenient form of hoof-picker is a strong, blunt iron spike or hook, and in use its point should not be forced down the sides or cleft of the frog with more vigour than is necessary to remove the dirt. Any sharp-pointed instrument is unsuitable for this purpose. Washing of the hoof, when required, should if possible be done outside the stable, and the legs should not be wetted during the operation.

Washing stable brushes.—It is occasionally necessary to thoroughly wash stable brushes, to get rid of accumulated grease. The usual method by which this is accomplished, namely, boiling the brush or soaking it in a tub of hot water, ruins the article by separating the back, and causes avoidable waste. The brushes should have the backs scrubbed with soap and water and wiped dry, the bristles should be " dapped" in hot, strong soda water till free from grease, and then similarly dipped in strong brine. The latter process is essential to reharden the bristles which become soft in water or soda water. After cleaning they should be stood, bristles down, till dry. Instead of " dapping " they may be allowed to stand in shallow trays of soda and salt water, but the backs should not be immersed.

Washing.

The washing of horses as a general practice is to be strongly condemned. In cold and changeable, temperate climates, it may very easily lead to sickness, and even in warm and equable temperatures its practice is not always unattended with danger. The only purposes for which the use of water, or soap and water, is necessary on the body of the healthy horse is for the removal of dirt stains which will not groom off, and for the occasional cleansing of the mane, tail, and hoofs. The dangers which washing may give rise to are not, however, due to the wetting of the skin, but to want of attention to the subsequent drying; and in all cases where it is found necessary to wash, too much care cannot be bestowed on making sure that the animal is thoroughly dried, and the warmth of the skin kept up, or a chill may result. The use of soap removes a great proportion of the usual greasiness of the coat, and consequently some of nature's protection from cold, and until this is restored an unusual liability to chills is present, which can only be guarded against by thorough drying and protection from draughts. From the same cause, *i.e.*, removal of the natural grease, the coat of the washed horse is dull and lacks the glossiness which it would otherwise carry. Washing of the body, then, should be prohibited as a rule, except for the special purposes mentioned, and should it be necessary at any time to break the rule, the greatest care should be taken to dry the skin thoroughly, clothe the animal warmly for the time; and keep it out of draughts.

Washing the legs and belly on return from work in order to get rid of mud is frequently followed by stiffness and cracking of the surface (chapping). This is more likely to happen if warm water is used or when the weather is cold, and especially when there is a keen wind; it is most common in the heels, legs, and bellies of horses which are washed on return from work. When confined to the hollow of the heel, the condition is called "cracked" or "greasy heel," the latter term originating from the fatty nature of the discharge from the oil glands of the skin which collects round the injury. On the legs and belly it is commonly attributed to the irritation of mud, and is frequently called "mud fever."

The condition is a serious one and may incapacitate horses for long periods, but it may be practically banished from the stable by prohibiting the routine washing of legs and feet. Mud should be left till dry, and then brushed off.

It has been stated that animals with white legs are more frequent sufferers from cracked heels than others, and this is no doubt the case; but it is not on account of weakness or peculiarity of the white skin, but owing to the fact that it is more frequently washed.

There must, however, be occasions on which it becomes necessary for the sake of appearance to wash white legs, and if they are thoroughly dried no harm results as a rule. The drying must, however, be quite thorough, and the circulation of the part well maintained by brisk rubbing. It is a good plan to rub a little bran over the washed surface to absorb thoroughly all moisture, or where peat moss is in use, a handful of clean moss dust, which does not stain the skin, will answer the same purpose. Wood-ash dusted over the body before grooming is a good method of removing grease from the coat; wood-ash can also be used for cleaning white legs. In no case should any washing be permitted without special sanction on each occasion. Washing the hoofs both round the wall and on the sole is occasionally required as a matter of cleanliness after the feet have been picked out. It is not necessary to do it as a matter of routine, and whenever possible it should be done outside the stable.

Horses at work take no harm from rain and may be ridden through water with impunity, because the natural greasiness and subsequent exertion of the journey keep up the circulation and warmth of the wetted skin till it is dry again. Occasionally horses which are turned to grass will be found with cracked heels from wet and exposure to wind whilst grazing, and the same thing may sometimes happen in camp; but both causes are infrequent as compared with washing.

Clipping.

Under natural conditions the horse's thick winter coat provides him with an extra warm covering during the time that the weather is cold and food scarce. The extra warmth of the long, thick hair, added to the increased greasiness always found under a heavy ungroomed coat, keeps the body warm and so helps considerably to maintain the weight and condition.

If, however, horses are required to work hard, the coat becomes a positive drawback, adding considerably to the exhaustive nature of the labour, keeping the animal in a constant sweat and preventing rapid drying of the skin after exertion—as a result it is found that a loss of condition is inevitable. On the other hand, a clipped horse not only maintains condition, but is capable of a greater amount of work with less distress and is, moreover, dried and cleaned with much less labour and risk of chills. There is, then, every reason why army horses should be clipped if they are required to work during the winter; the only question to consider is whether the clip shall be whole or partial, and on this point all are not entirely agreed. Horses working at a walk only are sometimes clipped "trace high," *i.e.*, on the legs and belly only, but this method cannot be entertained for any horse which is called on to work at a faster pace.

It is the custom with many horse owners to leave a "saddle patch" on the back as a protection against saddle galls, and to allow the hair of the legs to remain untouched, with a view to preventing injuries from thorns, or cracked heels.

Experience, however, shows that while saddle patches make the back sweat considerably, their value as a preventive of saddle injuries is open to considerable question, and as far as troop horses are concerned they should be dispensed with; for if the hair is to be left over the large area covered by the service saddlery, the object of clipping cannot be fully attained. Leaving hair on the legs makes them harder to dry and clean, but if the back of the fetlocks and tendons be neatly trimmed, this may be left to the discretion of the officer concerned. An argument which is sometimes advanced for not removing the hair from the back of the fetlock is that it acts as a natural drain for water when the animal sweats or is wet. Again, experience shows that with heavy-coated horses wet through from sweat or weather, those with trimmed legs do not suffer more from cracked heels than those with a long coat, and are certainly easier to dry and clean.

Altogether, apart from its beneficial effect on the horse's condition and working power, clipping enables the men to dry and clean wet and dirty animals better, more quickly, and with less labour; and in considering the question as a whole this point should not be lost sight of. The attempt to dry and groom a pair of muddy, soaking, heavy-coated horses is a heart-breaking end to a day's work, and should be avoided if possible.

The operation of clipping.—Whether the hand or power clipper is used, some little skill is necessary to produce the best results, and as the tooth blades of all cutters are hard tempered and very accurately adjusted, they are easily broken and frequently found out of order unless carefully handled. In using the hand clipper the pressure exerted on the skin should be quite even throughout or the result will be "ridgy," and the right hand, which operates the blades, should do so without any pressure whatever. Care must be taken not to cut any of the mane and tail hair, and when the legs are left unclipped the appearance is enhanced by slanting the boundary line from the back of the elbow upwards to the front of the forearm, where there is a natural dip in the limb, similarly in the hind limbs the line should slope downwards and backwards from the point of the stifle.

If the power clipper is used, the driving machine should be worked at an even pace and should be placed in such a position that it cannot be knocked over by any unexpected movement of the animal, or a barrier should be erected to protect it. With either variety the blades must be kept free from accumulating scurf and dirt, occasional brushing and wiping with a little paraffin oil being all that is required.

In trimming the back of the fetlocks when the hair of the legs is left on, the back of the joint should be clipped quite short, and the length of the hair above and around gradually edged off. When skilfully done there should be no apparent ridge to indicate where the clipping ended.

Singeing.—With modern clippers singeing is unnecessary, but as a matter of appearance, a lamp may be run over the animal occasionally to keep down rapid-growing hairs, which give a ragged look to the coat.

Period for clipping.—Horses may be clipped with advantage from the time their coat thickens in the autumn until their summer coat show signs of coming in the spring. The frequency of the operation will probably depend on the time, labour, and number of machines available. If there is no limit to these, the machine should be run over the coat every time it shows at all long, and frequent clipping certainly keeps animals smart in appearance, as well as giving the other advantages already enumerated. Where, however, labour and machines are limited, it will be found most advantageous to clip at the beginning of winter, say November, and again about the New Year. The idea that the summer coat is entirely spoilt by clipping after the New Year is not in accordance with fact and, provided it is otherwise convenient, the process may be carried on till the winter coat shows signs of coming out, when hand-rubbing should be relied upon to remove its remnants. This period will vary with the severity of the season, and the individual animal. Some animals are, in fact, clipped all the year round and carry quite good coats.

To sum up: on Service, the following points with regard to clipping animals must be considered :—

(*a*) The nature of the work.
(*b*) Environment.
(*c*) Supply of food.
(*d*) Supply of clothing.
(*e*) Clipping as a means of cleanliness to control parasitic disease.

During the last campaign in Europe it was considered desirable to clip out in the autumn and clip trace high in mid-winter.

The benefit which animals voyaging from a cold to a hot climate at a time when their coats are thick derive from clipping *en route* is evident. It is true that the long coat falls off naturally under these circumstances, for the hair rapidly adapts itself to changes of climate, but its removal by the machine at once relieves the animal of an unnecessary blanket and should be carried out when possible.

Clothing.

The use of clothing during the winter months for working horses which have been clipped is practically universal, and where horses are called on to work up to their rations, it is beneficial to the animal's condition, and economical to the owner. A sharp line of distinction must, however, be drawn between the legitimate use of clothing as a compensation for the loss of a thick warm coat, and its abuse, so commonly observed in England, where, in order to preserve a sleek appearance, several rugs are placed on the animal and the stable is closed against all ventilation in order to keep the atmosphere warm. This procedure, although attaining its object, namely, fat and sleekness, does so at the risk of impairing the constitution, rendering the animal more liable to sickness, and lessening its chance of recovery when attacked by any serious disorder.

Observation leaves no doubt that the use of a rug in winter and after clipping, helps to maintain condition, and therefore working power, without an increase of ration. The modern troop stable is a cold stable when properly ventilated, and although this is right and healthy, yet the temperature of the body must be maintained, and if no artificial substitute for the coat is provided when the animal is at rest in a cold atmosphere, more of the food will be utilized for the maintenance of the body heat, and less will be available for the production of work than would otherwise be the case. Economy and efficiency combined therefore point to the use of a rug whenever the horse is worked up to the amount of food he receives, otherwise his condition must be maintained by extra rations. The comfort and appearance of the animal are both added to by the use of a rug.

Clothing cannot always be carried on service owing to transport difficulties and the need of mobility, and this is used as an argument against its use in peace, but judging from experience, animals which have been used to a rug endure the rigours of active service quite as well as any others, and on this head nothing need be feared, as the horse does not get ill from cold, since the coat rapidly adapts itself to climatic conditions. Provided horses get plenty to eat, they take no harm from exposure.

Patterns and Fit of Clothing.

In the Service the only kind of clothing issued is a shaped stable rug, and is all that is necessary; but generally the term "clothing" as applied to horses comprises a hood, pad, roller, breast piece, and quarter sheet. With the exception of the hood, all these articles are combined in a shaped rug which fastens across the chest and has a surcingle stitched on. Some rugs fasten centrally on the breast, whilst others have a flap which buckles on the side, the latter being the better plan, as it prevents the front being blown up when in camp. For a similar reason a well fitting "fillet string" should be fastened round the quarters to prevent the wind blowing the rug over the back; or the rug may be fastened down by a fillet string passing inside the thigh and fastened to the flap of the rug, as in the Government pattern. Loose rugs may cause a stampede.

The fit at the neck is another point which should be looked to. Very often the opening is much too large and as a consequence the rug gradually works back over the shoulders till the top is drawn tightly across the withers and may cause a sore from pressure. When surcingles are stitched on, a space of four inches should be left free where the web passes over the backbone or shrinkage from wet may cause injury by tight pressure. *A well-fitting rug* should embrace the neck like a collar, but in rather looser fashion, cover the body down to the level of the elbows and extend as far back as the dock; the fillet string should be capable of adjustment and the buckle of the surcingle sufficiently high up to prevent the horse lying on it when down.

Rugs are made of thick woollen blanketing or of jute sacking lined with stout woollen collar check, and both are quite serviceable, though the latter perhaps shows dirt least.

Rollers.—If the roller is not stitched to the rug, it should have a pad on each side of the spine, sufficiently thick to prevent the webbing coming down on the centre of the back when it is drawn tight. These pads are frequently so badly designed and stuffed that they do not prevent pressure on the backbone and a sore is the result: they should be thickest near the spine and thin off to nothing at their lower edges. Pieces of felt laid on each other, then skived off, and covered with leather or serge, make a very serviceable pad.

Cleaning clothing.—The rug should be well shaken and brushed every morning, and not wetted if it can be helped; if, however, it becomes necessary to scrub it, as little water as possible should be used, and the material well stretched when drying to prevent shrinkage. When rugs have to be disinfected by soaking, the fluid should be used cold for the same reason.

Bandages.—Although bandages are not used for troop horses unless they are in hospital, their employment is so very general in other stables that a reference to the proper methods of using them is not out of place here. Bandages are put on either to keep the legs warm and the circulation active or to protect them from injury whilst at the work, the first of these uses being mainly considered here. To keep the legs warm a bandage should not be any tighter than will prevent it slipping down; should cover as large a surface as possible; be applied without wrinkles and with even pressure throughout, and not fastened any tighter than the whole has been put on.

Stable bandages are usually about seven or eight feet long, and should be put on as follows:—starting just below the knee or hock, enough should be unrolled to make one turn round the leg, at a slight downward slope; keeping the bandage close to the leg, allow it to unroll itself round and down the limb in the same direction it was started, until it reaches the coronet; here it will naturally take an upward direction and its unrolling should be continued till the point from which it started is reached, where the tapes are to be tied in a bow on the outside of the leg, and the ends should be tucked in neatly. In this position they will be out of the way and not likely to be rubbed undone. As an additional security the corner of the loose end first applied may be turned down so that the next turn of the bandage will pass over and fix it. The nice adjustment of a bandage can only be acquired by practice, but the above directions will enable a correct method to be adopted. The usual errors are: starting to unwind at too great a slope and then endeavouring to correct this by pulling the material in the required direction; and failing to get the bandage over the fetlock without altering its direction.

Warm bandages put on too tightly defeat their object by stopping the circulation, and wrinkles are very likely to cause injury to the skin from the pressure of the folds which lie over them: for the same reason, knots or bows should not be tied either on the back of the tendons or on the front of the shin; they should invariably be removed twice daily and readjusted, a precaution which should prevent any injury from pressure. The legs should be hand-rubbed after removing bandages.

Bandages put on for work should reach from below the knee to above the fetlock and should not in any way interfere with either joint; they should be fastened with a double strap and buckle stitched on the material, or if tapes are used, by a knot; they should be removed as soon as the work is done. These bandages should not be put on tight.

Material of bandages should be pure woollen for warmth, and some are now made with a fleecy side for this purpose.

Bandages which are put on to protect the legs from injury while at work are, or should be, made of stockinette, an elastic material which permits of some pressure being applied when they are put on.

To roll a bandage.—Hold the bandage by the end to which the tapes are attached, the side on which they are stitched facing you. Double the tapes into a small bundle about the width of the bandage and lay them across the place they are stitched to, then roll the tapes inside. When the bandage is applied the tapes will then be outside in the most suitable position for fastening.

Knee caps to protect the knee in case of a fall at exercise are only seen, in the Service, on the charger. They are made of stout woollen or kersey with thick leather bosses on the front, which are shaped to prevent them interfering with the bending of the joint. The top strap, which must be soft and padded on its inner face, should be tight enough to keep the knee cap in position, whilst the lower one should be quite slack, so that the limb may be freely bent when trotting. If these precautions are not observed, knee caps may occasion the very accident they are designed to prevent.

Methods of Securing Horses in Stables.

A head collar, chain or rope and log are usually supplied for this purpose, but there may be occasions when a head collar is not forthcoming, and a halter is substituted. If a ready-made one is not to hand, an efficient article may be made from any rope as follows :—tie a small loop at one end and about four inches further along tie another similar loop. Both loops should be just large enough to admit the free passage of the rope. Now pass the free end through the first and second loops successively. When adjusting, another knot may be added at each loop to prevent slipping.

Head collars are generally made of leather, in the Service always, but webbing is occasionally employed. The throat lash may be sewn on each side of the cheek piece, or be a separate strap passing over the poll, and attached to the crown piece by a loop. The fit of a head collar is a matter which does not invariably receive the attention it should, for one which is so loose as to be easily got rid of teaches the habit of "slipping" the head collar, which is often difficult to overcome. The nose band must be sufficiently loose to admit the free movement of the jaws in mastication and yawning which is the utmost extent the animal requires to open his mouth ; the brow band should be just long enough to allow the cheek pieces to pass from the crown down, without rubbing the bones on each side of the temples or cutting the base of the ears, both of which accidents occur when it is too short; and the throat lash should not be slacker than admits of easy swallowing. The cheek pieces should end just below that prominent knob of bone which is seen half-way between the eye and the corner of the mouth, so that when side ropes or pillar chains are fitted these will be out of the reach of the lips.

Slipping the head collar is a trick at which some horses become very expert, and they accomplish it either by getting the head rope over the head and then leaning back, or rubbing the poll under the edge of the manger. In either case the crown piece is pulled forward over the ears and the head collar drops off. To prevent it: (i) if the throat lash is stitched on to the cheek piece, leave off the brow band, the crown piece will then ride further back on the neck and admit of the throat lash being tightened: (ii) if the throat lash is a separate strap, lengthen the loop by which it is attached to the crown piece or slip it out of the ear loops of the brow band:—or, (iii) discard the head collar and substitute a broad neck strap, which should be fitted with only enough looseness to allow the animal to swallow.

Boarding up the space from the edge of the manger to the floor may defeat those horses which rub their polls in the effort to get rid of the head collar.

Head collar chains are noisy, very heavy, and from their weight more likely to give rise to accident than ropes and straps, but they last a long time, which is their sole advantage. The proper length for a head collar chain, or any other similar means of fastening, is the distance from the lower ring of the backstrap of the head collar to the ground when the horse is standing upright. The chain is looped on to the ring just mentioned, and the other end which carries a " T " is passed through a " log." The object of the log is, of course, to carry back the slack of the chain whenever it is drawn through the manger ring or hole, and so keep it taut; but it is evident this action depends on the comparative weight of the chain and log respectively, and as the former not infrequently outweighs the latter, the result is that the log is unable to carry back the slack, and a long loop of chain is left hanging from the edge of the manger. Over this the horse not infrequently puts a fore-leg, occasionally a hind one, should he be engaged in scratching his ear at the moment the loop is hanging. When the head is raised the chain is tightened, and finding himself a fixture the animal struggles, gets cast, and may do himself severe injury. It should, therefore, be determined by actual test that each log is sufficiently heavy to pull back easily the entire length of chain in whatever position it may be. Usually the chain runs through a hole in the manger and drops to the floor, but a far better arrangement is to attach it to a bar running from the edge of the manger to the floor or wall behind. On this bar a ring, of sufficient diameter to slide easily, is welded, and to it is fastened one end of a 2 ft. 6 in. chain, the other being attached to the head collar. This arrangement, as will be readily seen, permits the necessary freedom of movement as the ring slides up and down the bar, and at the same time obviates any slackness of the chain no matter what the position of the animal's head may be.

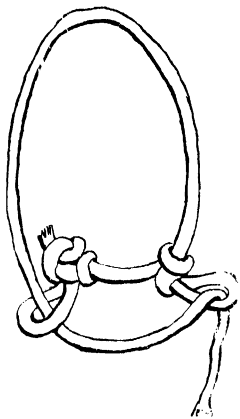


FIG. 20.—Improvised halter.

Ropes and straps, with wooden logs, though they do not last so long as chains, have much to recommend them, and of the two ropes are to be preferred. They are comparatively noiseless, much lighter, and not so likely to be a source of accident, as their lightness causes the slack to run back more easily. A rope, well-tarred or soaked in creosote, is best, as horses and mules are less likely to chew it than either new hemp or leather.

Double ropes are sometimes attached to each side of the head collar, instead of the usual single one from the back strap, and this method is useful if it is desired to confine the horse to one side of the stall, for by shortening one of them, he will be compelled to stand on that side.

Pillar reins or *chains* are attached to the back of the stall posts, and are very useful for cribbers and windsuckers, or for the temporary accommodation of horses which it is not desired to feed. They should not be longer than will reach to each side of the head collar, for if slack, they are likely to be seized by the animal, and when the horse has a bit in his mouth, accidents are the occasional consequence.

The short rack consists of a ring fixed above the manger to which is attached a chain just sufficiently long to allow the horse to reach the manger when the "T" of the chain is fixed to the head collar. It is found in most troop stables, and is used during feed times to prevent the horse interfering with his neighbour.

Bedding.

The provision of a good bed is an important detail in the economical management of working horses. It is quite possible for them to take a considerable amount of rest standing, and as a matter of fact there are some which rarely lie; but the more rest they can be induced to take, the longer their legs will probably last, and the more likely are they to keep good condition. A good bed has a marked effect in inducing horses to lie down for long periods, and frequently, during both day and night, and it also prevents injury to the elbows and other parts from contact with the hard stable floor. An ideal bed should provide a level elastic surface, be dry and warm, should either completely absorb and deodorize all urine, or allow it to drain away immediately, and have no injurious action on the hoofs, conditions which no material will fulfil unless carefully managed. The various articles which may be used for bedding are, straw, several varieties, bracken and leaves, sawdust, shavings, sand, and peat moss.

Straws.—Straw of any variety, which is to be used for bedding, should be long, dry, clean, free from mould, bright in colour, and not much bruised in threshing. This description applies, of course, to first-class truss straws; excellent beds may be made from inferior qualities, but they do not last so long, are more wasteful, and should only be used when the price admits of a larger issue than it is possible to make of better straw.

To examine straw in the truss, note whether the stems are much crushed and split. This detracts from its value, as once the outside varnish-like coat is broken, urine does not drain off completely but is partly absorbed by the stalk, which becomes sodden, and, on subsequent drying, brittle. The truss should be opened, and the interior examined, for here, if anywhere, the damaged portions will be found. Mouldiness may be detected by smell, and by the presence of discoloured spots and patches; dampness by the feel, and probably by accompanying mouldiness also.

Bale straw, whether English or foreign, is less economical than truss, owing to the extensive crushing which is inevitable, and which lessens its wearing quality.

The trade weight of a truss is 36 lb., and 36 trusses make a "load"; a bale may be of any size, but usually they are not less than two trusses in weight.

As a bedding, straw is doubtless the most attractive material on account of its bright, cleanly appearance, and the comfortable elastic bed it provides when new, and well arranged; but unless a sufficient amount can be supplied to admit of its being frequently changed, and thoroughly dried, it becomes a dirty, damp, urine-soaked mass, particularly in wet weather, which is neither comfortable nor sanitary.

Management of straw bedding.—Old bedding, when removed from the stalls, should be well-shaken up, and only the dung and short refuse taken to the dung-heap. In fine weather it should be spread in the open till thoroughly aerated and dried, then placed in wind-rows till required. In hot climates it may become too dry and brittle if exposed to the sun for long periods, and should, when sufficiently dry, be stacked in large heaps. In wet weather, it should be spread out under cover, outside the stable if possible, to get well-aired and as dry as can be. The fresh straw should be well mixed with old before bedding down, and kept towards the rear of the stall, where it cannot be reached and eaten by the animal. Under no circumstances should the bedding be stacked in the front of the stall, under the manger, where a greedy horse can eat it, and where he is compelled to breathe the ammonia which rises from it.

In making a bed, the litter should be tossed so that it lies evenly over the stall, the straws criss-crossed, and not all one way. This will ensure its being elastic, and not easily disarranged. The rear of the bed should have the loose ends of the straw neatly turned in, which is done by placing the handle of a fork near the edge, pressing one foot on it to steady it, and twisting the straggling ends beneath it. As horses usually lie well back to the extent of their head chain or rope, the bed should not be made right up to the front of the stall.

Wheat straw is the best; it is long, stout, and sufficiently tough, is not so sweet as oat straw, and, therefore, not so readily eaten. It should be of a bright but pale yellow colour, and if it has been much weathered, becomes discoloured and greyish.

Oat straw is not so hard and tough, is more easily crushed, and does not wear so long; but as it is more digestible, and sweeter to the taste, it makes excellent chaff either alone or when mixed with hay. In colour it should be a bright golden.

Barley straw is not suitable for bedding; the awns on the ears are so prickly that they may cause an irritation of the skin, and, if eaten, colic.

Rye straw is the toughest of all, and wears longest, but it is scarce and dear, there being another market for the limited supply as a stuffing for collars. The straws are finer than wheat, and the colour not so bright.

Rice straw.—Rice straw is used in some places in the East. It makes good bedding and is very durable.

Bracken and *leaves* are, at the best, inferior bedding materials, but are sometimes made use of in the country as a matter of economy. They are not very absorbent, nor do they act well as drainers, so that except as an emergency bed, for which use might occasionally arise in camp, they are not likely to be met in the Service. Bracken should be cut green and stacked; if cut when it has turned brown, it quickly crumbles into dust.

Sawdust may be utilized when it can be obtained in plenty, but owing to its liability to rapid fermentation, it cannot be successfully employed unless the supply is ample. In any case, only sawdust from well-seasoned wood is suitable, green sawdust becoming hot as soon as it is pressed together in the bed and soiled by the urine. As with all absorbent litters, stable drains should be stopped before the bed is laid, or it will fill and choke them; the soiled portions must be removed at every opportunity and the whole well turned and aerated daily. If these precautions are not observed, the sawdust gets hot, and rapidly becomes fly-blown and full of maggots.

Shavings are occasionally used in the neighbourhood of factories which produce them in quantity. They make a fair bed, are not so liable to get hot as sawdust, but are not so absorbent, and often contain small blocks and chips of wood which must be carefully picked out before use.

Sand under favourable conditions makes a most excellent bedding, but is unsuited for damp, cold climates. In hot, dry weather and especially where the stable floors are not impervious to wet, it makes a comfortable, sanitary bed and is much liked by horses. Sand free from any trace of salt must be used, or horses will eat large quantities and suffer from serious sand colic. If sand is used in cold weather a layer of straw on the top makes a very comfortable bed.

A sand bath, i.e., a large circular bed, several inches deep, is an excellent addition to any stable; horses thoroughly enjoy a roll on it when they return hot from work, and it dries them at once. It is occasionally stated that sand spoils the coat, but the objection has no foundation in fact.

Peat moss makes excellent bedding; it is very highly absorbent, gives a firm but elastic surface, sufficiently warm, yet cool to the feet, and is a deodorizer of the urine. To this last quality some of the faults of which it has been accused can be traced, for there being no smell in the stable, sufficient attention may not have been paid to the litter, with the result that horses' feet have suffered. Peat moss requires the same attention as any other absorbent litter, and if this is not given, it will have the same effect as any other urine-saturated material, namely, to rot the horn of the foot, and cause an eruption on the skin from contact with it when lying down. These conditions are likely to occur if the so-called "continental" system of allowing bedding to remain down for long periods without any sanitary attention, is adopted. This can be prevented if the initial bedding is 8 in. deep and laid with a heavy roller; as occasion arises fresh peat moss is scattered over the top so that there is always a dry surface. The beddings should not be raked up but only the droppings and wet patches removed. About two bales of peat moss are required for each stall as the initial outlay, and after that 1 cwt. a month for replacement.

Good peat moss should contain no earthy matter, but consist of close-fibred lumps of moss, which can be easily broken by the hand, but which hold closely together by their interwoven threads. A certain quantity of other plants, often the variety called "horsetail" (equisetum), is unavoidable, but any amount of stones or dirt, or a dark earthy appearance, stamp it as a bad sample.

General notes on bedding.—Before using any absorbent litter, securely block all stable drains; if this is not done, the material will get down, gradually choke them, and render them very troublesome if they are required at any future time.

A wooden or brick ledge, or, in hot climates, a mud rim, at the back of a sand, sawdust, or peat moss bed, helps to keep it tidy.

Dung should be removed from the beds as soon as passed if possible as it is otherwise trodden into the litter and increases wastage.

In order to induce horses to take plenty of rest it is a good plan to keep them bedded down as much as possible, a comparatively simple matter with peat moss, but one which requires more management where straw is used and the quantity limited. In order to check waste as far as possible, the litter should not be put down until the horses are groomed, and since they often stale as soon as the bed is under them, a handful of the worst should be shaken under the geldings, and the back of the stall littered last; the wet straw and urine can then be removed and a dry bed left.

A system of leaving the litter down constantly, and adding fresh bedding to the mass daily without further attention, is practised in some parts of the Continent, and has been tried in our own stables. It certainly provided a thick, soft standing, but the greater part of the bed worked gradually to the rear of the stall and became a dung heap which, when it was removed, rendered the stables unbearable. In a drier, less variable climate the plan may be feasible from the point of view of keeping a thick bed under the horses, but it can never be a sanitary method and is to be condemned on this account.

Stable Tricks and Vices.

Horses should be kept out of the stable as long as possible daily, for long hours of work are a distinct preventive of stable tricks and vices as well as beneficial to the general health and condition.

Weaving is a nervous habit acquired by many wild animals in captivity, and occasionally by horses; the animal rocks itself to and fro continually, sometimes lifting each forefoot in turn as the body is swayed to the opposite side. As the collar chain when worn is drawn through the manger ring at each motion the habit is often accompanied by a good deal of noise, and while some do it constantly, others practise it at intervals only. A constant weaver gives himself no rest, and, as the habit is incurable, it must necessarily take a great deal out of animals which practise it, though no special accident or disease can be directly attributed to it. It is advisable that they should be kept apart, so that others are not disturbed, and do not learn the trick from observation: it is also well to provide weavers with a bedding, *e.g.*, peat moss, which will not readily slip from under the feet, and to give them a head rope or strap instead of a noisy chain. Divide the animals' rations into many small feeds to keep them occupied when in the stable.

Windsucking and crib-biting.—A windsucker is an animal that swallows air by arching its neck, drawing its head towards its chest, and giving a gulp. A crib-biter achieves the same end, but leans on or catches hold of the manger with the teeth in order to get a firm purchase, and at the moment he gulps a characteristic " grunt " is emitted. Horses are prone to learn these two vicious habits from their neighbours; once acquired they are never forgotten, and are incurable, though much may be done to prevent horses indulging in them until they learn to outwit the preventive. For both windsuckers and crib-biters, a broad strap, fitting tightly round the top of the neck, with a small wooden or metal gullet plate stitched on so that it projects on each side and sticks into the throat when the head is bent, will stop both habits whilst the discomfort is sufficiently great. A "flute" bit may be worn. This is a hollow tube snaffle, perforated with several holes throughout its length like a tin whistle, so that when it is adjusted suction cannot be exerted owing to the impossibility of completely closing the mouth; it is an effectual preventive whilst worn, but unfortunately it is not always replaced immediately after work or feeding, and so the animal gets an opportunity to fill himself with wind, of which he takes full advantage. A piece of thick indiarubber tubing, with a strap passing through it, fastened around the lower jaw just behind the tushes, will sometimes be effective, but is not invariably successful. Muzzles of various patterns with the object of preventing the teeth grasping or leaning against the manger have been tried, but are not sufficiently successful to warrant their adoption. Crib-biters may be put into a loose box with four blank walls and nothing to lay hold of, until they learn to windsuck, or they may be turned about in the stall and kept constantly on the pillar reins; but no means of effecting a permanent cure has yet been found.

The effect of the constant pressure of the incisor teeth of the crib-biter against the manger or other hard objects, results in the fronts of the teeth of both the upper and lower jaw getting worn away, and in bad cases they may be down to the level of the gums.

Indigestion and colic also frequently result from windsucking and crib-biting, and as the habits are easily acquired by others, horses that practise them should be separated as far as practicable.

Biting is a vice more common in stallions than in mares or geldings, though occasionally savages may be met with in all three. A playful habit of snatching at the man whilst being groomed which some horses display may not come under the head of viciousness, but as the results are equally painful, it should not be encouraged by unnecessary tickling. A wicked biter, when being groomed or otherwise handled, may be rendered safe for the time, by a thick wooden bit which prevents the teeth being closed; or by a side stick. A side stick is a short stick reaching from the cheek piece of the head collar to the roller or surcingle and tied to each. It allows vertical but not lateral motion of the head.

Tearing the clothing is another bad stable habit which is very persistent when once acquired, and can only be absolutely prevented by the use of a stout leather guard fixed on the head collar. This should be of sole leather, fastened to the back strap of the noseband and sufficiently deep to reach well below the level of the lips; this will render it impossible for the clothing to be reached by the teeth, and as it is permanently attached to the head collar, it is always in place when required.

Kicking in the stable may be due to want of work, the remedy for which is obvious; or a persistent vice which is always troublesome, and frequently dangerous, and is more common in mares than in geldings. Some animals kick constantly in the dark, and a light in the stable keeps them quiet, but others will continue the habit in spite of every precaution. The following are some methods by which it may be combated:—the bails and stalls post may be padded or wrapped with straw so that noise is prevented and the chances of injury lessened. It appears in some cases that the noise produced is a stimulus to repetition, and, if deadened, animals occasionally stop. Bunches of furze or other prickly plants may be hung in such a position that they are struck during the kick. The pain caused either stops the habit or increases it, and the plan therefore requires careful watching.

Kicking boards may be slung from the bails. These should be thick, heavy boards, extending at least half-way up to the stall from the rear stall post, reaching within a couple of inches of the ground, and hinged to the bail so that they swing when hit. They may be padded with sacking loosely filled with peat moss to deaden the sound. Although they do not cure the evil they are one of the best palliatives.

Kicking blocks of wood or rubber may be made to fit closely into the hollow of the heel, and being fastened there by a strap which passes through the body of the block, they prevent the heel being bent or the leg raised; these, however, must fit very accurately, for if they slip from the heel they are useless and may even increase the trouble. Another variety of kicking block is a shackle with a few links of heavy chain attached to which is sometimes added a smooth wooden ball. When the horse kicks, the chain or block hits him on the leg and in some cases stops the habit.

Attaching heavy weights to the legs by means of shackles, *e.g.*, bags of sand, or hanging these behind the animal so that they swing back when struck, are harmless and sometimes quite efficacious expedients, and the legs may be shackled together if other means fail.

It will be noted that some of the methods given above are likely to cause considerable damage to the animal if the kicking is persisted in, and they should all be carefully supervised when employed; horses which are not cured of the habit by one method, will sometimes yield to another, and none should be persisted in if they do not at once check it.

Gnawing the walls and eating their own droppings are instances of depraved appetite occasionally observed in horses. The former is usually ascribed to a craving for lime salts, but it is by no means proved that it is anything but a bad habit, and the presence of a lump of rock salt in the manger will suffice to distract the attention till it is forgotten. If the habit continues, that portion of the wall within reach may be covered with tar varnish (tar 1 part, naphtha 3 parts). Eating dung is a dirty habit which, once acquired, seems to be very difficult to stop. The animal will even try to slip its head collar in order to get at its own fæces, although it does not attempt to eat those of other animals. As indigestion may be a possible cause, in both the above cases, a careful veterinary examination of the animal, and an equally thorough overhauling of the food, should be undertaken.

To prevent animals eating off the ground, a baggage strap passed behind the poll so as to hang just below the throat lash is looped to another baggage strap passing over the nostrils in the position of the nose band. Every time a horse attempts to lower its head there is a pressure on the muscles of the neck and nostrils which prevents an extension of the head.

Daily Routine of Stable Duties.

The usual hours for stables at home are :—morning 6 to 7 in summer, 6.30 to 7.30 in winter ; mid-day on return from work or exercise ; evening 5 to 5.30 .

At morning stables.—The stable to be cleaned out, the bedding placed in wind-rows and the stable aired. Every horse should then be quartered, the feet picked out, and manes and tails brushed down.

When the horses have been watered the saddle or harness may be put on, the girths being left loose and the horse racked up and left to feed while the men have breakfast, though in cold weather it is preferable to replace rugs and not saddle up until actually required.

At mid-day stables.—Immediately on return from work, after watering their horses, the men should take off the bridles, put on the stable head collars, remove the arms from the saddles, dry the throat, rack up the horses, and give them a little hay to pick at. Harness and saddle may be left on with loosened girths whilst the men change into fatigue dress ; as soon as this is done "Stables" should sound, when every man should be with his horse, and all officers and non-commissioned officers of the unit present.

The saddle or harness should be removed, the blanket being put outside to dry and the horse carefully examined for possible galls or other injuries, the feet picked or washed out, and the horse should be thoroughly dried, if not already so, and groomed. Any injuries or loose shoes should be reported to the non-commissioned officer in charge of the stable. After grooming the horse is taken outside to be inspected by the officer or non-commissioned officer in charge of the stable, who is to carefully examine every part of him, paying special attention to the tail, mane, throat, ears, knees, belly, and insides of the thighs and hocks. If the horse is perfectly clean he is to be taken to water and fed. When the quantity of litter permits, horses should be bedded down before leaving stables.

No horse is well groomed unless he is groomed quickly. As quick grooming is to be encouraged horses should always be inspected as soon as they are groomed and the men allowed to go on with their saddlery. The stable head-collar should be cleaned before the horse is passed.

At evening stables.—At evening stables the horses are to be watered, wisped, bedded down, and fed. For this half an hour is sufficient.

Non-commissioned officers in charge of horses must watch during stables that the above routine is carried out, that every man gets to work on his horse at once and continues at it until his horse is passed as clean. They must give advice and assistance to young soldiers, and get them into the habit of handling brush and comb correctly. Should any injuries be reported they must inform the officer commanding the troop or section.

The officer in command should satisfy himself that the forage and bedding are up to standard quality, and that no horses are passed unless they are thoroughly clean and have been examined to see that they are uninjured and their shoes are in good order. Before horses are fed he should ensure that all gutters are swept clean, barrows emptied, utensils conveniently placed, buckets filled with clean water, and the ventilation suitably arranged.

Officers should make a point of occasionally visiting their stables at various times of the day. Horses' habits and peculiarities may be much better studied when the men are away than when grooming is going on.

It will frequently happen that the horses do not return from work until or after the men's dinner hour. In this case the saddles may be removed, but the blankets left on, being kept in place by the surcingles ; the horses should be watered, their throats dried, and they should then be fed, care being taken that they are not left in a draught. "Stables" should sound one hour after return from work.

It is important that horses should be put on the short rack at time of feeding and taken off the short rack chains as soon as they have finished feeding.

A stable guard should invariably be posted while the men are away from stables. The stable man is not to leave the stable: it is his duty to unrack the horses when all have finished their feeds, tie up any horses that may get loose, straighten rugs, remove droppings, and report any case of injury or animal off its feed. He is responsible for the safety of the saddlery and utensils, and that the ventilation is not interfered with. A horse that lies down in the day should not be disturbed unless saddlery or arms are in danger of injury.

On no account is an officer, non-commissioned officer, or man, to smoke or strike a light in the stables or near any forage.

Should the stalls be slippery, sand or litter is to be sprinkled on the flooring.

Horses should never be hurried in turning round in their stalls. No man is on any account to strike a horse in the stable. A statement that the horse kicked or bit at the man cannot be taken as an excuse.

Horses are particularly terrified by fire, and should a fire occur in the stables they must be led, backed, or ridden out of the stable. If they are unwilling a coat or cloth should be thrown over their eyes. Care should be taken that they do not break back to their stables.

CHAPTER V.

FOODS, FEEDING AND WATERING.

FORAGE includes all articles used for feeding equines and bovines: articles used for bedding are also considered under this heading. Since the amount of work which animals can perform depends to a large extent on the quality of their food, it is the duty of every officer of a mounted unit to be able to distinguish good forage from bad.

Food is necessary for an animal to—

1. build up the tissues and organs during growth.
2. make good the wastage due to wear and tear.
3. keep up the body temperature.
4. supply the necessary energy for internal and external work.

At first it may seem difficult to understand how food given in the form of grain and hay to a horse can be converted into flesh, fat and bone; this conversion is explained by analysis, when it is observed that both plant and animal are built up of similar bodies, which may be resolved into six groups—

1. Proteins (flesh-making or nitrogenous materials).
2. Fats, starches and sugars (fats, heat and energy producers).
3. Salts.
4. Water.
5. Fibrous or woody material.
6. Vitamins (essential factors).

Each of these constituents has definite functions, and by the analysis of food it is possible to ascertain the actual percentage of each constituent from which one can obtain the feeding value of a particular diet.

1. Proteins. Their functions are to:—
   (*a*) build up the body tissues.
   (*b*) repair muscular waste.
   (*c*) produce energy and heat.

Protein, although a costly constituent of the food, is essential for the requirements of the body; if a diet containing no proteins were fed to an animal wastage and death would follow.

A higher percentage is required in young animals for muscle growth, and in animals doing hard work, to repair muscular waste.

The proportion of proteins compared to the amount of "fats, starches and sugars" is known as the "nitrogenous ratio." In the adult this ratio varies from 1 : 5 in very hard worked horses to 1 : 10 in resting horses. It should never exceed these figures, except in young animals, when it is given 1 : 3 as in milk.

If given in excess to body requirements, it is utilized in the production of fat—a very extravagant method of feeding. If food is given containing a large proportion of proteins over and above the body requirements for any length of time, it upsets the digestion, causing diarrhœa, liver disorders, swollen legs and over-heating of the body with eruptions on the skin.

2. Fats, starches and sugars. Their functions are to produce fat, energy and heat.

Fat produces 2⅓ times more heat and energy than starches and sugars.

Too large a proportion of starch and sugar lowers the digestibility of proteins.

Fats, starches and sugars of the food are worthless as energy producers without the presence of proteins.

The proportion of fat to proteins in a diet should be about 1 part of fat to 2½ parts of proteins; this proportion is known as the "fatty-ratio."

It therefore follows, when selecting a diet, attention should be made to see that it is "well balanced," that is to say, the "ratios" mentioned above are considered.

3. The salts in the body are not only found in the bones, but in the blood, the hair, the horn, the muscle, the sweat, and in some fats. They direct the constant changes taking place in the body, and when excreted they must be replaced, which is done through the medium of the food.

The salts required are mainly the compounds of lime, soda and potash. The percentages vary in different foods—generally higher in hay and straw than in cereals.

The presence of salts in the food is essential, particularly in young animals; it is for this reason that maize given alone is an unsatisfactory diet, and the deficiency of salts in this grain can be made good by hay, particularly alfalfa (lucerne) and sainfoin.

Death would ensue, if salts were entirely absent in the food.

4. Water forms a considerable portion of all foods, even those which are considered dry, the percentage varying from about 10 per cent. or 12 per cent. in grain to 90 per cent. in roots.

5. Fibrous or woody elements. These comparatively indigestible materials exist in varying proportions in all vegetable foods. Whilst their actual digestion may not be carried out to a very great extent, they are nevertheless found to be necessary as providing—

(*a*) bulk to the food—so essential in herbivorous animals.
(*b*) mechanical aid in splitting up the other parts of the food for absorption.

The proportion in which they exist may vary from about 2 per cent. in maize to 40 per cent. in straw.

6. As the result of recent research, it is considered that the mere mixing of proteins, fats, starch and sugars, etc., will not maintain the health and produce growth of the animal, unless other essential substances called " vitamins," or accessory food factors, are present in the food.

They are present in natural foods in minute quantities and exercise an influence in nutrition, out of all proportion to the amounts consumed. Their absence from a diet leads to definite symptoms of disease like bone degeneration, nervous affections, scurvy, rickets and sterility. They are especially important during the period of growth of young animals. Vitamins are destroyed by prolonged heating and are possibly absent from boiled food.

The actual percentage of a given food which is digested by the animal is known as the " digestive coefficient." This not only affects the bulk of the food, but the individual groups of the food, building up the whole mass ; and although this percentage varies in the different grains and grasses, it invariably happens that where the food is proportionately rich in one of the following groups—proteins, fats or starches and sugars—it has been demonstrated that a higher percentage of that particular group is digested by the animal. As an example :—

Beans on analysis show a high percentage of proteins and a low percentage of fats ; by experiments it has been observed that 86 per cent. of the proteins present in the food were digested by the animal and only 11 per cent. of the fats. Again, there is a higher proportion of starches and sugars in maize than in oats ; by experiments it was demonstrated that 93 per cent. of the starches and sugars were digested in maize compared to only 75 per cent. of those in oats.

In considering the question of digestibility of the food, it is necessary to understand what happens to this food from the time it enters the mouth until the nutriments are extracted from it and the remaining undigested waste matter is excreted as " droppings."

The attached table will give a fair idea of the work performed by the various digestive organs in extracting nutriments from the food for the body requirements.

The action of digestion may be compared to the action of fuel furnishing heat and energy for the working of an engine. The food is the fuel, and the digestive tract the furnace, from which heat and energy are produced for the animal's body.

DIGESTIVE APPARATUS.

Parts of the digestive tract.	Action.	Secretions and their actions.	Lessons learnt for stable management.
Mouth ...	Food is broken up by the molar teeth saturated with saliva (a juice secreted by glands of the mouth), and passes to the back of the mouth in the shape of a cylindrical ball.	*Saliva*—Converts starch into sugar.	Give bulk to encourage slow mastication and flow of saliva. Food must be broken up in the mouth.
Stomach— (*a*) Small. (*b*) Only half lining membrane secretes true gastric juice. (*c*) Exit larger than entrance. (*d*) Does not lie on the belly wall. (*e*) Passage of food slower through full than empty stomach.	Food is further broken up.	*Swallowed saliva*—Converts starch into sugar. *True gastric juice*—Converts starch into sugar. Flesh - forming elements broken up.	1. Feed in small quantities and often. 2. Give bulk, to promote secretion of gastric juice. 3. Never water immediately after feeding, as undigested food will be washed into the intestines. 4. Never work immediately after a heavy feed, because of the pressure of a full stomach on the diaphragm. 5. Give clean and proper food, as a horse cannot vomit
Small intestines.	Food is further broken up into a liquid mass. Some of the nutriments in the food are absorbed through the walls of the intestines.	*Intestinal juice*—Converts starch into sugar. Bile (from the liver)—emulsifies fats and disinfects the bowels. *Pancreatic juice* (from the Pancreas—"sweet bread").	—

Parts of the digestive tract.	Action.	Secretions and their actions.	Lessons learnt for stable management.
Small intestines.—*contd.*		Converts starch into sugar. Emulsifies fats. Breaks up flesh-forming elements for absorption.	
Cæcum ...	*Absorption of nutriments in the food.* The contents must always be in a very liquid condition. The storing up of liquid is required for the wants of the body and for proper digestion.	—	1. Never water immediately after a feed. 2. Ensure a horse has a plentiful supply of clean and palatable water, otherwise digestion cannot be properly carried out.
Large and small colon.	Fibre chiefly broken up by bacterial action, absorption of fluids and soluble nutriments take place. Contents in a liquid, semi-liquid or firm state.	—	Keep bowels active by judicious feeding and exercise to prevent absorption of waste products.

The digestibility of food depends on the following factors :

1. The quality of food.
2. The quantity of food.
3. The combination of foods.
4. Water in the food.
5. The work of the animal.
6. The health of the animal.
7. The age of the animal.

1. Food grown on land of a poor quality, badly harvested, badly preserved, adulterated, weevilled or mildewed will show a lower percentage of digestibility than food of a good sample, clean and well saved. It therefore follows that the inspection of forage is one of the essential duties in management of animals.

2. This heading can be divided into two sub-heads, both of which lower the digestibility of the food—

(1) Insufficient food, particularly absence of bulky food, causes loss of condition and general debility.

(2) Food in excess of the animal's needs either causes diarrhœa, or ferments in the bowels and produces poisons which are absorbed in the system, affecting the animal's general health.

A good horsemaster is one who can get the maximum amount of work out of his horses at the minimum cost without *the animals losing condition.*

3. This is generally known as the balance of food, and means the proportion of the various constituents of the food to one another.

The nitrogenous ratio should range between 1 portion of proteins and 10 portions of fat, heat, and energy producers for resting animals, to 1 : 5 for hard-worked animals. The fat ratio should remain at 1 portion of fat to $2\frac{1}{2}$ portions of proteins.

Horses cannot thrive on concentrated food; bulky food in the form of hay or oat straw, etc., is essential. Any variance of these principles will lower the digestibility of the food; this should be remembered in the substitution of foods.

4. Before the nutriments of the food can be absorbed from the bowels into the body they must be in solution. There is a constant drainage of water going on in the body, particularly during work, and the bowels are constantly being drawn upon by the body to carry on its functions. A deficiency in water will not only affect digestion, but is liable to cause diseases—as colic, debility—and affect the general health of the animal. Too much attention cannot be paid to the watering of animals; it is as essential as feeding.

It is on record that a horse receiving water has lived 30 days without food, but if water is withdrawn the period is reduced by a quarter; this may show what an important part the supply of water plays in nutrition.

5. Slow work does not usually affect digestion, but this is not so with animals called upon to do fast work; and it is for this reason that it is easier to keep in condition draught horses doing slow, steady work than saddle horses.

Fatigue and overwork bring about a loss of tone in the digestive apparatus, the secretion is reduced and there is want of power in the wall of the bowel.

In cases of temporary fatigue, as after a hard day's hunting, it is customary to give gruel or a linseed and bran mash when the animal returns to the stable, followed by a hard feed 2 hours afterwards.

If horses are called upon to do hard work on a loaded stomach the animals' breathing is interfered with and fatal digestive troubles may ensue.

Again, it is necessary to bear in mind that animals require several hours of the day to digest their food ; for this reason the majority of the food should be given during non-working hours.

It naturally follows that an animal in good health has more vigour to digest food than one suffering from disease, therefore special forms of diet are given to sick animals.

It has been shown that the food must be broken up in the mouth. Irregular or diseased teeth, interfering with mastication, would accordingly affect the digestion of the food ; it is for this reason that such stress is laid on the condition of the teeth and the condition of the feed in order to promote thorough mastication.

When a horse chews its food partially and then drops it from the mouth it is said to be *quidding*, and this is generally due to irregular or diseased teeth.

Old animals may lose condition through want of tone in the digestive apparatus and irregularity of teeth ; these defects can be rectified by attention to the teeth and special preparation of the food, such as crushing the grain.

The unit of heat is known as a calorie, and the unit of work is expressed in foot-pounds.

From the knowledge of the number of calories in the food the amount of work an animal can perform can be ascertained, and from the amount of work the animal is doing a correct diet can be gauged.

The amount of food required to prevent loss of body weight when an animal is not working, or being exercised, is known as the " maintenance " or " resting " diet.

This food is required to maintain body temperature, and to repair the wear and tear caused by digestion and work of the internal organs.

Food requirements are largely determined by the skin surface of the animal ; a large skin surface means a large area for radiation of heat, and loss of heat must be made good by food, therefore a pony weighing 500 lb. requires comparatively more food than a horse weighing 1,000 lb., because the skin surface is greater per lb. body weight.

An increase of the external temperature lessens the call for heat maintenance in the body and results in fat or weight production.

This explains the increased well-being generally observable throughout the animal kingdom in the spring of the year.

Factors such as weight carried, pace, ground, etc., have to be considered in calculating a working diet.

The amount of food constituents given must depend upon the character of the work, and the main constituent to attend to is the proteid (flesh-making).

The liberal feeding of horses that work hard is sound economy.

In adopting a new diet, the following factors should be considered :—

(*a*) Its feeding value.
(*b*) The balance of food.
(*c*) Its nitrogenous ratio.
(*d*) The price of food.

(*See* Table on pp. 92 and 93 showing the comparative feeding value of common foods given to the horse.)

Oats.

Experience has shown that oats are, generally speaking, the best of all grains for horses. They combine all the elements necessary for nutrition in such proportions that the animal is able to consume a large amount without upsetting the digestion, and to extract the greatest possible amount of nourishment from it ; and although many other grains are successfully used as horse food, wherever oats can be obtained they are universally acknowledged to be the best, provided the question of cost does not enter into consideration. In England they are the staple feed, though usually mixed with cheaper grains in commercial stables, and in addition to the home-grown supply, large quantities are obtained from abroad, Russia, Canada, the United States, South America, Australia, New Zealand, Turkey, and Germany all exporting to this country.

Characteristics of Oats.

Good oats should be plump and short, of good colour, hard to the feel, quite dry, rattling when allowed to fall on a solid surface, without smell, breaking sharply across when bitten, tasting like good oatmeal, and, in a good sample, practically all the same size. On looking closely it will be seen that there is a split down the under side of the husk ; a good oat should be so plump that the kernel bulges through this split, making a double line down the grain. A plump oat is a heavy oat, it has little or no beard, consequently lies closer together and therefore weighs heavier than a longer, thinner, more bearded variety. The size and plumpness of the grain should be due, not to an increase in the husk but to the size of the kernel, and consequently some thin skinned varieties may be smaller and meaner in appearance than thick, heavy husked though inferior samples. The colour of oats varies considerably ; some varieties being a deep brown, others black and others again almost white. Whatever the colour it should be good of its sort, any unusual discoloration showing that the grain has suffered from damp or has been tampered with to improve its appearance. Practice alone is the only *way of learning to judge these points successfully, and to tell by feel whether oats are in good condition or not.* If a handful be firmly grasped it should not be possible to further close the hand by increasing the pressure, for this would show either that the grain was soft or that it was so light and heavily bearded that the individual grains did not lie as closely together as they might. Thorough dryness is very important when oats have to be kept long in bulk, and they should shell out of the husk with ease when nipped at one end. In well conditioned samples some grains may be found which have already escaped from the shell and this is a good indication of keeping condition. To test roughly the proportion of kernel to husk a small quantity may be crushed beneath the boot on the floor when the whiteness of the contained flour should be quite apparent. A few grains chewed in the mouth should leave no bitter flavour, but taste only of oatmeal, bitterness being indicative of dampness and subsequent kiln drying. New oats may smell a little earthy, but an old sample should have practically no odour. New oats are heavier and softer than old owing to the extra percentage of moisture they contain, and they are considered to be indigestible.

The weight of Oats.

In judging the quality of oats they should be valued to a certain extent in accordance with their weight per bushel measure. Oats vary widely in weight, some samples being as light as 30 lb. to the bushel while others scale over 50. The Government contract requires the oats to weigh not less than 40 lb. to the imperial bushel, or in the case of clipped oats 42, a weight which will ensure a good sound feed if the inspecting officer understands his business. Heavy oats, especially if they combine quality with weight, are usually higher in price than their additional value warrants. As a general rule the effect of cleaning a sample of dirty oats is to increase the weight to the bushel as the husks, dirt, etc., removed are very light in proportion to bulk.

Weighing Oats.

To ascertain the natural weight to the bushel the grain should be run through a shoot or poured quickly from a sack until the measure overflows, and the surplus immediately struck from the top with a thick, round stick, which should be long enough to afford a firm grasp at each end, and so enable the striker to level the grain with the edge of the measure at one stroke. By pouring the grain slowly or from a height; by shaking or striking the measure during the

TABLE SHOWING THE COMPARATIVE FEEDING VALUE OF COMMON FOOD-STUFFS GIVEN TO THE HORSE.

(*See* page 90.)

—	1 Percentage of salts.	2 Percentage of water.	3 Percentage of woody and fibrous material.	4 Amount of digestible nutriment reduced to "heat units" or "starch equivalent" of 100 lb. of food.	5 Nitrogenous ratio.	6 Fatty ratio.	7 Substitution per heat unit compared with oats.	8 Method of giving.
Grains—								
Oats ...	3	13	10	60	1 : 0·65	1 : 2·5	1 lb.	Whole, crushed, kibbled, boiled, steamed.
Maize ...	1·5	10·6	2·2	89·5	1 : 9	1 : 2·4	12 oz.	In cob, whole, crushed or soaked.
Barley ...	2·5	14·3	5	68	1 : 7·5	1 : 8	14 oz.	Crushed, parched or boiled.
Wheat ...	1·8	13·4	1·8	74·5	1 : 7·4	1 : 9	12·9 oz.	Give dry, either whole, crushed or parched.
Rye	2·0	13·4	1·9	66	1 : 7	1 : 8	14½ oz.	Coarsely ground or cooked.
Millets ...	2·0	11·5	1·5	—	—	—	—	Whole or crushed.
Rice ...	0·6	14	0·4	79	1 : 11	1 : 2·3	12 oz.	Crushed or boiled.
Beans ...	3·2	14·3	7·1	70	1 : 2·3	1 : 158	13·7 oz.	Split.
Peas ...	2·8	14	5·4	67	1 : 2·8	1 : 186	14 oz.	"
Gram ...	3·1	11·2	7·8	62·5	1 : 3	1 : 52	15 oz.	"
Linseed ...	3·4	12·3	7·2	120	1 : 5	1 : 0·2	8 oz.	Soaked or boiled.

By-products—								
Bran ...	5·8	13·2	8·9	45	1 : 4·5	1 : 3	1⅓ lb.	Dry or in a mash.
Brewers' grains, wet ...	1·1	76·1	3·9	18	1 : 3	1 : 2	3⅔ lb.	Give quite fresh.
Linseed cake	7·3	11·8	9·4	74	1 : 2	1 : 3	12½ oz. Compared to meadow hay.	Broken or soaked.
Green grass—								
Grass ...	2·1	75·0	6·0	10	1 : 5	1 : 6	3 lb.	Fresh and mixed with hay.
Vetches ...	1·3	82·0	5·1	9	1 : 4¼	1 : 2	3½ lb.	,, ,, ,,
Lucerne ...	2·0	74·0	7·3	9·3	1 : 2⅓	1 : 6	3¼ lb.	,, ,, ,,
Hay—								
Meadow ...	6·2	14·3	23·3	32	1 : 5	1 : 5	1 lb.	Long or chopped.
Clover ...	6·3	16·3	25·1	29½	1 : 3·5	1 : 9	1 lb.	,, ,,
Lucerne ...	6·8	16·5	23·6	32	1 : 2	1 : 34	1 lb.	,, ,,
Sainfoin ...	7·3	16·5	28	39	1 : 2½	1 : 26	1 lb.	,, ,,
Straw—								
Wheat ...	4·6	14·3	37·7	1	1 : 15	1 : ½	—	As chaff.
Oats ...	5·5	14·0	33·9	10	1 : 13	1 : 1¾	3 lb. Compared to oats.	Long or as chaff.
Roots—								
Carrots ...	1·0	87	1·3	9·2	1 : 7	—	6½ lb.	Sliced.
Swedes ...	1	88	1	7	1 : 9	—	8½ lb.	,,
Sugar Beet:								
Fresh ...	0·3	93	1·4	5	1 : 8	—	18 lb.	,,
Dry ...	4	11	17	52	1 : 7	1 : 12	1 lb. 2 oz.	,,

process; or by allowing the oats to settle before they are struck, the weight may be increased by as much as 4 lb. a bushel, and care should be taken when weighing samples that none of these things are permitted. Again, the quality of the oat is determined by the percentage of kernel to the husk. This is estimated by removing the husk from a given sample and weighing. In a good sample the percentage by weight of kernel to husk should not fall below 70.

Varieties of Oats.

English.—Both white and black English oats are equally good feed, although some prejudice exists in favour of the white, which it must be admitted are generally produced on richer soils; weight for weight, however, there does not seem to be any practical difference in their nutritive qualities. "Winter" or "tawny" is the name given to those oats which are sown in the autumn. Generally speaking, English oats are plump, short, and contain a large proportion of kernel, but are on the other hand often of a poor colour and soft to the feel, owing to their having been harvested under unfavourable, damp conditions.

Russian.—There appear to be two distinct classes of Russian oats, one small, smooth and silky, with a very fine, yellow husk, and the other somewhat larger, rough to the feel, and thicker in the husk. Compared with English grain both are small, narrow and mean looking, but they lie close, weigh heavy, are generally in good hard condition and of excellent feeding value. Mixed with them there is generally to be seen a small quantity of minute black seeds which detract considerably from their appearance; the proportion is, however, exceedingly small, and although these seeds are rejected by horses they do not seem to exert any harmful influence on the quality of the feed generally. In judging Russian oats one should remember that the thin, silky-skinned varieties are naturally of a brighter yellow colour than is usual in others.

Canadian.—The best quality of these oats usually imported is known as No. 2 Canada Western Oats. This quality consists of at least 90 per cent. of white oats and weighs about 40 lb. to the imperial bushel. It is a variety which has the appearance of having been roughly clipped, owing to the shortness of the kernel. The condition of these oats is generally very satisfactory, due to the low moisture content, and when oats for storage purposes are required this grade should be considered before any other. There is practically no admixture of weeds or other seeds, but a few kernels of wheat can generally be found.

The statutory grading of Canadian oats is as follows:—

STATUTORY GRADES OF WESTERN GRAIN.—OATS.

Number and Name of Grade.	Minimum weight to the bushel in pounds.	Variety of grain.	Standard of quality.	Maximum Limits of :— Seeds per cent.	Wild oats per cent.	Other grains per cent.	Total not to exceed per cent.
No. 1 Canadian Western white.	38	95 per cent. white.	Well matured. Practically free from damage.	About $\frac{1}{2}$ per cent.	About 1 per cent.	Free	1
No. 2 Canadian Western white.	36	90 per cent. white.	Well matured. Practically free from damage.	About 1 per cent.	About 2 per cent.	2	3
No. 3 Canadian Western.	34	Domestic oats. Any variety.	Reasonably well matured. Practically free from damage.	About 1 per cent.	About 4 per cent.	4	6
Special feed ...	—	Domestic oats. Any variety.	Reasonably well matured and sound except as to frost.	About $\frac{1}{2}$ per cent.	About 1 per cent.	4	5
Ex.1 Feed ...	38	Domestic oats. Any variety.	Reasonably well matured and sound except as to frost.	About 1 per cent.	About 2 per cent.	4	6
No. 1 Feed ...	34	Domestic oats. Any variety.	Reasonably well matured, but frosted, stained, or otherwise damaged. May contain 2 per cent. heat damage.	$1\frac{1}{2}$	7	8	12
No. 2 Feed ...	28	Domestic oats. Any variety.	Frosted, immature, stained, or otherwise damaged. May contain 3 per cent. heat damage.	2	12	20	22
No. 3 Feed ...	—	Domestic oats. Any variety.	Light weight, immature, damaged. May contain 5 per cent. heat damage.	3	25	30	33
Mixed Feed Oats	—	Wild oats or oat scalpings.	Excluded from any recognized grades of grain.	3 per cent. chaff, dust or weed seeds.	—	49	49

German.—The best German oats resemble home-grown (English) oats, and it is only by being in close touch with the season's variations that one can distinguish German oats from English, with the exception that there occasionally is to be found a few grains of lentils or tares in German oats which would not appear in a sample of home-grown oats.

Turkish.—Are usually of a nut-brown colour, said to be due to the soil on which they are grown. They are remarkable in possessing unusually thick, tough husks, which gives them a bold appearance not borne out by their weight. Coming as they do from a dry, hot climate, they are generally in very good hard condition.

Australian and New Zealand.—Resemble our own, from which indeed they have been produced, and they are often of the very highest quality and weight. Some Australian oats grown from Turkish seed have the characteristics of the latter and are said to be especially useful for sowing in extremely dry districts.

Indian.—The oats now grown in India (originally from English seed) are, compared with our own, extremely poor in appearance; small; light and heavily bearded, with a large proportion of husk; and although judged by our standard they could only be considered inferior, experience shows that in the climate which produces them they are even more suitable and yield better feeding results than heavier, richer, imported sorts.

"*Plate*" (S. American).—Are long and reddish in colour and have a tough husk. They show a good percentage of kernel and are well harvested.

Inferior Oats.

From whatever source they may spring, poor qualities of oats always have the same characteristics. The worse they are the longer, thinner, more abundantly bearded and lighter do they become, and although such a sample may be hard and dry, when a handful is squeezed tightly it will feel soft and compressible owing to the excess of beard which prevents the seeds lying close.

Defects in Oats.

Clipped oats.—By passing oats rapidly over a revolving wire brush, or by shaking them violently, it has been found possible to remove any excess of beard without damaging the grain; this is called "clipping," and results in producing a shorter, plumper looking, more attractive article. "Clipping" may not be regarded perhaps as an actual defect, since it really results in the buyer obtaining a heavier weight to the sack than he otherwise would, but the fact of the process having been thought advisable shows that the sample was not a very high-class one originally. "Clipping" may be detected both by the appearance of the altered oat, which has a square-cut end, and by plunging the hand some depth into the sack, when large quantities of the removed beards will be found adhering to it on removal.

Foxy oats.—When oats are stored in large quantities before they are sufficiently dried, notably for instance in grain ships, they become "heated," in some cases to such an extent as to be actually steaming; at the same time their colour alters to a deeper yellow than before and they acquire a peculiar acrid smell. Such oats are termed "foxy." This defect, like all others, may vary considerably in degree, but when it exists to any extent, particularly in newly imported shipments, it is readily detected.

Kiln-dried oats.—Kiln drying in itself is not a defect, and if the process is adopted only to make sure that the oats are dry enough to keep in bulk, it does not of course affect their quality, but, generally speaking, oats are only kiln dried because they were previously damp or foxy, and the fact that the process has been carried out is generally therefore an indication of damaged quality. Kiln drying gets rid of the foxy odour, restores the hardness, but further deepens the colour, so that grains originally a pale yellow become quite brown. To restore the pale colour of the kiln-dried article recourse is had to "bleaching," which is effected by exposing the grain to the fumes of sulphur. To detect this if it has been well done may be a matter of some difficulty, but if a small quantity is rubbed rapidly between the palms and quickly held near the nose the odour of sulphur may be detected. Chewing a few grains will leave a sulphurous or bitter aftertaste in the mouth, and a careful scrutiny of the suspected sample should also be made, as some grains may have escaped the bleaching process and remain quite brown from the kiln drying, while others again may be so excessively decolourized as to be almost, if not quite, white.

Mustiness and mouldiness.—Both these conditions are the result in different degrees of the grain having been damped by rain during the harvest or accidentally after storing. When the growth of the mould is so great as to be noticeable a simple inspection is sufficient to detect it, but the defect can be detected by the musty smell before it becomes visible, and the condition is frequently accompanied by a soft and spongy feel, varying with the amount of damp present.

Sprouting oats are those which have already germinated, and in which the sprouts are visible; their quality is, of course, so much affected as to render them unfit for consumption under ordinary circumstances, and unlikely to be tendered for sale.

Rat-tainted oats.—The presence of large numbers of rats in a barn will sometimes cause the grain to become so tainted that horses will refuse it. The condition may be detected by the presence of nibbled oats and the characteristic odour and droppings of the animals.

Dirty oats.—In many foreign samples of oats which are threshed in the open field a certain quantity of earth and small stones may be found, and in addition such samples may contain small nails with flat heads, which are used for the purpose of tacking canvas to the ship's side to protect the cargo during the voyage. The screening of foreign oats in order to clear them of all such particles is a matter, therefore, which should receive close attention, as their inclusion is likely to produce digestive troubles.

Measures by which oats are sold.—In bulk, oats are sold by the quarter of 304 and 320 lb. according to their quality; these weights are known as "trade weights" and are merely approximate, denoting the comparatively good or poor quality of the sample. In smaller quantities they are dealt in by the bushel, or, when purchased by weight, at so much for every 40 lb., which is generally accepted as a fair trade weight for a bushel of good oats. A "quartern" = a quarter of a gallon, or quart, 4 gallons = a bushel, 4 bushels = a sack, 2 sacks = a quarter.

Feeding Oats.

Oats are the easiest grain to feed to horses; they thrive on them in the best possible manner, and are able to consume and digest a larger quantity of them than any other grain without special preparation and without their digestion becoming upset. With horses in strong work the amount which they may be given is practically as much as the animal cares to consume, and provided that a suitable quantity of other forage is included in the ration, this will usually vary from 12 to 16 lb. a day. For animals in moderate work an average of 10 lb. a day suffices, and working horses when rested for a length of time may be given 4 to 6 lb. daily. Whilst oats may be given whole it is a decided advantage to have them bruised previously, not because the horse is unable to grind them with his teeth, but to ensure that the husk of each individual grain is split so that any which do escape mastication may be readily acted upon by the gastric and other fluids during the process of digestion. Animals which eat hurriedly, either from natural greediness or for fear that their neighbours may rob them, are naturally inclined to swallow their grain ration without due mastication, and especially is this the case in large bodies of horses fed in open stables. The grain should not be crushed flat, but merely have the husk split; it is indeed a fault to crush it too much, as the contained flour may be thereby lost. Crushing is especially useful with the small, hard, foreign varieties, which are even more liable to be swallowed whole than the larger, plumper, and somewhat softer British oats. Oats can be steamed or boiled, but as a general rule this is not to be advocated, such methods being usually more suitable to the needs of the hospital than the troop stable.

MAIZE.

Known as "mealies" in South Africa, and in most parts of North and South America as "corn," maize is in those countries the staple horse grain. It is used, though not extensively, in India (called Mukki) and in Egypt (called Doura Shami), and its introduction into this country is of comparatively recent date. Containing as it does a very small percentage of mineral salts, it is admittedly, even where it is in general use, an unsuitable food for the rearing of young stock; but experience has thoroughly proved that it produces excellent results in all classes of working horses when it is judiciously given with a nitrogenous diet such as clover hay, alfalfa or beans, etc., to make good the protein deficiency in maize.

A mixture containing one part of beans and two parts of maize is recommended, and it is said that 7¾ lb. of this mixture is equivalent in feeding value to 10 lb. of oats.

Characteristics of Maize.

It should be perfectly dry, of bright colour, not at all brown, quite hard, free from dirt and weevils; when bitten it should taste sweet and have no distinct smell. Maize is bought by the quarter, and should weigh 60 lb. to the bushel.

Varieties of Maize.

There are three chief varieties, North American, South American, and small round. North American maize, also known as "flat" or "horse tooth," is large, flat and roughly triangular, and is the variety most appreciated as a horse food in England. In colour the grains of a single sample may vary very considerably, ranging from a deep red to practically colourless seeds. South American maize, imported chiefly from the River Plate, and sometimes called "Plate Maize," is of a brilliant yellow colour, which is fairly uniform in the sample; it is flat but is rounder in outline and not so large as the previously mentioned variety. Small round maize is grown in many countries, and varies in shade from bright yellow to colourless, though the colour of any particular sample should be uniform; its feeding value is considered slightly inferior to the other sorts.

Defects in Maize.

Maize travels very badly in bulk once it is shelled from the cob, and is extremely liable to get "heated" during the voyage unless it starts in the most perfect condition. The individual grains then become darker in colour, softer to the feel, and acquire a peculiarly pungent odour, while in recent samples an increase of their temperature may be actually felt. It may also suffer from mustiness or mouldiness, and in all cases where the quality is under suspicion the points of the seeds should be closely examined, as this is the spot where damage is most easily detected.

Feeding Maize.

Where its use is general and it is fed as the entire grain ration, it is often customary to give it on the cob or stalk, and this is said to increase its feeding value and digestibility. If horses are accustomed to it they may and do consume it whole without ill effects, but whenever possible it should be crushed, as it is hard, difficult to masticate and takes a comparatively long time to digest. However it is given, it is important to bear in mind that owing to this slowness of digestion animals should not be watered until a considerable time has elapsed after feeding. When it is impossible to crush and the animal is unaccustomed to it, the grain may be soaked until it is soft, or preferably boiled. It is not, however, advisable, at any rate in a temperate climate, to feed horses required for fast work on cooked rations, although this means of preparation may be occasionally taken advantage of to tempt the appetite of the delicate feeder and such as may be suffering from overwork or are convalescent from disease. In England maize is usually and most advantageously fed in mixtures which contain varying proportions of oats and beans or peas in addition, but some large horse-owning companies feed on maize only and find it satisfactory. The admixture of chaff is particularly called for in such rations owing to the paramount necessity for thorough mastication.

When fed as a whole ration the same quantity as of oats may be given.

Barley.

Though not generally used in England, barley is a very good horse food and is in very general use, both in and out of the Service, everywhere east of Gibraltar, constituting in many places the majority of, and in some, the entire grain ration.

Characteristics of Barley.

The grain should be plump and short, quite hard, with a thin wrinkled skin and small fine but not shrunken ends; its colour should generally be a pale golden, and it should be free from any distinctive odour. Specimens grown in hot countries are generally somewhat smaller than those from temperate climates. Barley is sold by the quarter and should weigh about 54 lb. to the bushel.

Feeding Barley.

In the East this grain is a very general horse food and is sometimes given without crushing or other preparation, in which state, however, the toughness and indigestibility of its husk is such that it can only be consumed with impunity by animals native to the country, and not always even by them. For all others it should be prepared by crushing, parching or boiling, or it rapidly gives rise to indigestion and colic. When suitably prepared, however, it may be fed as a whole ration if necessary, and it forms a large proportion of the Service issues in the Mediterranean, India, China, Egypt and other Eastern stations. As new barley is injurious to horses and mules, and frequently produces fatal digestive troubles or laminitis, it should not be used until at least one month after threshing.

Crushing barley is a matter which requires some care, for the husk is so extremely tough that it will successfully resist the pressure of a roller which would squeeze an oat flat. When the hand mill (*chuckie*), which is commonly used in India, has to be employed for this purpose an extra weight should be placed on the top of the upper stone in order to increase its power.

Parching barley.—When properly carried out the result is that the husk is just split and the contents become softer and of a floury consistence. The method usually adopted is as follows:—a small quantity of sand is made, and kept, almost red hot on the fire, a little of this and a handful of barley are thrown together in a flat pan which is also kept hot and the two are stirred together until it is seen that each individual grain shows a white line down its centre where the husk is split; sand and grain are then transferred to a small sieve through which the sand runs and is placed in another receptacle to be re-heated. The grain may subsequently be ground if desired, but it will be found perfectly digestible without this being done.

Brewers' grains, "draff," the refuse of malt after brewing, which may be obtained either fresh or desiccated, is occasionally given to horses and much relished by them; as a change of diet, or as an occasional addition to tempt the appetite, they may be recommended, but as a general ration for army horses liable to be called upon to perform severe fast work they are unsuitable. They should be quite fresh, and given without delay, as they rapidly get sour.

Rye.

Rye forms a large portion of the ration of many animals in Denmark, Belgium and Sweden; in Russia rye flour is given horses as a corn ration, and is fed to horses in America in smaller proportion. It is inferior to oats, and in countries where it is fed as a general ration it is stated to be given coarsely ground or cooked and mixed with chaff. In large quantities it is said to cause diarrhœa, and it rapidly ferments and becomes unfit for food if allowed to stand long after cooking. This grain is extremely liable to suffer from the growth of the ergot fungus, which may be recognized as a small body about half an inch long and of a purplish black colour. As a horse food on service it should not, except under pressure of necessity, be fed alone as a whole ration, but mixed with any other forage available.

Rice.

In Burmah and the rice-growing districts of India, notably Bengal and Assam, horses are fed on unhusked rice (paddy), and though it is extremely indigestible for animals unaccustomed to its use, for those constantly fed upon it, it is a serviceable grain, and keeps them in good working condition; it is improved by being crushed, and may also be given boiled, but should not be fed without the husk, as the removal of this renders it unsuitable for horses owing to its want of woody fibre. The amount necessary for a full ration is rather greater than of oats.

Wheat.

Although in England wheat is looked upon as a most unsuitable food for horses, it is undoubted that at any rate part of this prejudice is due to want of experience in its use, owing to its value as a food for ourselves. It can be fed to animals without exciting those alarming symptoms generally supposed to be produced by it, and especially should this be borne in mind on service when it may be necessary to turn every possible eatable thing to account. It is stated to have been given whole up to 7½ lb. daily without ill effects; flour (*atta*) is constantly given in India as a nourishing food to animals which are undergoing severe exertion; and damaged flour as a supplementary horse food has been used with advantage on service on more than one occasion. It is essential that the grain should be quite dry, as it is otherwise extremely indigestible; it should if possible be crushed or parched and mixed with some other forage in order to ensure thorough mastication. It is only mentioned here as an emergency ration to be utilized when no other offers, or to supplement short supplies.

BRAN.

Bran is a by-product of wheat after the extraction of flour by milling. The feeding value of bran depends on the amount of flour it contains and on the presence of Vitamins " B " and " E." In countries where milling is scientifically carried out the flour content is reduced to a minimum and its value as a nourishing food is correspondingly reduced; in England, therefore, as an article of the horse's diet it is generally given in order to make the animal chew its food thoroughly, to add bulk, or to regulate the bowels, and in the form of bran mash it is a fairly constant item of the Saturday night ration.

After wheat has been milled the flour is sifted out and we are left with the wheat offals. These offals in turn are separated into various grades according to the size of the particles. Bran is the coarsest of these grades, being that portion which will not pass through a wire sieve composed of 16 meshes to the lineal inch, and termed " wire sieve No. 16."

The product derived from this operation is known as straight-run bran, which again can be separated into several grades—broad (or flaked) bran, medium bran, fine bran, and No. 2 bran. There is not much difference in the chemical composition or nutritive value between straight-run bran and broad bran, nor between the latter and the other grades of bran mentioned.

Broad bran is ordinarily obtained by sifting out the largest flakes from straight-run bran, being that portion which will not pass through a wire sieve composed of 10 meshes to the lineal inch and termed " wire sieve No. 10." From the broad bran practically all the dusty material has been removed.

Where bran is produced by hand it necessarily contains a much larger proportion of flour than is the case with the machine-made product, and hence its feeding quality is very much enhanced; indeed, to such an extent is this the case that in India it is often found possible to keep animals in sufficiently good condition, while they are doing exercise, with little or no addition to this food.

Characteristics of Bran.

Good bran should be quite dry, and sweet, flaky, free from lumps, and varying slightly in colour according to the wheat from which it is obtained, some samples being redder than others. When chewed it should not taste sour or gritty, and when the hand is plunged into it, it should be perceptibly covered with flour on withdrawal.

Occasionally adulteration with sand, barley or rice hulls may be detected, the first by throwing a sample into water when it will sink, and also by chewing a small quantity, and the two latter by close inspection of the individual flakes, when roughness of the barley or rice husks will be observed. When bran is hand-made on an earthy floor it is difficult to avoid some sandy particles.

Under the influence of damp, bran rapidly becomes sour and lumpy, and this is the most common defect to be looked for in English samples.

Feeding bran.—As previously stated, bran can only be regarded as a work-producing food if it contains a good proportion of flour, and this is not to be looked for at home. It is, however, valuable as an adjunct to the grain ration (1) in order to ensure mastication; (2) to increase bulk; (3) to mix with very heating foods, and so enable the digestion to cope with them without being upset. Given as a mash it is generally supposed to be a slight laxative and to produce the opposite effect when dry. A bran mash should be made by scalding about 2 to 3 lb. of bran in a bucket with boiling water, it should then be covered and allowed to stand until cool enough to eat; the addition of a little salt makes it palatable.

BEANS AND PEAS.

These grains are by far the most nutritious of any given to animals, containing as they do an exceedingly large proportion of flesh-forming elements; but owing to this fact they are very "heating" foods, which cannot be given in large quantities under any circumstances, and are not advisable at all unless the animals receiving them are performing a considerable amount of hard work or undergoing exposure.

Characteristics of Beans and Peas.

Beans should be hard and dry, sweet to taste, light brown in colour, and free from weevil; they should weigh about 64 lb. a bushel. Peas should also be dry, sound and free from weevil, not a dark colour, and the same weight. Varieties of peas are distinguished as blue, white or grey, according to their colour.

Varieties.—English beans are smaller, rounder, and plumper than imported sorts; their skins, however, are thinner, and their quality, when in good condition, the best. Imported beans, especially Egyptians, are larger, flatter, and more wrinkled, whilst their skins are tougher and thicker. "Java" beans, imported from Ceylon, Burmah, and the Dutch Indies, are quite unfit for consumption, owing to their poisonous qualities.

Defects in Beans and Peas.

New beans are indigestible, and they should not be used until they are a year old; with increasing age, however, they depreciate in condition, are extremely liable to become invaded by weevils, and (English beans especially) darker in colour. Peas are likely to suffer from wet either during the harvest or when stacked, when their colour becomes black.

Feeding beans.—As previously remarked, beans and peas are altogether too nutritious to be fed in very large quantities, and the amount which it is advisable to give in addition to other forage is probably not more than 4 or 5 lb. at the outside, and this only to big horses that are doing severe work. They should always be split on account of the extreme toughness of their husks, but fine grinding is not to be advocated, as it leads to waste.

LINSEED

Is often used as an addition to the ration of thin horses, its characteristic being that it contains an exceedingly large proportion of fat-forming material. Linseed cakes, which are so commonly given to cattle, and sometimes horses, and are well known for their fattening properties, are composed of the residue of linseed from which the oil (linseed oil) has already been expressed.

Quality.—The best linseed may not always be the largest in appearance; the grains should be plump and well filled rather than large and flat. All samples should be bright in appearance and free from dirt. English-grown linseed is usually of the best quality, but large quantities of excellent value are imported from Holland, Russia, and Morocco.

Feeding linseed.—Owing to the extreme toughness of the husk animals cannot consume linseed in its natural state, and it must be either ground or boiled ; even when so prepared the indigestibility of the husk is such that it passes through the body unchanged. When boiled, linseed should be cooked quite slowly and repeatedly stirred to prevent it sticking to the side of the vessel and burning ; if time is not an object, a long continued period of soaking (24 hours) will answer the same purpose. Crushed linseed takes less time to cook or soak. When thoroughly cooked or soaked the result is a jelly-like material of the consistence of starch, and in this condition it is readily eaten and is an excellent addition to any ration for the purpose of fattening the animal. Half a pound to one pound daily is usually a sufficient quantity for this purpose, and the water in which the grain has been cooked (linseed tea) should be added to the ration, as it is very nutritious.

Linseed cake, which is compressed refuse linseed after the oil has been extracted, may be given as part of a mixed ration and should be broken up into small pieces before being placed in the manger ; linseed oil added to the food is, however, although frequently given, not so suitable or nourishing a method as giving the actual grain or cake, because the digestion does not so readily absorb it in this form.

Decorticated cotton cake may also be given in a similar manner. The undecorticated variety is likely to produce digestive trouble.

GRAM.

Gram (Chenna), a variety of pea, is the chief grain used in Western and Northern India ; as a general ration it contains much too large a proportion of flesh-formers to be suitable for an unlimited ration, and 10 lb. is generally said to be the most which can be given daily with advantage. In appearance it is a reddish or yellowish brown, rather shrivelled pea, roughly pyramidal in shape ; the outer skin is very hard, and when split the kernel is a bright yellow colour, tasting very much like ordinary peas. Inferior qualities are small, much shrivelled, greenish or almost black in colour, and sometimes bitter to the taste. As the grain is harvested in the open field small quantities of sand and stones may be found in a sample and it requires carefully cleaning before being fit for use ; it is frequently adulterated by the addition of a proportion of cheaper grain, and this practice is so prevalent that it is customary to distinguish two qualities, viz., first and second sort, the latter of which is acknowledged to contain

5 per cent. inferior grains. As the grain increases in age it tends to become darker and is very liable to the attacks of weevils ; it should be kept for at least four months after being harvested before it is really fit for issue. The presence of Lathyrus seeds in gram should always be looked for (*see* Lathyrus, p. 108).

Feeding gram.—Although it may occasionally be necessary to give gram whole and dry, it is so hard a grain to masticate that this should be avoided if possible ; the general method of feeding is to crush it sufficiently to split the husk and give it mixed with a proportion of bran, either dry or just sufficiently damp to facilitate chewing and prevent the bran being scattered. Natives, however, constantly soak it for a considerable period and then give it without the addition of other food, and although this plan is not followed in the Service it appears to answer as regards practical utility. In soaking this or any other grain in a hot climate it must be remembered that fermentation is very easily set up, and grain left in this condition for too long a time becomes quite sour. Six hours is generally sufficient.

KULTHI

Was until recently the staple grain food in the south of India ; it is a small, hard, brown bean, much mixed with stones and requiring careful cleaning before use. As a general grain food it is even more " heating " in its properties than beans or gram and not more than 10 lb. should be given daily. The only method of preparation is to boil it slowly in a small quantity of water until floury, when it tastes and smells something like haricot beans ; in this condition it is mixed with bran and chaff, and the water in which it was cooked should be given to the animals to drink as it is most nutritious.

Parching and crushing have proved unsatisfactory methods for the preparation of kulthi, although both have been given a trial.

MOTH, MŨNG, AND ŨRAD

Are all small peas widely distributed in India, but principally used in the north, and are considered to be excellent as condition raisers, for which purpose they are generally given boiled in quantities of from 1 to 4 lb. ; there is no reason why they should not be made use of as a general grain ration should necessity arise, either whole or crushed.

Millets.

All varieties of millet are made use of in various portions of the globe for feeding horses and are met with in India as "Bajri" and "Jawari"; in South Africa as "Kaffir Corn," in China as "Kaoliang," and in Egypt and the Sudan as "Doura"; they may usually be fed without preparation, but can be crushed with advantage, and the same quantities as of oats may be considered a sufficient ration; one form, "Jawari," constitutes almost the sole grain food of the Balooch horses in the Western Punjab, and they are capable of undergoing the severest exertion upon it.

Lathyrus Sativus

Is a small, somewhat three-cornered mottled grey pea, which is imported into this country under the generic term, "Indian peas." It grows abundantly in many districts of India and is commonly found in inferior samples of gram; it is often mistaken for a seed of a weed called "Akta" (Vicia Sativa) which, when partaken of freely, induces a form of paralysis which, in the horse, is accompanied by symptoms of severe roaring.

Vicia Sativa.

The seeds are brown in colour, round and very much smaller than the lathyrus pea. They can easily be removed from the grain by sifting with a sieve of appropriate mesh.

Ratti Seeds.

These seeds are oval in shape, about the size of a small pea, scarlet in colour with a black spot at one end. They are poisonous to horses, causing loss of appetite, shivering, and paralysis, and in severe cases death ensues. These seeds are common in India, and have been known to have been mixed with ghoor and maliciously administered to horses.

Various other Foods.

Potatoes are utilized for horses in Ireland and parts of England. They should be cooked before use, as they are indigestible raw. Turnips and other roots are sometimes fed as a mash, after boiling and mixing with the rest of the feed.

Meat was utilized successfully during the siege of Metz by being cut into small pieces and rolled in bran, and Norwegian stock of all kinds is accustomed to consume a soup made from boiled fish when mixed with other food.

Sugar has long been known as a palatable article of food for horses, but has not been much used in England till recently, when, under the name of "Molassine," a combination of sugar refuse and peat moss, has appeared on the market.

Raw sugar cannot be given in large quantities without disturbing the digestion, but as sugar cane, treacle, or crystal sugar it can be added to the food in sufficient amount.

Sugar as a food is said to be both sustaining and fattening, and especially useful during exposure to cold and hardship; as an addition to otherwise insufficient rations, it may be of use under these conditions.

Locust beans or caroub beans are like an enlarged broad bean pod in shape but are dark chocolate in colour. They contain a high percentage of sugar and can be given crushed to animals at the rate of 2 lb. per diem.

Dates fed in small quantities are relished, and are very nutritious.

Gruel and Similar Preparations.

Gruel is made either by pouring boiling water on oatmeal and letting it cool, or by simply stirring up a couple of handfuls of oatmeal in a bucket of cold or chilled water. In either case it should not contain sufficient oatmeal to make it at all thick, and both are readily swallowed and enjoyed. In England oatmeal gruel is very constantly given to horses after long, tiring work as a refresher on the way home, and is an excellent method of sustaining them. Similar preparations may be made from other grains (*e.g.*, maize meal or bean meal), and are all useful on occasions. Linseed tea, that is, the water in which linseed has been cooked, is very nourishing and liked by horses.

"Suttoo" is a gruel made by stirring finely ground gram in water, and is frequently given in India as part of the daily ration.

Rice water (Kunji), made by boiling the grain to a pulp and stirring in water, is especially useful as drink for horses which suffer from diarrhœa after exertion.

Compressed Rations.

Various compressed food cakes have been tried and are constantly improving in manufacture; as rations on service they are, owing to portability, worthy of every trial. They consist of mixtures of oats, beans, maize, bran, and sometimes chaff, in various proportions, and provided the original ingredients are of good quality, they are excellent feeding. They should be broken up well, thoroughly damped before issue, and to prevent waste this should be done in a place sheltered from wind, or a large amount of good food will get blown away.

The weight of a compressed daily ration is usually 2 to 4 lb. less than a fresh ration of similar ingredients, the absence of water in the dry preparation accounting for the balance.

Hay.

Hay consists of dried grass and other plants which have been allowed to mature in a stack. Those plants which are not true grasses are spoken of as "herbage." It was formerly the custom to speak of hay as "upland," "lowland," and "water meadow," and before the introduction of modern methods of drainage and farming it was possible to say from an inspection of the sample to which of these three classes it belonged; at the present time, however, when adequate drainage has made such great improvement in many lowlands the terms will hardly apply, except as regards water meadow hay, which may be recognized by the presence of water grasses, sedges and rushes and by its generally coarser growth. Hay is now produced either on land which is, and has been for a very long time, laid down for this particular purpose, when it is spoken of as "meadow" or "soft" hay; or from seed sown as a rotation crop which according to the number of years it may be left undisturbed is spoken of as a one, two or three years' "ley." This variety is variously termed "seed," "mixture," "artificial" or "hard" hay.

Meadow hay grown on permanent grass land can be distinguished by the large variety of grasses, the fineness of the growth and generally by the superior aroma.

Seed hay is characterized by the small variety of the contained grasses, the great vigour of their growth, its general hardness as compared with meadow hay, and very often by the large proportion of clover and other herbage it contains.

Haymaking.—Hay is cut by the farmer at two distinct periods of its growth with different ends in view; first, if he desires to afford his land some help from the seed, he cuts it late, so that, in the making, a good proportion of the already well formed seed will fall out and be restored; second, if he wishes to produce the finest possible quality of hay or has the intention of getting a second crop, he cuts earlier when the majority of the grasses are in full bloom or just after the flower has disappeared. From the purchaser's point of view the latter of course is by far preferable, and in judging samples close attention should be given to the period at which the crop appears to have been cut. As soon as seed has formed the stems of the plants get woody and are less nutritious when made into hay than they would have been during late flowering.

The processes of drying, carrying and stacking are all included under the term "saving." Well-saved hay has been dried rapidly without being wetted by rain, and is therefore of a much better colour and less touzled than any which has been weathered, *i.e.*, rained upon, left lying upon the ground, and subsequently much tossed to dry it. Rain is particularly injurious to hay because it dissolves out of the cut stalks a proportion of those nutritious properties which give it such a high feeding value. The comparative greenness of well-saved hay, even when it is old, cannot fail to distinguish it from other samples which have been stacked under less fortunate conditions. Meadow hay, being generally a lighter crop and more easily dried than "mixtures" containing a large proportion of heavy succulent clovers and other herbage, is generally easier to save.

After cutting, the grass is turned or tossed to ensure drying, then raked into "windrows" and afterwards "cocked" or "coiled" previous to stacking.

In Ireland, Scotland, and the north, the haycocks are made gradually larger as the hay dries till they assume a considerable size, and in Ireland they are often left in the fields in that condition. In the Midlands and south, the hay is carried as soon as possible—the difference in method being due to climatic conditions.

Loss in weight and chemical change.—After grass is cut for hay it loses about three-quarters of its weight by evaporation, but no chemical change takes place in the field.

In the rick, however, very considerable chemical changes take place, such as the creation of sugar by the action of heat on the starch contained in the grasses.

The difference between good and bad hay is more often than not brought about by too little or too great heat being evolved in the stack.

Overheating, even when it does not blacken or char the hay, produces so much acetic acid as to make the fodder sour and unpalatable.

Experiments have shown that 387 lb. of grass are required to make 100 lb. of hay—the loss is chiefly water, but not entirely so. Some loss is due to fermentation in the stack—the sugar is converted into alcohol and carbonic acid.

The Chief Grasses and Plants of English Hay. (*See* Plates.)

Useful grasses.—The Meadow grasses (*poas*). These are widely distributed grasses of which four varieties, the "Smooth-stalked meadow grass," the "Rough-stalked meadow grass," the "Evergreen meadow grass," and "Annual meadow grass" are commonly found in meadow hay. They do not grow to any great size, but they produce a good bottom, and both the rough and smooth-stalked varieties especially have highly nutritive properties, all animals exhibiting a marked partiality for them. The flowering head of grasses of this class is somewhat difficult to distinguish from the fescues, and the distinction can only be made by practice, but as both are excellent it is not very important. The famous "blue grass" of Kentucky is the smooth-stalked meadow grass.

The "Fescues," another large class, have several varieties which are frequently met with, the "Meadow" and the "Tall" being constantly, and "Hard" and the "Sheep's fescue" occasionally seen. These latter are chiefly found on good upland pastures used for sheep grazing and though fine and small are very nutritious. The Hard Fescue is one of the best pasture grasses, eaten with relish by all stock, and though not very large is of superior quality and value. It takes its name from the crisp feel of the spikelets when the flowering head is ripe.

The "Meadow Fescue" is of moderate size but most nutritious and productive, is readily eaten by all stock, and may be regarded as one of the most valuable grasses the country produces.

The "Tall Fescue," a much larger grass, is not so highly esteemed, but is nevertheless a distinctly good variety. Other varieties are the "Fine," "Various leaved" and "Red fescues."

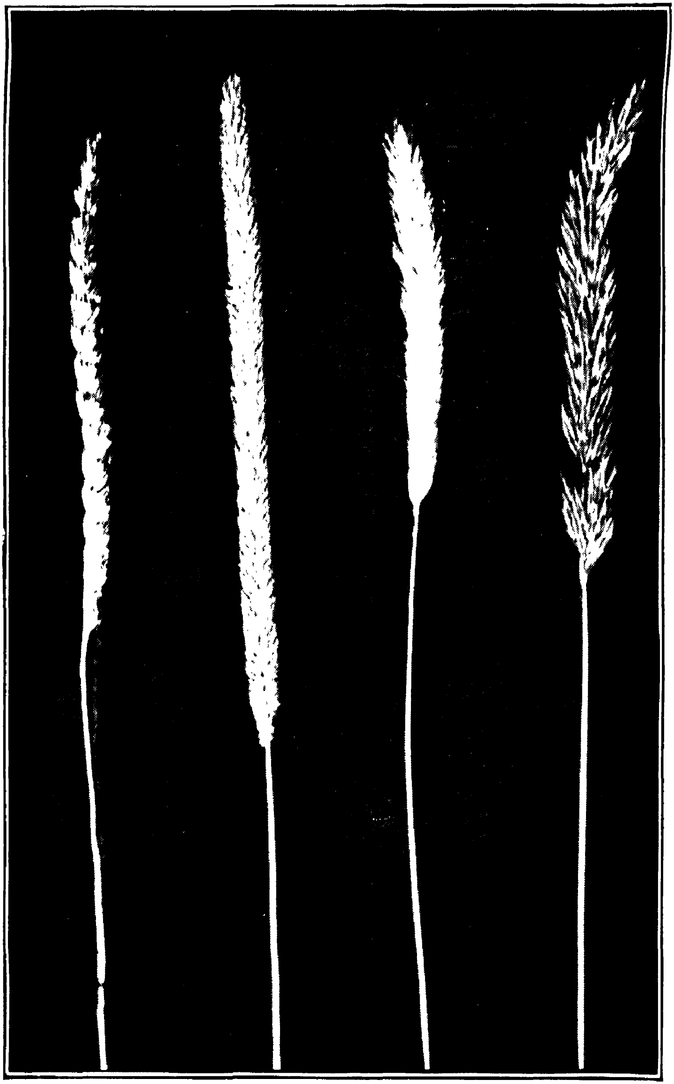
"Meadow Fox tail," so called from its distinct resemblance to a "brush," produces a large quantity of herbage in proportion to its stalk, which makes it an excellent hay and pasture grass, and is also very hardy, growing well under trees; it is easily distinguished by its very characteristic flowering head.

"Meadow Cat's tail" or "Timothy" grass, named after its importer, Mr. Timothy Hanson. In its native country (America) crops of this grass may attain a height of 6 ft., but here it is not nearly so tall; it is extremely hardy, flourishing best on a damp, cool soil, but apt to get woody if cut late; an excellent hay grass. Its flowering head may be distinguished from the Fox tail by its comparative hardness and bristle-like feel and by the absence of the short fine hairs which cover the latter.

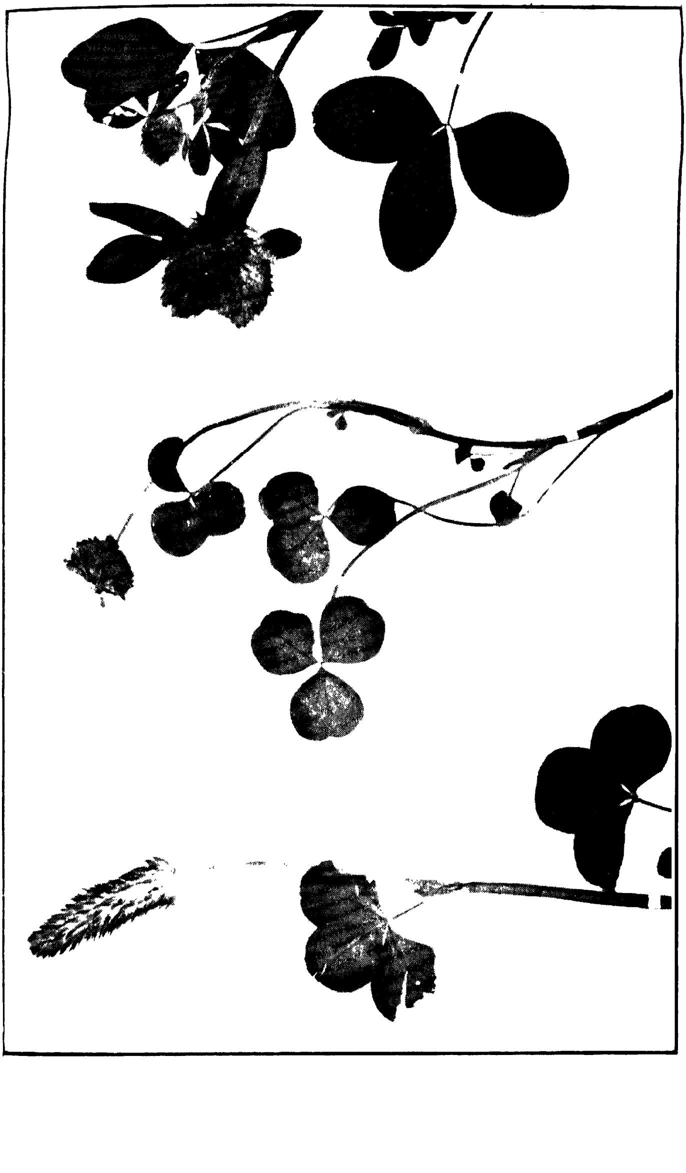
"Crested Dog's tail" is a pasture rather than a hay grass, its herbage not being very bulky, but it is nevertheless very nutritious and a notable feature of many of our sheep downs,

[*To face p.* 112.

Rye. Cocksfoot. Meadow Fescue. Hard Fescue.



Timothy Meadow Fox Tail Sweet Vernal.



To face p. 113.]

Kidney Vetch. Lucerne. Sainfoin.

where, with the Hard and Sheep's fescues it is responsible for a great deal of the grazing. The serrated appearance of its flowering head cannot fail to distinguish it from other varieties.

"Rye Grasses."—Of the many known varieties of Rye grasses two are chiefly found in hay, the Perennial and Italian. Rye grasses may be distinguished by the flattened appearance of the flowering head, the spikelets of which stick out alternately from each side of the stalk, the whole grass looking as if it had been pressed flat; they may be cut comparatively later than others owing to the fact that they do not deteriorate so rapidly after flowering. Perennial Rye grass is smaller than the Italian variety, from which it may also be distinguished by the long hairy awns of the latter. Italian Rye grass is a biennial plant, much larger than the perennial variety, producing enormous yields, particularly on sewage farms, where it is grown for use as a green crop; both are excellent feeding grasses.

"Yellow Oat grass," so named from the golden appearance of its flowering head, is a valuable hay grass which flourishes particularly in the South of England and the Thames Valley.

"The Tall Oat grass," a much larger variety than the last mentioned, has rather a bitter flavour, and is in consequence not so well regarded in this country; but on the Continent and especially in Sweden, where it is abundantly cultivated, it is very highly esteemed. The oat grasses may be recognized by their general resemblance in appearance to oats, though much smaller.

"Cock's Foot," known in America as Orchard Grass, from the fact that it flourishes beneath trees, is a rough, tall grass with a very distinctive flowering head; it grows in large tufts, and is liable to become extremely coarse if not cut sufficiently soon; it is, however, an excellent grass, and liked by horses.

"Fiorin," one of a family commonly known as Bents, is constantly found in hay, but does not appear to be of very great feeding value; the colour of the flowering heads varies from white to purple and they are characterized by their hairlike fineness.

"Sweet Vernal" is a grass of excellent quality though only of medium size and not producing a great quantity of herbage; it has, however, such an extremely pleasant aroma and is so much relished by all animals that it is a universal favourite; it grows very abundantly in Devonshire and also in the eastern counties. It is to this grass that the aroma of hay is chiefly due.

Useless Grasses.

The " Barren Fescue " is a weed grass easily distinguished from other Fescues by the very long awns of the spikelets ; it is found in poor and sandy soil.

" Couch grass " or " Twitch " may on casual inspection be mistaken for Rye grass, but if looked at carefully it will be seen that the spikelets grow from all sides of the stem and not from opposite sides only, nor has it the crushed flat appearance so characteristic of rye grass ; it is chiefly found on arable land and not as a rule in meadow hay, since it disappears from old pastures. " Bearded wheat grass " closely resembles couch grass in appearance.

" Darnel " is another grass which may be mistaken for rye grass, from which, however, it is easily distinguished by the fact that the outside sheath of each spikelet is longer than the spikelet itself ; it is not only useless, but in large quantities poisonous. The small quantity found in hay has never been found to cause any symptom.

" The Slender Fox Tail," or " hunger weed," is also a weed on arable land which may be found in artificial but rarely in meadow hay ; it generally resembles the meadow fox tail, except that its flowering head is much more slender and is darkly spotted, from which cause it is called " black twitch " in the Midlands. Another worthless variety is the " Floating Fox Tail."

" Soft Brome " is a worthless grass in hay, because it seeds so very early that when the crop is cut its herbage is all shrivelléd and the stem woody ; in appearance it is not liable to be mistaken for any other grass, and the spikelets have a peculiar elastic soft feel which further distinguishes them. " Upright Brome " is equally valueless.

The " Barren Brome " has long awns to the spikelet and is quite useless.

" Tufted Hair grass " or " Tussock grass," found in low-lying meadows, has a tall, handsome, waving head, the spikelets of which are a lustrous brown colour. " Wavy hair grass " is a smaller but similar variety found in woods and on sandy soil ; both are equally worthless in hay.

" Quaking grass," also found on heaths and sandy soils, is valueless, and its constantly shivering spikelets, which are also a quite distinctive shape, make it unmistakable.

" Yorkshire Fog " or " Meadow soft grass," and a creeping variety called " Creeping soft grass," have flowering heads which are practically alike and equally worthless. Until the flower is quite full the head is enclosed in a sheath ; in colour it varies from white to purple and has a soft, woolly feel and bitter taste which causes it to be avoided by stock.

"Meadow barley" and "Wall barley" are both worthless grasses with long, hard awns bearing a close resemblance to small ears of barley which makes their recognition easy.

The "Reed Sweet grass," "Floating Sweet grass" and "Reed canary" or "Ribbon grass," together with Sedges and Rushes, are only found in the neighbourhood of low-lying and water meadows; the two first-mentioned grasses are useful for the feeding of stock, but the locality in which they grow prevents them being classed as good hay grasses.

Clovers.

"Red Clover."—There are three kinds of red clover, "Broad red clover," a biennial plant with a hollow stem and a broadly pointed leaf; and two perennial varieties closely resembling each other, which are commonly called "Cow grass," have solid stems and lance-shaped leaves. They are all large, juicy plants which may be fed green or as hay; as a hay crop they are difficult to save, but are excellent feeding.

"Alsike," originally imported from Sweden and sometimes called Swedish clover, is often grown instead of the red varieties, as it is not so susceptible to clover sickness, a disease caused by minute worms in the stem; this variety, however, only grows well on moist lands, which precludes its general adoption in many districts.

"White" or "Dutch" clover, originally imported from Holland, is a smaller plant than the above varieties, and more suitable therefore as pasture than for hay, but is of excellent quality, and since it is found on all good land is constantly met with in good hay.

"Valerian," "Italian" or "Crimson clover," commonly called "Trifolium," is an annual plant, grows tall and heavy, has a long brilliant crimson flower, and as it comes to maturity very early is not often made into hay by itself, although in combination with early grasses it is found in some mixtures. Owing to the heaviness of the crop it is difficult to save well except in very good weather, and becomes coarse and woody unless cut young: it makes excellent green food.

Three other small clovers may be found, viz.:—

"Birdsfoot trefoil," a small perennial variety with a yellow flower (red in the bud).

"Yellow suckling clover," which is often sown with Rye grass, and "Nonsuch" clover or Hop trefoil, which may be easily mistaken for the other, but are distinguished by the black seed pods of the latter.

All clovers are excellent feeding, and their presence in hay is valuable if they are well saved.

The red clovers are much grown in conjunction with Rye grass and make the best class of hard hay provided it is first cut. A second cut of Rye grass and clover may be recognized by the generally small size of the growth of both grass and clover heads, by the predominance of the clover (in first cut, rye is more abundant) and by its soft feel and tangled appearance.

Other Plants used as Green Food or in Hay.

"Lucerne," a tall green plant with a small purple flower, naturally a native of warm climates, but thriving in many localities in England. On suitable soils and under irrigation it is practically perennial, grows most luxuriously, and is especially useful as a green food owing to the many cuttings which can be made from it. In America, where its culture has received much attention, it bears the highest reputation both when used in this manner and when made into hay, and though as hay it is found to be extremely brittle and dusty, and in this country is considered wasteful, its feeding properties can hardly be overestimated. As it roots very deeply on suitable soils it is most useful for dry localities, and is cultivated with much care by horse-owners in India, where its value as a green food is highly esteemed. In America it is known as "Alfalfa," its Spanish name (of Arabic origin).

"Sainfoin," a large, fine-leafed plant with pinkish flowers; yields an excellent hay, which, in spite of the apparent coarseness of its stalks, is much relished by animals and is very nutritious. There are two varieties "common" and "giant" or "double cut," the latter of which is more productive, and yields twice a year, but is only biennial. In judging sainfoin hay the extreme thickness of the stalks, provided they are not tough, is not considered a drawback, and as it is easier to save than other heavy crops it is generally in good condition. The best sainfoin hay is cut before the plant comes into flower.

"The Kidney vetch," found only in Hampshire, may be met with in the hay of that county. It has been said that horses dislike it, but whether this is so is by no means certain, as many of them certainly consume it with apparent relish. (*See also* Vetches, p. 123.)

Weeds.

The following are a few of the weeds which may be found in hay, and are those commonly met with:—

"Coltsfoot," specially prevalent on poor land, has a large, more or less rounded leaf, green on the upper and white on the under-surface ; the leaves only are found in hay, as its yellow flowers precede them.

" Goose grass " or " silver weed " is a feathery leafed plant, which also has a whitish under-surface.

" Docks," tall plants with large red and green leaves and brownish-red stem and flower ; they are especially common in clover.

" Sorrel," in appearance like a miniature dock ; has a sharply acid flavour when green, which it imparts to the hay and is not liked by horses.

" Knap weed," " blackhead," or " hardhead," common on all soils, is easily recognizable by the hard, scaly, indigestible heads and tough branching stems.

" Plantain," " ribbed grass," or " lamb tongue," is very common, as it is not regarded by all as obnoxious, seeing that it is eaten by sheep ; its presence in hay, however, is objectionable, as horses do not like it.

" Thistles " are not liked by horses owing to their prickles ; their presence in quantities shows that the land has not been well done, and a general want of quality may be looked for, therefore, in a sample containing many.

" Dandelion," although found on all soils, should not be in excess, for the same reason.

" Cat's ear," which closely resembles a very small dandelion, but with a solid branched stem, is very objectionable owing to its bitterness.

" Yellow rattle " grows most freely on poor, low-lying land, and its presence indicates a poor quality of crop. It takes its name from the sound it gives on shaking a ripe seed head.

" Buttercups " and " Marguerites," or " Ox-eye daises " are both weeds as far as hay is concerned ; the latter flourishes best in low, damp soils, and has a bitter taste, disliked by horses.

" Nettles," " wild parsnip," or other similar plants are found at the edges of fields, and may find their way into a stack ; but their presence should be exceptional. Weeds cannot altogether be eliminated from hay, but in a good sample there is a very small proportion only.

Characteristics of Good Hay.

Good hay should be of a good colour, *i.e.*, greenish or brownish but not yellow, crisp to the feel, sweet to taste, and of pleasant aroma, especially meadow hay ; the grasses should be between flower and seed, and well-grown specimens of their sorts ; and while the feel imparted should not be too soft, it should not, on the other hand, give the impression of being woody. The colour of flowering heads should be to some extent retained in well-saved samples up to one year old, and the herbage plants found in it should be recognizable by their form and not too brittle and dusty. On opening a truss, the fibres of the stalks should not be much tangled, but should lie more or less in parallel bundles, showing that it has not been necessary to unduly toss the crop while being made, though this characteristic is not so much marked in hay that has been machine-tossed as in that turned by hand. There should be no suspicion of must or mould, and not more than the merest trace of being mowburnt.

In meadow hay there should be a large variety of well-grown, good grasses, and but few useless grasses and weeds, though a proportion exists in all samples. In mixtures the grass and herbage should be luxuriant of their kind, and quite free from useless varieties, whilst hay which has been grown on swampy meadows may be recognized by the proportion of water grasses and plants, their coarse growth and sometimes pungent smell.

The general quality and character of the sample is naturally affected by the soil on which it was produced, that from a poor soil being lighter in bulk and shorter and smaller in the individual grasses than the same class from a richer neighbourhood. If grown on well-cleaned land there will be a comparative absence of all kinds of weed, while a crop that is taken from park land or orchards will contain quantities of tree leaves and be comparatively poorer in quality in proportion to the number of trees under which it has been grown. The season also has a marked effect both on quantity and quality, a hot, dry spring and summer resulting in a very light but well-saved and fragrant crop; and whilst rain during the spring will naturally increase the bulk, its continuance through the summer foretells a heavy but indifferently saved yield. The period at which the crop was cut is denoted by the presence or absence of flower and seed in the grass heads and by the woodiness of their stems.

Aftermath.—When there appears to be a chance of a second crop, the first cut is made at as early a date as possible, and the subsequent growth, which consists chiefly of leaves with few stems and flowering heads, is called "aftermath," or "second cut"; it is soft and woolly to the feel, without aroma, and of inferior feeding value.

Substance.—The feel when handled should be crisp and firm, but not too woody, though this will naturally vary with the particular variety under consideration, meadow hay being finer and softer than a mixture of rye grass and clover, while this again may seem fine when compared with a sample of sainfoin. On the other hand, it should on no account be without some substance and firmness, lack of which is characteristic of second cuts.

Dust.—Old samples may be somewhat dusty, dust in hay being an invariable accompaniment of age; it is increased by the crop having been cut too late and so being extra dry, by unduly long exposure to the sun, or by the herbage having been rendered brittle as the result of being weathered during making; and whilst good old hay is invariably slightly dusty, it may be taken that very dusty samples have originally suffered from one of the above causes.

Colour.—The colour of hay may vary from greenish to light brown, but it should not be yellow or dark brown, nor should the stems of the grasses be spotted by blight. Meadow hay is generally of a greener tint than artificial mixtures, since it is usually a lighter crop composed of finer, quicker drying plants, and therefore easier to save. Colour lasts longest in flowering heads and grass stems, and fades quickest in broad succulent leaves of various kinds of herbage and some weeds; it disappears slowly with age, but should be fairly preserved at one year; rain washes it out very rapidly, and a heavy shower may convert a crop from green to pale brown.

Mowburnt hay.—If carried before the juicy stems of the grasses are sufficiently dried up, the subsequent fermentation ("heating") in the stack produces such great heat, especially towards the centre, that the hay may be charred, or the rick may even catch fire. When the condition is, however, very slightly marked, it merely imparts a brown tinge to the sample, which also acquires a sweet and somewhat pungent smell, both conditions being in proportion to the extent of the heating. In very slight degree it is no drawback to the quality and is, as a matter of fact, much relished by horses; indeed, what we should call slightly mowburnt hay is in some parts of Europe made purposely under the name of "brown hay"; but if the condition is at all pronounced it becomes unfit for consumption, is often refused by the animal, or if partaken of may induce a simple form of diabetes.

Musty and mouldy hay.—Although it may have been quite dry as regards the juice contained in the grasses, hay which is stacked damp from rain or subsequently wetted, is likely to turn musty, and if the dampness is pronounced, to become mouldy; musty hay is sometimes a dark brown colour and sometimes a bright yellow, has a characteristic unpleasant odour and a bitter taste, in spite of which, if it is not very badly affected, horses may eat it, though as a food it is naturally inferior in proportion as the condition is marked. When mould is visible it appears as light or white patches here and there in the truss, and the surrounding portions are generally deep brown or black in colour ; it is naturally unfit for fodder. Both mustiness and mouldiness may be found in isolated trusses of an otherwise good sample if they happen to have been exposed to damp after they were cut out of the stack.

Taste.—The taste of good hay is not very marked, being faintly sweet and rather mawkish ; the sweetness is more pronounced in mowburnt samples, and when musty or mouldy it becomes bitter.

"*Nose.*"—The aroma of good hay is due to the aromatic grasses contained in it, Sweet Vernal being the variety which is mainly responsible. This pleasant characteristic is generally spoken of as the "nose" of the hay, and when in perfection has the well-known smell of a newly mown field ; it becomes fainter with age, but persists as long as the hay is good. Rain destroys it very rapidly, and in such case absence rather than presence of smell is to be desired, any marked odour being due to the result of damp. Mowburnt hay, as previously noted, acquires when only slightly marked a decidedly sweet and pleasant nose.

Distinction between new and old hay.—In the trade, hay is termed "old" after Michaelmas Day (29th September), and this practice is followed in contracts ; but, generally speaking, when reference is made to "good old hay," it is understood to be between 6 and 18 months old, before which period it is not at its best as a rule, and after which it deteriorates. In the autumn it is sometimes difficult to decide whether a particular sample is to be classed as new or old. In an early season, when the cut is light and well saved, it will mature quickly, and trusses cut from a heavy stack where they have been subjected to enormous pressure and some heat may have a deceptive appearance of age. The following are the points to be considered in deciding. New hay is softer, wants crispness, carries more colour, tastes sweeter, and has a stronger nose than old. The fibres are not so dry or brittle, contain more moisture, and it consequently cuts out bulkier and heavier in the truss. Thick stems of plants, and the nodes on the stalks of grasses, hold moisture longest, and this may be tested by cutting and biting them. Old hay is crisper to feel, more brittle, has less decided taste and smell, with the colour of the grasses and flower heads more faded and the herbage and weeds blackened. It is more closely packed owing to longer pressure in the stack, and cuts out smaller and more solidly in the truss. When the sample has been slightly mowburnt, the difficulty is increased, and allowance should also be made for the fact that the finer kinds of hay are more compressible and cut out more solid than the rougher, herbaceous sorts.

Clover hay.—When grown alone as a hay, clover is, owing to its weight and succulence, a difficult crop to save well except under the most favourable conditions, and even then it may waste in the stack to a fifth of its original weight. It is excellent and palatable feeding, though, owing to its brittleness and consequent dustiness, it is liable to be somewhat wasteful, and is also very prone to be affected by mould.

Oat hay is extensively grown in Australia and South Africa, being known in the latter country as "forage." For its production the crop is cut half ripe, whilst the grain is still in milk; and either long or chaffed, it makes most excellent fodder, being especially a good board ship ration wherever it can be procured.

Lucerne hay is rarely made in England, but in Western and Southern America, where it is called "alfalfa"; it is extensively produced and is very highly regarded both as a horse and general stock food. In this country it is said to be wasteful owing to its extreme brittleness and dustiness.

Sainfoin hay is excellent when cut at a suitable age and well saved. To the uninitiated its coarse woody appearance is deceptive, but although bulky and somewhat rough looking it makes a very nutritious food, eminently suitable for the larger, heavier classes of horses.

Timothy hay.—A considerable quantity of hay composed entirely of this grass is imported from Canada and America, where it grows in great luxuriance; the quality of the imported specimens varies considerably, but the best are excellent feed, though very dusty, and it is generally advisable to damp it before issue.

Algerian hay is occasionally imported during bad seasons, is of a fair quality, and like all hay produced in warm, dry climates, is particularly well saved, the colours of the flowers being especially pronounced. It contains a variety of grasses not seen in this country, and frequently a large number of hard thorny seeds, which are rejected by horses.

Compressed hay.—Ordinary trussed or baled hay is bulky, suffers much in handling and will not, so packed, keep for lengthy periods. These circumstances have rendered compressed hay necessary where it is requisite to keep hay for some years for reserve purposes.

To economize in space and facilitate distribution it is compressed into small bales averaging 80 lb. in weight. The pressing is done by machinery established at the Supply Reserve Depot.

The bales are rectangular in shape, and measure 26 in. × 15 in. × 13 in., approximately 28 bales go to a ton, occupying a space of 82 cubic ft.

In this pack the hay suffers little damage from handling, and owing to its portability is particularly suited to service conditions.

As the process of compressing adds materially to the ultimate cost, nothing but first-class hay should be accepted for the purpose.

Really well-saved first-quality rye grass, rye grass and clover mixture, or Timothy of the first and second year's ley, have proved the most successful description for this purpose, though coarser types of seed or hard hay may be provided failing the availability of the first-named. Hay which is new or which contains considerable moisture cannot be pressed without risk of heating, and in the normal way stocks for pressing are not purchased until after the 1st January following the season of its growth.

Hay, even when stored in the most careful manner, suffers uninterrupted nutritive loss from slow chemical changes going on in it and from the breaking off of its leaves. Further, there is the additional loss due to continuous shrinkage.

Good old hay is understood to be between six to eighteen months old, before which period it is not at its best as a rule, and after which it usually deteriorates.

The additional cost of this type of forage precludes the possibility of frequent turnover, but unless the circumstances are exceptional stocks should not be retained beyond three years.

Weights of Hay in Trusses, Stacks and Bales.

The trade weight of a truss is 56 lb. "old hay," and 60 lb. "new hay."

The contents of a stack of hay in cubic yards, divided by 11 (or by 16 in the case of straw), give the approximate weight of the stack in tons. From the above the following formulæ are deduced for rectangular stacks :—

Hay—

$$\frac{\text{Height} \times \text{breadth} \times \text{length}}{11} = \text{tons of hay.}$$

Straw—

$$\frac{\text{Height} \times \text{breadth} \times \text{length}}{16} = \text{tons of straw.}$$

In both cases all dimensions are in yards, the "height" being the distance from the ground to the eaves, plus half the distance from eaves to ridge.

If the stack be circular, then –

$$\frac{3\frac{1}{7} \times \text{radius}^2 \times \text{height}}{11} = \text{tons of hay.}$$

$$\frac{3\frac{1}{7} \times \text{radius}^2 \times \text{height}}{16} = \text{tons of straw.}$$

The radius and height are both expressed in yards, the height being the distance from ground to eaves, plus half the distance from eaves to apex.

Deduct about 10 per cent. for a new, or loosely packed stack, and the result will give roughly the weight of hay or straw available for food. The tops, bottoms, and sides of a haystack are usually unfit for use, especially if the stack is badly weathered.

Bales of hay usually weigh about 1 cwt., but owing to the variations in methods of baling they may vary in weight considerably.

Green Food.

Besides the many plants already mentioned which may be used as green food, the following are either grown for the purpose, or may be used should occasion require.

"Vetches" or "tares" are sown from winter to spring with the object of producing a green food during spring and summer, either alone or with oats or rye, and form the "green meat" which is sold in bundles throughout England. They are plants of the pea tribe, with blue, yellow or purple flowers, and should be cut just before they come into seed.

Oats and *rye* are sown in England for green food, the former usually with tares and the latter alone; they should be cut before the head has hardened and while the stem and leaf is quite juicy and tender.

Other cereals (*wheat, barley*) may also be used green, and in India and other countries often are; in fact, almost any green crop may be utilized for feeding animals when necessary, *millet and maize stalks, sugar cane, guinea grass, and bamboo leaves* all being useful when obtainable.

Furze.—When cut young and well bruised this is an excellent fodder, and is in use in some parts of Ireland as a general horse food. It was largely used for the mounted troops during the Peninsular War.

Carrots, whether of the red or white type, are greatly appreciated by all horses, and even in the smallest quantities are much relished when mixed with the food. When only a pound or two, as is usually the case, can be given each animal this is by far the best means of feeding them. After being scrubbed they should be cut into small slices, lengthwise and not across, as the latter method may cause a greedy animal to choke.

Feeding green stuff.—In spring and summer a judicious mixture of green stuff with the usual ration is advisable for all working horses. It should not be given in large quantities suddenly, especially to horses in work; but a few pounds daily mixed with the hay and chopped with the feed are most appetizing, and assist the digestion by being slightly laxative. In large quantities, green food may produce diarrhœa and even colic, and discretion must always be used in introducing it into the ration. Carrots have the advantage of being procurable when green meat is out of season. When feeding entirely on green foods 35 to 40 lb. is not an excessive amount to give; but for service horses this is rarely advisable, and about 10 lb. may be taken as a maximum addition to the ration.

The tendency of horses to gorge themselves on green stuff, if allowed to, must be borne in mind; and it should not be left in the stable at night in case some animal slips his head collar and finds his way to it.

When sufficient grazing is procurable and feasible, it is always to be preferred to "soiling," *i.e.*, feeding green food in the stall.

Indian Fodder.

Hay, as made in England, is not often met with in India. Instead of being stacked with just sufficient moisture left in the stalks to cause slight fermentation, which renders hay so palatable to animals, it is, owing to climatic conditions, frequently over-dried or badly rain-washed, and so loses in nutritive quality; moreover, haymaking is rarely undertaken with sufficient care and skill to produce good results, and to this must be attributed the infrequency of its production, for where good grass cultivation has been obtained and sufficient knowledge and foresight been brought to bear on the question, hay as good, has been produced as in England, and there is no reason why, in suitable localities, a plentiful supply for troops should not be obtained. Wherever hay-feeding has been adopted there has been a marked decrease of outbreaks of anthrax, and for this reason alone enough should be cultivated to form a reserve supply, if not the total ration.

In the hills, grass, much of which is excellent feeding when green, is left standing and only cut as required, with the result that for a considerable period animals in these districts are offered bundles of sticks instead of hay.

Grasses are of excellent quality and variety; one or two chiefly used for horses are here mentioned; many good grasses are only suitable for horses when young, as they grow too coarse and woody.

Dhūb (North India), *Hariala* (South India), *Khabbal* (N.W. Frontier), is a creeping grass with an underground stem which throws out tufts of roots at intervals. It is a splendid feeding grass, very hardy and able to grow with a minimum of moisture. Under favourable conditions it attains a height of 18 in., and when cultivated makes the best class of hay. Naturally, it is not so luxuriant in arid districts, but yet grows well, and its succulent stems run freely just below the surface. The native method of cutting is to pare off the surface of the ground and the grass with it, by means of a "Kūrpa" or broad trowel; the dirt is then shaken, beaten, or washed out. Washing, generally in most polluted puddles, to improve the appearance of the bundle, and soaking in the same for hours to increase its weight, are both favourite dodges of the grass cutters and should be strictly prohibited. Forty pounds is considered the correct amount for a grass cutter to bring daily, but in the hot weather twenty-five pounds is more frequently the actual amount obtained. Dhūb is one of the best forage grasses and may be regarded as the staple horse grass of India.

Janewa, a tall grass with its flowering head covered by small, spear-like processes, which, however, are not stiff enough to become a nuisance in mastication. This is an excellent grass, and in some of the western districts is universally consumed, both green and as hay. Janewa, from its habit of growth and the districts in which it is found, is specially suited for haymaking, and the product, when carefully saved, is excellent.

Spear grass or *Siriala*, a widely distributed, excellent forage grass, attaining a height of 2 to 3 ft. It is peculiar from the fact that the barbed ends of the seed covers (spears) become so sharp as the grass ripens that they render it quite uneatable. If cut green, and before these spears have hardened, it is an excellent grass and much liked by horses, but if any attempt is made to feed it when too ripe the inside of the mouth will be found stuck full of the barbed seeds, which inflame the gums and prevent mastication till they are removed.

Maniari or *Haniari*, the best of the hill grasses, grows to a height of 3 to 4 ft. It is a very good fodder when cut young enough and makes capital hay, but before it is cut by the natives it is usually left standing till too old, until, in fact, it is quite woody, and is then comparatively innutritious.

Lucerne, on soils where it flourishes, grows with great luxuriance and may be cultivated and fed to horses instead of grass with the best result. The idea prevalent in India that a pound or two of this plant is enough for a horse, and that more might upset him, is erroneous, and when obtainable it may be fed in practically unlimited quantities.

Guinea grass.—This, like lucerne, is usually provided in small quantities as a tit-bit, but when obtainable may be given to the same amount as other green grasses.

Khasil, Khawid, are native terms for green wheat, oats, or barley. Up till the time the grain begins to ripen these crops are sometimes cut and fed to horses with good effect. The native practice is to give unlimited quantities, and this sudden change produces a diarrhœa which is regarded as beneficial, but better effects may be obtained from a more gradual introduction of the Khasil into the ration. Wheat and oats may be fed in this way until they are ripening and the straw hardening, but barley should be given only when quite green owing to the indigestibility of the awns.

Bamboo leaves and *shoots* are a staple horse fodder in some eastern districts and are good feeding if a sufficient quantity (average thirty pounds daily) can be obtained. The shoots should be cut quite young and the leaves stripped when green or they are indigestible.

Bhūsa is practically "chaff." Crops, whether grain or pulse, are still threshed in the East by bullocks being driven over them in a circle and trampling out the grain. During this process the straw is much broken up and split and is called "Bhūsa." It is the main food of working oxen, and in some places of horses, and may always be used with advantage in the same way as chaff. The bhūsa obtained from the straw of cereals is called "safæd," or "white," and that from other crops, *e.g.*, peas and beans, "Missa bhūsa." Owing to its mode of preparation it contains much dirt and requires careful screening before use.

In certain districts in India when the crop of monsoon grass is heavy, part of the crop is converted into Silage by placing it in deep pits in the ground and covering it over with earth. The pits are opened at a time when green fodder is scarce and the Silage constitutes a valuable addition to the ration as well as effecting a saving of grass which might otherwise be wasted. The only possible objection to the use of such a ration is that it has a smell peculiarly its own.

Charri and *Karbi*, the stalks of millet and maize, may be used as fodder when the crop has been harvested, and they retain sufficient succulence to be much relished. Charri is readily eaten by horses, but the coarser Karbi, unless young, is generally more suitable for cattle, though it may be utilized for all animals on occasion.

Care should be taken not to feed animals on green millet or a grass akin to it called "Johnson grass" or "Burroo" when young or as a second or third cutting during a break in the monsoon, because these plants at this stage contain a ferment (cyanogenetic glucoside) which is poisonous.

Egyptian Fodder.

Tibben is broken chaff of barley or wheat straw. It is made by machinery, or a special harrow fitted with numerous sharp metal wheels called "Nurag," or in the same manner as bhūsa in India; machine-made tibben, being cleanest, is the best. Tibben is used either as a part or whole bulk ration for animals in Egypt, and they thrive on it, if of good quality.

Bursim is a variety of trefoil, largely grown during the winter months after the Nile flood and, owing to its rapid growth, three or four crops are obtained annually. It is an excellent green food, greedily devoured by all herbivorous animals, and may be given in unlimited quantities. When dried it is called "*dreis*," and forms an excellent hay, though, like other clover hays, rather liable to mould. Bursim is the staple green food of Egypt, and its value is difficult to over-estimate. *Bursim Hagazi* is the local name for lucerne hay, of which there is an excellent but limited supply in the country.

Doura is the stalk of millet and young maize with the heads and cobs attached. A good general fodder, relished by horses, but said to cause colic when given to them in excess. "Doura" is also the name by which millet generally is known in Egypt.

Sucrapaille is tibben or chopped Bursim which has been dressed with treacle, thus rendering it more palatable and nutritious.

Preparation of Food.

Cleaning.—Some samples of oats and other grains require cleaning before being fed on account of the quantity of dirt, stones or nails found in them. Some proportion of dirt and stones is unavoidable in grains which are threshed in the open field as they are in Eastern Europe and the East generally. Nails, of a broad-headed type, are used to tack canvas linings round the holds of grainships, and these not infrequently become loosened. The large quantity of dust from oats which are very dry, or have been "clipped," will sometimes necessitate their being screened before use.

Crushing.—The value of crushing food is that it ensures every grain being thoroughly digested, even though it may have escaped mastication, and the whole nutritive benefit of the amount of food given is thus obtained. With very hard grains, such as old beans and maize, with small thin-husked foreign oats, and with any grain which is newly introduced into the ration, and to which the horse is unaccustomed, it is particularly indicated. An objection which is sometimes urged against crushing the food of troop horses, is that it encourages them to swallow their food without much mastication and unfits them for eating the rations they are likely to obtain on service. This view is not, however, borne out by experience, for it is found that horses accustomed to crushed grain as a rule have not proved less hardy and useful on service. In this connexion the use of chaff must be alluded to, for by its admixture with the crushed grain, full mastication becomes a necessity, and liability to bolt food is avoided.

It is a matter of some importance that the rollers of the "crusher" or "kibbler" should be set so that the grain shall not be ground to powder, but shall only have the outer husk split. If powdered a proportion of the flour will escape and may be wasted. Oats are easily crushed, beans and peas are split and maize broken without difficulty, but barley is more resistant, and requires a closer setting of the rollers, and sometimes a second passage through.

Parching is usually employed only in the case of barley, and is fully described under the heading of that grain (*see* p. 101).

Soaking.—This is not a process to be recommended as a rule: its employment in hot weather requires careful supervision, as fermentation is apt to take place and render the grain sour. It is sometimes resorted to in the case of grain in India, and a prolonged soaking of twenty-four hours will render linseed eatable if boiling cannot be employed. Under the name of "Steaming," hot water is sometimes used to soak oats for sick horses or delicate feeders.

Boiling.—In the case of Kulthi boiling is a necessity, and it is also frequently utilized for the preparation of barley and linseed.

On boiled Kulthi and barley, horses may be kept in excellent working condition, but it is not advisable to feed troop horses on boiled rations if it can be avoided.

If for no other reason than to avoid the carriage of cauldrons and fuel, boiled food as a ration for troop horses is out of the question.

The utility of boiled foods in the Service is limited to their occasional use as condition raisers for horses which require fattening.

In England, boiling horses' food as a method of preparation is usually confined to turnip mashes in farm stables; in Ireland boiled potatoes are a common feed on which horses work and maintain condition; in hotter countries the value of boiled barley and maize, as part or whole of a feed, is well known to most careful horsemasters, and they are frequently used to improve condition in thin horses. That such occasional feeding is harmful to the animals' digestion is a result which has not been observed, and although boiled food is not desirable as a rule, there are occasions where its judicious employment as a change diet for horses out of condition is quite warranted, and the results obtained are often excellent. Chaff should be largely mixed with boiled food to compel mastication.

The addition of salt.—The addition of salt to horses' food is not a necessity, they may be kept in the best condition without it, all the salt they actually require for the body's nourishment being contained in their food. Horses are very fond of salt, and it is no doubt a pleasant addition to their ration on this account, adding to the attractiveness and palatability of the food and causing them to eat with great relish and enjoyment. When procurable, a large lump of "rock" salt in the manger or a salt lick fastened on the wall is a constant attraction, and is sometimes of value in inducing the delicate feeder and shy drinker to attack his meals with greater heartiness.

CHAFF ("Chop").

Whenever possible, hay should be fed as chaff; it is economical and it ensures the thorough mastication of grain when mixed with it. The principle of feeding hay as chaff is universally recognized in commercial stables as it prevents the waste which occurs through horses pulling long hay out of the racks and soiling it underfoot. It is not always possible, though it would be an advantage, to get a large proportion of hay chopped in the Service; but in any case, sufficient should be provided to mix with each grain feed, and so ensure its thorough mastication. ~~Chaff may be made from hay only~~, or from a mixture of hay and ~~straw—oat~~ straw for choice; it should be cut short, but not so short as to make it a dust—about one inch—and only good quality stuff should be put into it. It is customary in the trade to chop inferior qualities of hay, and consequently chaff should always be a home-made article. It is improved by storage in bulk prior to issue, and should be well damped before feeding, with the object of preventing the dust which would otherwise arise from it, irritating the horse's nostrils. If this is not done the snorting of the animal may blow away a considerable quantity of his feed.

The economy and utility of chaff feeding cannot be over-estimated; it should be in every way encouraged when practicable. If very small quantities only are obtainable, greedy feeders should be the first to receive them.

Amount of Food.

The weight of food required by a hard-working draught horse varies from about 24 to 32 lb., of which about half is generally corn, and the remainder must make a sufficiently bulky ration for the class of animal. Bulk is an essential for a horse's diet: concentrated foods, no matter how nourishing, will not maintain condition alone, and although an unlimited supply of corn will sensibly diminish the amount of fodder consumed, it cannot take its place, and the digestion will not support an unlimited corn ration unless a sufficient bulk of fodder accompanies it. This is a notable fact in the practical feeding of horses, and must not be lost sight of. Horses in moderate work require 20 to 24 lb., of which 10 to 12 lb. should be corn. As a subsistence maintenance ration, half this amount of corn and a full allowance of hay should be allowed.

Method of Feeding.

There are two distinct methods of feeding in vogue. On service and in private stables where long hay is used, horses are fed with corn three or four times daily, and after consuming this a proportion of hay is given. The majority of the hay is reserved till evening when the animals are left with ample leisure to consume and digest it. The other method is that adopted in many commercial stables, where the whole of the hay is chaffed and mixed with the corn; the supply of food is made practically continuous throughout the day—one horse-keeper being responsible for the feeding of eight to ten horses, and keeping them supplied with the mixture. The same plan is practically followed by the carter, who puts on the nosebag, containing a mixture of corn and chaff, at every available opportunity. There can be no doubt that the latter of these two methods is preferable, and more in accord with the horse's natural habits, but it is not always practicable to carry it out in the army, and a modification of this method is now adopted. When chaff is not used it is advisable to give a small quantity of long hay before the corn feed to ensure that a corn feed is not given on an empty stomach, also to prevent the animal bolting its feed.

The following distribution of a day's ration may be taken as a guide, but officers are expected to exercise their discretion in adapting their feeding arrangements to the requirements of the work performed at the time :—

EXAMPLES OF FEEDING.

	Heavy draught.		Other horses over 15 hands.		Horses under 15 hands.	
	Oats.	Hay.	Oats.	Hay.	Oats.	Hay.
	lb.	lb.	lb.	lb.	lb.	lb.
Reveille ...	—	2	—	1	—	1
Morning ...	3	2(C)	2	1¼(C)	1½	1¼(C)
Mid-day ...	4	2(C)	2½	1¼(C)	2	1¼(C)
Afternoon ...	—	1½	—	1½	—	1½
5 p.m. ...	4	2(C)	2½	1¼(C)	2	1¼(C)
8 p.m. ...	4	2(C)	3	1¼(C)	2½	1¼(C)
Hay up ...	—	3½	—	2½	—	2½
Totals ...	15	15	10	10	8	10

NOTE.—(C)—Chop.

If it is not possible to feed the long hay as above, then give half at mid-day, and half at evening stables.

It is better to feed four times instead of three.

PRINCIPLES OF FEEDING.

As the result of experience three rules have been laid down as guiding principles in feeding :—

(1) *Water before feeding.*

(2) *Feed in small quantities and often.*

(3) *Do not work hard immediately after a full feed.*

(1) *Water before feeding.*—This is the established custom in the Service, but it is not invariably followed outside the army, although very general. The reasons for its adoption are as follows :—the horse drinks very rapidly, and in large gulps ; the water runs quickly through the gullet, stomach, and small bowel into the water-gut. If you put your ear to the near side of a horse drinking, the rushing of the water can be heard. Such a stream passing through an already full stomach would wash some of the contents with it into the bowel, and if the meal is only just finished, they would not be

sufficiently mixed with the gastric juice. As a consequence their digestion would be incomplete, and this means an avoidable loss of nourishment, and, perhaps, indigestion and colic. Some owners make a practice of watering after feeding, and as horses readily become accustomed to any method which is systematically adopted, actual illness does not result as frequently as might be imagined, but the practice is unsound, and as a matter of fact is becoming less and less common.

It must not be imagined, however, that "water before feeding" means "do not give any water till the next meal." The horse's stomach is, as a matter of fact, never really empty, some food usually remains in it; but within an hour of feeding water may be given if desired; and when left constantly with the horse it will be found that a sip or two is frequently taken, but not a long draught.

A working horse, especially if tired and hot, will naturally swallow an inordinate quantity of water very rapidly, and the common-sense application of this rule, is to allow him the opportunity of quenching his thirst before giving him a dry corn feed.

(2) *Feed in small quantities and often.*—The digestive apparatus of the horse is arranged to admit of leisurely feeding for many hours at a stretch. The stomach is small, and cannot contain large quantities at a time like that of the ox, there is no gall-bladder to store up the bile, which flows constantly from the liver directly into the bowel, but the capacious bowels are capable of accommodating a large quantity of food during slow digestion. The bulk of the food then does not stay long in the stomach, but once it is about two-thirds full, passes through at the rate that it is taken into the mouth, until feeding is finished. A horse out at pasture spends most of his time eating, steadily grazing by the hour; the only variations he allows himself are an occasional short gallop with others, a brief and infrequent visit to the stream, and a few hours' rest. But the working horse receives at stated intervals a large amount of very stimulating and palatable food which he learns to eat with rapidity. The stomach works best when it is about two-thirds full. If these periodical feeds, which require a good deal of digestion, are too large there is a danger of the animal over-distending the stomach, and so incurring the risk of indigestion. A feed of 3 lb. to 4 lb. of oats, mixed with a couple of handfuls of chaff, represents when chewed and mixed with saliva the amount which the average horse is capable of consuming to the best advantage at a meal. This may be followed by a long and slow consumption of hay, and the gradual passage of the food into

the bowel takes place under favourable conditions. But if the feed is much larger it causes a distension of the elastic stomach, and a corresponding weakening of its digestive power. Should this overloading be very excessive the stomach is stretched to such an extent as to be incapable of effort, the food soon ferments, gas is given off from it, and acute indigestion, which may lead to rupture of the stomach, ensues. If, then, a horse is to be given a larger quantity of corn than usual, it is not wise to increase the size of each feed, but to give the extra quantity as an additional meal. This plan of increasing the number instead of the quantity of feeds is more particularly to be recommended for the conditioning of thin horses, since their digestions as well as their muscles are weak and unable to cope with much at a time.

The principle of feeding in small quantities often is, as previously noted, thoroughly carried out in some of the best managed commerical studs; the total amount of food is handed over to the horse-keeper, and it is left to him to keep his horses continually supplied with small quantities throughout the day. The whole of the hay is, of course, chaffed to avoid waste and the animals learn to eat leisurely, thus avoiding any chance of overloading the stomach.

(3) *Do not work hard immediately after a full feed.*—Immediately after a meal the stomach and bowels are actually bigger than before, they contain more water and food and are perhaps slightly distended by gases resulting from the digestive process, consequently they occupy more room than was the case just previous to feeding. The extra room is provided by a little filling out of the belly generally and also—and this is the important point—by the bulging forwards of the stomach against the diaphragm (Fig. 2, p. 10). On the other side of the diaphragm (midriff) lie the lungs; any pressure on them impedes their power of expansion, and it is for this reason that strong work immediately after a meal causes instant blowing and distress. The lungs cannot expand and contract with sufficient facility to get rid of their contained blood and provide the amount of fresh air necessary for it, and laboured breathing is the result. If hard work is persisted in under these conditions either the lungs get choked with blood or the digestion stops; the latter is most serious, rupture of the stomach as a result of gaseous distension being not uncommon. Heavy draught or fast work should therefore be avoided directly after a full feed, but no harm results from continuing a quiet journey.

GRAZING.

To the working horse fed constantly on hard food, grazing and green stuff are the acme of luxury and enjoyment, and in addition the effect of green grass on the digestion is beneficial. No occasion should be neglected if grazing, for even the shortest period, is obtainable. Many opportunities for a brief bite may pass unnoticed by a thoughtless, careless or untrained man, and every mounted soldier should be taught that the use of his eyes in this matter is as much a duty as any other part of his military education. In many stations exercise may be combined with grazing, and where government or public land is available, parties may be sent out under a non-commissioned officer at any convenient time. Men should be encouraged to take their horses out to any available patch about the barracks: halts on the march, at field days, whenever dismounted, may sometimes be taken advantage of without interfering with other duty, provided the man has been accustomed on such occasions to look round on his horse's account. Incidentally, the practice of grazing may be taken advantage of to accustom horses to knee haltering and to teach them to stand without being held. Horses that are trained to graze and stand quietly acquire habits which are most valuable in the field.

Every care should be taken to prevent animals eating *poisonous plants* such as *Yew, Deadly Nightshade*, etc., the consumption of which, even in small quantities, may result in death.

APPLICATION OF PRINCIPLES OF FEEDING.

In *the practical application of the principles of feeding*, shrewd observation of the animal under all conditions, and sound common sense in stable arrangements must be added to the knowledge which may be usefully derived from a book. All are not equally gifted in this respect, but any one of average intelligence can make himself sufficiently familiar with the details of animal management to keep healthy horses in good condition, provided he not only reads up the subject but also takes the trouble to acquire that practical knowledge which only observation can give. Whatever the work, the food must be suitable in amount and quality.

Bulk essential.—Without sufficient bulk, condition cannot be maintained for long, however nourishing the food, but where fast work is required and the lighter class of horse concerned, the bulk should naturally be less than when heavy, slow work and draught horses are to be provided for, and a fine class of hay or other fodder is desirable. The effect of bulky food on the respiration immediately after a meal has also to be borne in mind relative to the class of work, and for this reason *it is inadvisable to feed with hay to any extent before the day's work begins, if it is to be of a fast character.* Exhausting work has a temporarily weakening effect on the digestion, and *tired horses* should be allowed to recover from its effects before they are asked to digest a heavy meal. Plenty of water, a mouthful of hay, a small and sloppy feed and warmth, until the system has recovered from exhaustion, should be the treatment prescribed in such cases.

Generally speaking, horses are, when once in condition, hardy, greedy animals, and, if judiciously fed and worked, easy to keep in good heart and flesh, but occasionally *a timid, delicate feeder* will be met, more especially in the light, well-bred class. If carefully treated such animals may become quite normal feeders, and they improve in this respect as they carry more flesh. They should be fed apart until they show good appetite, and will often feed at night, although they will not clear up in the day ; if this is the case no more than they will consume at the moment should be given at each feed until nightfall, when they may be left with an ample supply. For such horses a constant water supply is often of the greatest benefit, and frequent changes of food are attended with good results ; small quantities of scraped carrots or chopped green meat mixed with grain feed will often tempt them to eat much more than they otherwise would, whilst rock salt may be profitably left in the manger.

Feeding of Special Cases.

Horses which bolt their food.—In open stables horses learn to feed greedily ; they consume their grain with the greatest rapidity, either to see what they can steal from their neighbours or from fear that they will themselves be robbed. To prevent the greedy habit as much as possible, chaff should form a part of each feed, and the more the better. Any horses which, in spite of this, are known to bolt their food, should have it spread out thinly over as wide a surface as possible to prevent them getting large mouthfuls ; a manger with several bars across the top to divide it into compartments, or a few large round stones placed among the feed are also methods of preventing the bolter from securing the huge mouthful which he delights in.

Horses subject to diarrhœa as a result of work should have their corn, of whatever variety it is, well ground to assist their digestion ; the addition of a little dry bran to each feed is also a good plan, but water should not be withheld from such horses under the idea that it will keep the bowels firm. They are usually excitable animals, and the diarrhœa is really a nervous affection; when at rest the droppings of such animals are quite normal.

Windsuckers and crib-biters should, if possible, be fed apart from the rest and in such a way as to prevent them practising the habit. Turning them round in the stall on the pillar chains, and feeding from a movable manger and hay net is a very useful method in stables, and the wearing of a hollow bit or cribbing strap is a preventive. When the crib-biter can be accommodated in a box, with four blank walls, and fed off the ground, this is the best plan, till he learns to windsuck. The habit may be learnt by adjacent horses and hence the desirability of separating those which have acquired it.

Horses which have had fever in the feet or have thick legs should have the amount of their food very nicely regulated according to the work they do, and if rested, even for a short time, should have their rations proportionately decreased. Complete rest, after they have once got into a good condition, is not good for such, and they should always receive a sufficient amount of exercise to keep the circulation of their limbs active, and no more food than suffices for their actual daily requirements.

Horses affected in the wind may be, if not so bad as to be useless, greatly improved by keeping the bulk of their food down to the smallest possible limits; avoiding the use of coarse fodder, feeding chaff only instead of long hay, and taking special care not to let them feed just before work. It is not, of course, advisable to retain horses badly broken winded, but the above routine will enable as much use to be got out of them as possible.

Thin horses.—Naturally, a horse is not a thin animal, and usually a thin horse is overworked, badly fed, has received insufficient water, or has something the matter with him. A thorough expert examination should be made to try and find any specific cause for the condition, and possibly the teeth or bowels may be found to require attention. The feeding of a thin, but otherwise healthy horse, should take into account the fact that the weakness of the muscles of his limbs is reflected in the muscles of his bowels and stomach, and until he gains strength he is not capable of digesting large feeds without running the risk of indigestion and colic. Little and often should, then, in such cases be very strictly observed, and as the bodily strength grows and work is proportionately increased, so the quantity of each feed may be added to. For putting flesh on horses, boiled barley, maize and linseed are very useful and may be given at least once daily, but the quantity of the last should never be excessive. An unlimited water supply is also an important factor in the restoration of thin, weak horses to condition.

Young horses require great care and judgment when first brought into work. They want liberal but not over-feeding and should not be allowed to lose their bloom and flesh, which are difficult to restore if once lost as the result of injudicious work or feeding during their first lessons. Starting with about a half ration of corn and a liberal supply of fodder and green stuff, or carrots if procurable, the grain should be increased in proportion to the work exacted, and this should in no case be excessive. Once in condition young horses are easy to feed and keep fit.

Old horses, say sixteen years or older, require a larger proportion of stimulating food than young ones to keep condition and perform the same amount of work, and the addition of beans or peas to their rations is an excellent practice when hard work is demanded.

WATERING.

Quantity required.—According to the temperature and work horses will require anything from five to fifteen gallons a day, an average quantity being eight. Hot weather and hard work, or both combined, will nearly double ordinary requirements, and in making any calculation of the amount required these factors must be considered.

Quality of water.—Horses are said to prefer soft water, but it is not a point of much practical importance, for most stabled horses are given hard water and thrive on it, and the best horse-breeding districts are those with a limestone foundation where a great deal of the water is hard. It should in any case be fresh, pure, and well aerated, free from taste, smell and colour.

Watering troughs should be of sufficient height to prevent restless animals pawing over the rim and should not present any sharp angles or corners. The depth of water need not be great, eight or ten inches being sufficient if the supply is free enough to maintain it whilst the trough is in use, but it should be broad and allow at least a yard of length for each animal; water troughs should be kept clean.

Periods of watering.—The structure of the horse's bowels is adapted for taking in large quantities of water at comparatively infrequent intervals. Three times daily may be counted an average number. In cool weather and when not at work horses will drink only twice daily, but under such conditions they get a good deal of moisture from their grazing. In work, especially when weather is warm, four times daily should be the rule. Water should be given previous to feeding (p. 131).

Horses should not be watered for at least an hour after feeding, but they may be allowed to drink freely whilst at work, even though sweating. If brought in hot they may be watered immediately, but should be kept moving until they have cooled down. The idea that horses should not be allowed to drink very cold water is a fallacy. The cab-horse drank ice-cold water in the winter, after working hard, and stood still in the street for hours afterwards without ill-effects.

Care should be taken not to allow too many horses to water at once, only such number as there is plenty of room for being taken to the trough. They should be allowed ample time to drink their fill and not be led away the first time they raise their heads from the water. This must be carefully explained to the untrained man who thinks because a horse puts his head up to get his wind after his first fill, that he has finished. Horses are to be led to water at a walk and have the head-collar chain put over the nose.

Brackish water is occasionally met with on service. Animals may refuse to drink it freely for one or two days, after which it is taken readily provided the saline content is not too great.

The saline content varies considerably, and a well which has been in use for a week may turn unpleasantly brackish.

After a short period of disuse the water from such a well often becomes palatable.

CHAPTER VI.

MANAGEMENT OF HORSES IN THE OPEN.

Condition and Exercise.

"*Condition,*" as applied to animals, means thorough bodily, muscular fitness for the work required. When using the term "condition," the picture of a racehorse, each muscle outlined, and strung up to crowd the greatest possible exertion into the shortest possible time, is apt to cross the mind; but although this type exemplifies "condition" in its highest degree, it may not truly represent the bodily state required for the particular work in hand. The condition of the race-horse is a maximum; it represents a maximum of food, a maximum of work, and a concentrated nervous energy which cannot be maintained at concert pitch indefinitely; the acme having been reached reaction is inevitable, and unless a judicious easy is allowed, loss of form and condition follow. Such a high-strung, nervous state is not required in workaday horses, such as the soldier's, and although thorough fitness is absolutely essential, the standard to be aimed at is not that of the five furlong sprinter. A well-regulated stable of hunters during the first part of the season exhibits the quality of condition which should be looked for at the commencement of a campaign: the body well covered with flesh, and that hardened on; no sign of running up light towards the flank; full of spirits; capable of long-continued exertion without fatigue, and with a good digestion waiting on a healthy appetite. Such a state of bodily health can be almost indefinitely continued when once attained, and allows some reserve of flesh and animal spirits to draw on when the pinch of hardship comes. This class of condition is *the* criterion of a horse's value on service; blood, power and good looks are of little value without it; its value in war is not to be estimated in money and cannot be purchased for it, whilst unless the animals of an army possess it they are valueless as weapons and may even be a danger to their owners. Condition of this description must not be confounded with fatness. The nice, fresh, young horse from the dealer's yard is fat, not fit; his muscles are soft and flabby, unable to stand severe exertion and rapidly fatigued. Not only his muscles, but every other structure in him is in the same state; his blood-vessels soon lose their elasticity; his heart fails in driving power; his lungs cannot sustain rapid breathing, nor his joints constant bending; and although he is jumping out of his skin at the beginning of the day, a very moderate amount of work makes you wonder if he is the same horse that started so gaily. To quote a sporting writer, " You cannot believe that the heavy-headed, labouring brute between your legs is the same animal that devoured the ground like a tiger and jumped the first fence like an indiarubber ball."

There is only one way to get animals into condition, whether they be required for light cavalry or heavy transport —sufficient good food and sufficient healthy exercise, judiciously combined, and continued over a long period, is the sole recipe. The transformation of fat, flabby flesh into hard, tough muscle is a gradual process, it cannot be forced; a regular course of graduated exercise is the only way to accomplish it. This work should never be so severe as to fatigue the animal; the soft muscles will suffer from the reaction of over-exertion to such an extent that an actual loss of flesh will result. Working tired animals when unfit is a most fruitful cause of accident and disease, and the worst possible horsemastership; this is the time when they sustain bad falls and severe sprains; the muscles do not act in absolute unison, and extra weight is thrown on the tendons, which naturally suffer. But, once good, hard, muscular development has been attained, any work within reason will not only be performed without great effort, but will continue to add to the quality of the condition already acquired. It is important to recognize this " cumulative " power of condition; it means that you can not only demand a good amount of work from a seasoned horse, but that it actually does him good, and while performing it he will at the same time run less and less risk of accident and disease; but throw him entirely out of work for any considerable period, and you will have to repeat the conditioning process over again, though not perhaps to quite the same extent. This must be particularly borne in mind when animals are again taken into work after a run at grass or a long bout of sickness.

Amount and class of work.—At first the work should be light, but spread over a considerable time, and indeed the longer the time which can be spent outside the stable the better. This is always a difficulty in an army; there is so much else to do besides exercising horses that it is not always easy to give as much time as we should like to devote to this essential, and the regularity of the work may be occasionally upset; but a minimum of two hours daily should be enforced, Sunday, of course, being an off-day. On all occasions when it is possible, three or four hours should be spent in the open air daily, the simple fact of being in and breathing a pure atmosphere having a good effect on the health and spirits.

The bulk of the work should be done at a slow pace.—The troop horse gets more than enough fast galloping work during the necessary training of the men, and at field days and manœuvres; his conditioning and exercise should be carried out at the walk and trot, the proportion being about four or three to one respectively. Though impossible to carry out in the Service, the exercise of the racehorse may be taken as an ideal. Two or two and a half hours constantly on the move in the morning, with two or three miles' trot and canter thrown in, and one to one and a half hours' walk in the evening, is the class of exercise which is given to get the animal fit to commence the faster part of his preparation, and even when this is in progress the long walking is continued. Plenty of walking, then, and a moderate amount of trotting should constitute the "healthy exercise" for getting into working condition and for maintaining it. Any attempt to try and crowd extra work into less time under the impression that it will have the same effect should be specially avoided and cannot be too strongly condemned; it does not harden muscle on the animal in the same way, but tends to run the meat off him, make him tucked up in the belly, perhaps irritable in the temper, as well as unduly heated on return from work and therefore more liable to chills.

The exercise should not follow the same route every day.—Horses have a wonderful memory in such matters, and as soon as they think they are on the direct road home, will often hurry, fidget and sweat till they get there. This nervous effect may usually be avoided by taking a different direction daily, breaking the work a little by an occasional halt, grazing and leading; in fact, by any variation of dull, monotonous road slogging.

The exercise should move on the broadest possible front, should walk steep hills and should utilize any soft level roadsides for trotting. The men should be accustomed to lead two horses, one on either side, and the horses trained to lead on either hand. The first mile should be covered slowly, so that the horses can feel their feet, stretch their legs and empty their bowels before they are called upon to trot, and the last mile should also be walked so that they return to stables cool.

The amount of weight which an animal is to carry or draw on service should be frequently loaded, especially in the case of saddle-horses and pack animals, for unless the skin and muscles of the back are accustomed to the pressure of the load for hours at a stretch, sore backs will result, however good the general condition.

Effect of feeding on condition.—To produce the best results, the policy of full feeding and fair work must be adopted. No other combination will get the best out of an animal. A small ration and little work will keep him round in appearance, but whether a camel or a charger, plenty of food and sufficient work, judiciously combined, is the only routine which will really fit him for use in war. This adjustment of ration to work is a practical point which a book cannot teach; it is one of the hall-marks of a good horsemaster and must be gained by observation and experience. When the work is light, *e.g.*, at the beginning of a young horse's training, half a full corn ration is generally accepted as a standard on which to begin feeding, but a rule-of-thumb method should be avoided and each horse's needs considered; in no case should the ration be so small, or the work so hard, that the colt's "bloom," *i.e.*, his round and glossy sleekness, disappears.

Thirst and sweating are very prominent features of the early stages of training, and are to some extent dependent on each other. Apart from the sweating which may naturally be expected as a result of work, some young horses are liable to sweat very profusely from purely nervous causes, and more especially when the work is conducted in a confined atmosphere.

It is not always possible to prevent every young horse sweating from the excitement of new lessons, particularly in the case of highly bred or excitable colts; but such outbreaks take more out of a horse than a far greater amount of quiet work, and should be avoided in every way.

Working in the open air in preference to a roofed school, absolute quietness of methods, the avoidance of long monotonous lessons, and the example of older, well-behaved animals, doing the same things quietly, are all valuable in keeping horses cool in body and temper; but there are instances, as stated above, where sweating cannot be prevented, and thirst is a natural result. *Thirsty horses* are to be allowed to drink their fill; it is best that they should not be sweating, but the fact of their being hot need not be a bar to their drinking, if care is taken to keep them on the move till cool, and so prevent risk of chills. As their condition improves the keenness of their thirst will diminish.

The quantity and quality of the sweat is very generally taken as an index of condition, and rightly so. When the body is soft and flabby, slight exertion produces a copious sweating, of a soapy, lathery nature, which dries slowly, and frequently breaks out again. As the condition improves, the amount of work required to make the skin damp increases, and the sweat itself is less greasy and more watery in consistence, while it dries with rapidity, and does not recur. There are, however, some free-sweating horses which lather freely even when in good fettle. Weather has a great influence on the amount animals perspire, for whereas on a cold, clear day it takes a lot of exertion to turn a hair, a damp muggy morning will make them sweat freely.

It has been observed that horses will not retain hard condition for an indefinite period of time. Condition is best maintained by those horses which sweat sufficiently.

It is noticed, particularly in hot climates, that many horses lose their condition and at the same time cease to sweat. They are then commonly known as non-sweaters. This may and very frequently does occur to horses that have previously been quite good doers, but from the time sweating ceases they become bad doers and will remain so, so long as they remain non-sweaters.

On the March.

It is taken for granted that the horses are in "condition," without which it is impossible for them to undergo the fatigue and exertion incident to any prolonged effort. This has already been dealt with under the heading of "Condition," but the importance of the point must be again insisted upon. Looked at solely from the animal's point of view, the length of a march is to be estimated not only in miles, but also with regard to the number of hours that the load has to be carried; this latter consideration is frequently the more important of the two, and particularly applies to pack transport. The advance of a column on service is occasionally at the rate of one mile in four or five hours, and under such circumstances, a five mile march on paper may call for the exhibition of extreme endurance in reality. If under the pressure of circumstances the marching of unconditioned animals is necessary the distances to be covered and the time occupied must be comparatively short, unless the military necessities of the case are such as to override all thought of loss, or exhaustion and sore backs will shortly account for the majority.

Previous to starting, a special inspection of the saddlery and shoeing should be undertaken, to make sure that all is in order, but alterations to saddlery should only be made if they are absolutely unavoidable: eleventh hour alterations are not always judicious, and unless actual injury is apparent saddlery is better let alone at this moment. Shoes should as far as possible be new. Wear varies considerably in different horses: on a macadamized road, especially if the weather is wet, hard wearers will get through good hind shoes in between

100 and 150 miles, and the average for road work will vary from 200 to 300 miles according to the pattern and weight of the shoes.

Hour of starting.—It is seldom advisable, unless for purely military reasons, to start before daylight, even with the object of avoiding heat. In the dark, feeding arrangements are not satisfactory, saddlery and harness may not be accurately adjusted and articles may be unseen and forgotten. Night marches are slower and more fatiguing than in the day, and unless the road is well known may possibly be lengthened by errors of direction. They are often necessary when marching through fly belts.

Choice of ground.—Attention should always be paid to the condition of the ground travelled over, the pace being increased when the going is good ; and bad, heavy, or newly metalled pieces walked over. Riding horses should be kept off the road if the going at the sides is soft and suitable. Vehicles should always keep to the hardest and smoothest routes.

Steep hills are particularly suitable places to relieve the horses of weight and let the men walk.

Pace.—Always remembering the fatigue which the weight carried produces, irrespective of the distance travelled, the maintenance of a good average pace throughout the entire journey is to be desired, and, provided it is not unduly hurried at any point, the quicker a journey is completed the less fatiguing is it to both horse and rider. The actual mileage an hour will naturally vary with the unit concerned : taking the walk at four miles an hour, the trot at eight, cavalry unaccompanied by other arms should maintain a rate of five to six miles an hour, including halts, over any ordinary distance, and this rate is capable of being kept up for very long journeys where the animals are accustomed to travel at the canter. Horse artillery can travel at the same pace as cavalry, field artillery at four miles, and transport at three miles an hour under favourable conditions.

Single horsemen with a thorough knowledge of the work and with mounts in the pink of condition may be able to travel forty to fifty miles at the rate of twelve or fourteen miles an hour ; but such a pace cannot be expected from any body of horsemen ; and the larger the force the slower will be the progress as a rule. Forty or fifty miles a day, if continued for several days, will test the condition of both horse and man very thoroughly, and even this result cannot be attained without severe loss unless the men are practised in the work and both they and the horses are as hard as nails.

The pace should be varied as much as possible, walk, trot and canter being all utilized, and the last of these is found by all long-distance riders to be the easiest pace for both horse and man on a journey. No pace should be maintained so long, without a break, as to weary either horse or man, but after ten or fifteen minutes' trot and canter a short walk should follow. To a very large extent the men should walk whenever the horses do, in order to relieve them of the weight; and this procedure has the further advantage of lessening the strain on the men themselves by bringing into play other muscles besides those exerted in riding.

Halts.—A first halt should be made after going one or two miles, to allow the horses to stale; make sure that the saddlery and harness is all correct and tighten the girths. It need not be more than a few minutes, but it is a very necessary precaution, more especially if the start is made at dawn when the light is poor and some detail in saddling may have escaped attention.

Subsequently, a short halt of five to ten minutes should be made hourly, and every two or three hours a sufficiently long one, to off-saddle and feed. If it is not possible to off-saddle, girths should be loosened and the saddle just raised off the back, to relieve pressure and allow the circulation of the skin to be restored. When the saddles are removed the horse should be allowed to roll and the back dried. At every halt stirrups should be put up to prevent accidents from catching the hind foot in the iron, and each man should look round his horse and at each shoe.

Formation.—The broadest front is the best for horses, and should be adopted whenever possible. It enables every animal to see the ground over which he is travelling and ensures a supply of fresh air, free from dust—an important consideration on a long, hot day. Where a road has to be followed, the force should, so far as the military situation permits, travel in small bodies, with a sufficient interval between them to allow dust to settle or blow away. On hot, still days, the horses in the centre and rear of a long narrow column breathe an atmosphere thicker than a London fog throughout the journey, and this must help materially to produce fatigue sooner than would otherwise be the case. It is most important, especially when the column is a long one, to prevent the whole force being affected by momentary checks which may occur in front. To avoid this a short interval should be maintained between squadrons whenever tactical conditions allow it. Any animal or vehicle meeting with accident should be immediately drawn to the side of the road and not be allowed to obstruct the passage of the remainder.

March discipline.—Good march discipline is essential, and this particularly applies to wheel transport in order that every horse is in draught and doing its share of work. To maintain this it is necessary that an officer or a N.C.O. should ride in the rear file to prevent any negligence on the part of the men. The N.C.O. with first-aid dressing should ride in the rear file to render immediate assistance to any animal which has met with an accident.

Watering.—Horses may be watered whenever opportunity occurs, especially on hot days, and there is little risk attached to their being allowed to drink frequently. The usual method of watering before feeding will, of course, be adhered to, but if a stream is crossed an hour after feeding they may again be allowed to drink if circumstances permit of the delay. Good health and condition are essential to enable animals to overcome temporary shortage of water. In a country in which facilities for watering are limited, the distance from camp to water should be taken into consideration in deciding the number of times of watering daily. Watering parades noon and evening is often more beneficial than watering three or four times a day when water is some distance away. Bits are to be removed and girths slackened when it is intended to give a full watering. Water buckets should always be carried.

When water is scarce its issue must be carefully regulated to avoid any waste. Horses can drink from very shallow vessels if their bridles are removed, and, taking advantage of this fact, small quantities may be poured into a shallow dish, from which they drink, the supply being regulated by the animal's rate of swallowing. It is a plan adopted by some regiments of Indian cavalry, and may be conveniently employed where water is carried in skins or small tanks. A very small quantity will revive overtaxed horses, and it should be given in repeated little rations rather than in one long draught. When the amount is very scanty, say a pint or less, it is best to offer the exact quantity to each in turn rather than to risk a large bucketful, as the first-comers are sure to get an undue proportion and may upset it in their eagerness. On one occasion during the campaign for the relief of Khartoum the Syrian horses of the 19th Hussars received no water for fifty-five hours and twenty of them for seventy hours. On another occasion when much exhausted and thirty-five miles from water, less than one pint for each horse was available. This was mixed with meal into a number of soft balls, which revived them, and they accomplished the remainder of the journey the next morning. In regard to this particular point it must be noted that thirst is better endured in hot climates by animals which are native to them, a fact which should be remembered when selecting for arduous duties. Public water troughs, etc., should be avoided owing to the risk of contagious disease being introduced.

Feeding on the march in peace and war are very different matters. In peace, whether at home or abroad, there is the certainty of receiving a sufficient ration at stated intervals, and practically no thought is required from officer or man in connexion with its provision; but in war the conditions are entirely changed and demand special attention, for while a mounted soldier's chief weapon is his horse, it is also the most difficult to keep in working order on service. For a man accustomed throughout his life to the care of horses, more particularly in a new or uncivilized country, it is a matter of simple routine to provide for his horse's wants at every possible opportunity; it becomes automatic with him to think for his horse; but the average soldier has not had such training and experience, and unless it is thoroughly drilled into him that he must think of and for his horse on all occasions, the latter is apt to suffer.

It is in the matter of fodder that the difficulty of providing sufficient horse rations is likely to be felt oftenest; corn may be supplied with regularity, but hay or other fodder is very bulky, and its punctual issue cannot be relied upon. Every mounted man should be made fully aware of his duty to his horse in this respect. Standing crops of all descriptions provide excellent fodder, and should not be passed without the horse being catered for; while, if circumstances permit, a sufficient quantity should be carried, to provide for the next halt. Opportunities for grazing may occur: when halted the horse will not fail to avail himself of them if the man allows him. Especially do the scout, the orderly, and the small party on detached duty, meet with such opportunities; but unless the men are so trained that it has become second nature to take advantage of them, many will be missed from want of thought or observation, when the mind is occupied by more exciting details. Visits to farmhouses may offer the chance to replenish empty nosebags, and these should be kept full, no matter what the contents, so long as they are eatable. Of course, on service, the niceties of method which we rightly adopt during peace cannot always be adhered to, and some risks must be taken. Unless time and food are equally plentiful—and this is not very often the case—the latter should be eaten whenever opportunity occurs, even with the prospect of immediate severe work: it is better under the circumstances that some cases of colic, and perhaps a death from ruptured stomach be risked, than the chance of a feed be missed, a chance which perhaps may not recur for many hours.

On the march the principle of feeding little and often should be adopted: at every halt of sufficient duration the nosebag should be put on. The cab-horse was probably called upon to perform the most severe continuous daily work of any light horse in England: at any moment he was called on to trot at a fast pace, drawing a considerable load, for half an hour or an hour at a stretch; and frequently during the day got fast work for shorter periods. His nosebag was kept on constantly when at rest, and the plan answered admirably. At no time was the stomach overloaded, at no time was it quite empty. It is a method which, as far as possible, should be imitated on the march.

When marching long distances the portability of food becomes a serious question, and compressed rations of various descriptions are likely to be issued. Of whatever materials these consist they should be well broken up and, if possible, mixed with any procurable fodder, which will give them bulk, *e.g.*, chaff, chopped straw or grass; and just previous to feeding they should be well damped as they are very dusty. Cocoa, biscuit, meal of any description, and even meat may be made use of; and the addition of a few ounces of sugar to a limited ration is a great help in sustaining horses engaged on a prolonged effort. The Turcomans were in the habit of giving their horses balls of meat, wheat meal and sugar in small quantities previous to and when engaged on raids, and the natives of India make use of wheat flour in the same manner during long marches.

While, however, such articles may help in emergency, horses cannot maintain condition without sufficient *bulk* of food, and constant effort must be made to provide fodder of any description, in addition to grain rations.

During peace in all marches of five hours it is advisable to feed once *en route*, if possible immediately after the horses have had a good drink. The bit being removed, the nosebag is to be buckled well up, to allow the horse to reach the feed easily and prevent him tossing his head and spilling the grain. Half-way through the feed it may require readjusting for the same reason. Horses that toss their heads persistently should have the top of the bag tightened round the face by a rubber cord, or strap, to prevent waste. When the horse ceases to feed he should be allowed to graze and the nosebag is to be turned inside out to dry.

Great care is to be taken to secure the mouths of all nosebags so that the contents may not be spilt on the way.

Swimming horses.—The horse is a powerful natural swimmer, and is capable of bearing a fully equipped man for a considerable distance. When afloat, the head is the only part visible, the body being just below the surface, and the tail awash behind.

If the rider remains mounted, his weight sinks the horse's body lower and he is himself immersed half-way up the body at least. Swimming mounted requires a capable horseman, who should be a good swimmer himself. Before riding in, it is well to tie the curb bit reins in such a way that they will not interfere with the animal, and in guiding the horse when under way it is better to splash the side of his face and so head him up or down rather than pull on the reins.

Generally both men and horses are stripped and the kit ferried over dry. In this case the reins should be knotted, so that they will not entangle the forelegs when swimming. The men ride into the water till the horses are out of their depth and then slip off on the down-stream side, holding to the main or tail, and are towed over. The free hand is used to splash the horses' heads and make them keep their direction. According to the strength of the current, they should be headed more or less up-stream, or they will be carried below the intended landing place. To guard against this, the place where the water is entered should be well up-stream, and the landing should be wide, or a second suitable place should be available a little lower down.

If the horses are to be towed after boats, a rope is passed round the upper part of the neck and tied, with a knot which does not slip, just tight enough to prevent it coming over the head. The animal is then driven into the water, and once afloat will follow the boat. If unwilling to enter, splash water on the back. Particular care is to be taken to exert no traction on the neck-rope once the horse is swimming, or the nostrils will be pulled under water and the animal may be drowned. For this reason the rope should be long, and the boat should be rowed slowly. Three or four horses can be taken across at once, if they are not troublesome.

Endless rope.—In using the endless rope method for swimming horses, care should be taken that the rope is not drawn faster than the horse can swim, or that the head rope is not so slack that the horse is liable to get its leg over when swimming and be drowned—when an accident of this sort happens it is necessary to keep the endless rope moving, otherwise all the animals which are in the water may be lost.

Where the crossing is not wide and free from dangers, the horses can be driven in and swim across by themselves. The head ropes or snaffles should be knotted round the neck, so that the men wading in can secure them as they land, and a picket boat should be placed down-stream to keep them from losing direction. Some horses should be kept well in sight at the landing places, as an objective for those swimming, for it must be remembered that the animals' range of vision is very limited when the head is on a level with the water, and if they cannot see something familiar to make a point at, they are apt to go down-stream.

In Camp.

Selection of site.—Where the site of the camp has not been already decided, choice should be made of ground flat enough to give a level standing to the horses, but with sufficient natural fall to carry away storm water ; sheltered from keen winds, and while within easy reach of the water supply, not draining into it, but below it. Marshy ground should be avoided always, but there are occasions when military conditions may preclude the avoidance of bad sites. The site chosen should be cleared of stones and other material which interferes with horses lying comfortably. In hot countries advantage should be taken of any natural shade. Protection from air-craft should be considered. Public camping grounds and serais (rest houses) should be avoided.

Position of picket lines.—Place picketing lines at right angles to, rather than parallel with, contours. This ensures a more or less level standing for each horse whatever the slope may be.

Water supply.—When a stream is the source, the watering place will be below the men's drinking water, but above the washing place. It should be as near the camp as possible but above it ; have a sound bank and bottom ; wide approaches and exits ; be capable of watering as many horses as possible, and not liable to be fouled by up-stream drainage or manufactories. If the bank is too steep, a ramp must be made, extending as far as practicable the entire length. If the bank and bottom are muddy, stones and gravel should be liberally used to make a firm, clean standing. Watering should always commence at the lowest part of the allotted length of water, so that each succeeding batch may procure a clean supply by entering a pace or two higher up. In watering, horses should be walked in single file across the river till its whole width is occupied, their heads turned up-stream to give them a clean drink, and, when satisfied, they should turn about and leave at the lowest part for the reason given above.

Where the stream is too narrow or shallow, it can be widened or deepened as may be required by the construction of a dam, or by digging out the bottom.

Two horses only should be taken to water by each man, and bridoons or pelhams are to be used. The practice of sending four or five horses tied together under one man is objectionable; it results in some of them not getting sufficient water, from being either hurried or disturbed in their drinking by the others to which they are tied.

If troughs are to be used a space of not less than one yard is necessary for each animal, and unless they are very broad it is not advisable to water from both sides at once, as, though this economizes time, the horses play with, and bite at each other, instead of drinking. It is better to allow the whole of the horses at the trough to quench their thirst before any fresh ones are permitted to approach, as the constant movement interferes with the more timid drinkers, and they do not fill themselves. Walking is the only pace to be permitted on the way to and from the troughs, and all noise and confusion should be avoided, as it excites horses, and they do not drink so freely as when quiet and undisturbed. When ready-made troughs are not available, they may be constructed of sods, and lined with tarpaulin.

Watering from ponds or other stagnant pools may be necessary, but it is to be avoided if another source is obtainable, for it is not possible to prevent such a supply being greatly fouled. Horses should not be allowed to walk into them further than necessary to reach the water easily, and if the place has to be used for any time, the edge should be regularly cleared of refuse. Vegetable scum and weed growing on the surface of such pools should not be cleared; they help to keep the water pure, though their appearance may not be very inviting.

Danger of dirty water.—Drinking dirty water, if persisted in, will upset digestion and lead to colic and general inefficiency.

If the available accommodation makes it necessary for units to follow each other at the same watering place, a time-table should be issued to prevent confusion.

Watering parades.—Strict discipline on watering parade is essential. With proper organization there should be no difficulties. The essential points are:—

(1) Personnel detailed for filling the troughs, so that they are filled before the first batch of horses arrive.
(2) Organized road traffic with an entrance and exit.
(3) March discipline to and from the water trough and camp.
(4) That every animal gets its full share of water.
(5) Each unit should have its own water trough to control the spread of contagious disease. Any horse with an infectious disease should be watered from a bucket.

Picketing.—By whatever method a horse is secured, it should be carried out in such a manner that he is not likely to injure himself or his neighbour. The comfort of the animal should be studied as far as possible, but the prevention of injury is of the first importance. It is at the commencement of operations, and during peace manœuvres, that this matter calls for most attention, as horses may be unused to the method, or so fresh that they attempt to bite or kick at each other. The first of these reasons should not exist; standing quietly under any form of restraint which is likely to be imposed on a troop horse, being an essential part of a remount's training, and before his first experience of camp life, he should be accustomed to head and heel ropes, foot-shackles, knee-haltering, linking, and standing alone. It is quite a simple matter of training, but if not taught before arrival in camp a crop of perfectly avoidable accidents is the assured result. On peace manœuvres, where horses are all well-fed and not overworked, there will always be a certain number of attempts to kick or bite, either in play or from vice; both are equally serious in results, and the horse must be so secured as to prevent damage. On service, horses are usually too overworked and underfed to give much trouble in this respect, and are also more accustomed to the mode of life. The great majority of injuries occur from the head and heel ropes being too long and slack, and in practice this apparently simple matter requires constant attention and supervision. It is inadvisable to change horses; they are more placid in the same company.

Picket lines may consist of a single long rope, or the "built-up" rope, a portion of which is carried by each man, and in either case they must be kept quite taut. They may be stretched along the ground, or at a height of 3 to 4 ft. from it. When heel ropes are not used, the latter is the better plan, as it prevents horses stepping over the line, and twisting their head ropes. The ends should be tied firmly to picket posts or substitutes, such as trees or wagon wheels, and kept as taut as possible. In standing camps a double set of lines, or a double set of heel-pegs on either side of the picket line, should be arranged for. This permits a change of standing when the ground is soiled or worn, and will be found a great convenience.

Head and heel ropes.—The head rope. First method of attaching to the head collar: pass the point of the rope through the lower ring of the backstrap of the head collar, then through the ring at the end of the head rope, and draw taut. Second method: tie the head rope on to the picket line securely, and at the correct length. Taking the ringed end, pass a loop of the rope through the lower ring of the backstrap of the head collar; slip the ring of the head rope through this loop, and draw the rope tight. This method does not cause a slip, and release can be effected quickly, leaving the rope secure to the picket line; it also ensures the head rope being the correct length.

Any knot by which the head rope is fastened to the picket line must be perfectly secure, and capable of being rapidly undone. The knot figured below has been employed with success. Tie the free end of the head rope round the picket line in a half-bow (Fig. 21), then pass the loop round the picket line, and under itself (Fig. 22). To free the knot, pull the loose end.

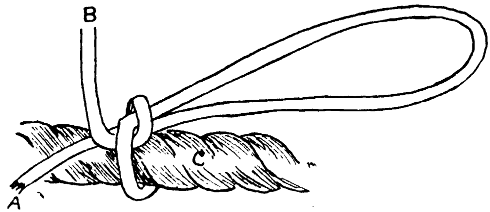


FIG. 21.

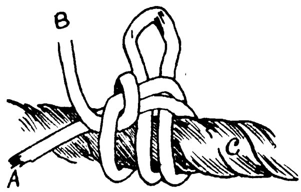


FIG. 22.

A. Free end of head rope.
B. Head rope leading to head collar.
C. Picket line.

The proper length for a head rope, however secured, is from the lower ring of the backstrap to the ground, when the horse is "standing up," with its head directly over the picket line or head peg, and no longer.

The heel ropes may be single or double. The object of a double heel rope is to prevent a kicker striking the next horse, and can only be effective if the V at the end of the rope is short enough to limit the play of the legs as much as possible. If the V is long the animal is as dangerous as ever. Lying down, getting up, and straddling to stale, are the only necessary movements, and a V with a maximum spread of about two feet is all that is required: if it is greater, the ropes should be tied together to make it this pattern. *The proper length* *of a heel rope* is from the heel to the heel peg in a straight line, when the horse is " standing up," with his head directly over the picket line or head peg, and no longer. The distance between the picket line and the heel pegs may vary from three to five yards, according to the size of the horse, twelve to thirteen feet being sufficient for all ordinary size troop horses. A gangway of at least five yards width between the horses' heads should be left. The interval between horses depends upon the space available, the minimum being five feet.

Picketed according to the above directions, a horse can perform all movements necessary to his well-being, and cannot, as a rule, injure himself or his neighbours. Giving him further latitude is inviting disaster.

Shackles are of several patterns :—(1) *A simple loop of leather* which is passed over the foot, slipped round the pastern or above the fetlock, and secured there by a thong. This is an excellent pattern, may be adjusted tight or slack as required, and is not liable to cause injury itself.

(2) *Straps and buckles*, sometimes lined with numnah to prevent chafing, are of several different varieties. They all have one common fault, viz., the tongue of the buckle is likely to tear through the strap holes, unless the leather is very strong and heavy. Where there is a guard under the buckle, to prevent it galling the skin, care must be taken not to double it under when adjusting. Numnah linings are not very satisfactory; they soak up wet, and retain gritty mud, which dries hard and rough.

(3) *Hook and eye pattern.*—These fastenings are of metal, and are attached to the leather work by rivets. No riveted fastenings are satisfactory; they are liable to work loose, and as the leather shrinks away from them, project on the inner side, and gall the skin. Metal hooks and eyes are so frequently strained or closed that they either fall undone or become impossible to fasten.

(4) *Button and eye pattern.*—A loop of leather or webbing, one end of which is doubled into an eye, and the other gathered into a toggle or button. So long as the button and loop fit well, this is a good pattern, but they are apt to stretch, get loose, and come undone too easily. A variety of this pattern, made of many strands of soft string (sootlee), is a favourite shackle in India, particularly for young horses likely to be restive; it is light and soft, so does not hurt them, even if they struggle, but it does not wear very long.

A good shackle of whatever pattern should present a smooth surface to the skin, have a secure fastening, and not be so heavy that its weight is likely to gall the skin of the heels when it rests upon them. They must always be kept quite soft and pliable. Shackles may be worn either round the pastern or above the fetlock, and as they are more likely to cause galls if worn constantly in the same position they should be frequently changed from one position to the other, and if a single one is worn, from leg to leg. When worn above the fetlocks they are not to be tied so tight as to cause the legs to swell.

Picket pegs may be used for the heel ropes only, or for fastening the head ropes also, and where single horsemen are liable to be detached, two pegs, or some method which renders them independent of others, are requisite. Many patterns of pegs have been tried, but none can be considered perfect under all circumstances :—

(1) Wooden pegs are usually shod and bound with iron, and provided with a rope or leathern loop, which facilitates the withdrawal of the peg from the ground. When not iron shod, wooden pegs must be periodically resharpened, as the points become frayed and blunt from driving.

(2) Iron pegs last longer than wooden ones, are easier to drive into the ground, but do not give such a secure hold when driven, and should they be accidentally pulled up, are more likely to inflict serious injury on the animal. On this account some iron pegs are made with a broad, heavy head, beneath which the rope is tied ; if the peg is drawn, the weight of the head turns it point uppermost, and it slips out of the rope easily. Other patterns have a ring, or cross-piece, for the attachment of the rope ; but, for the reason just given, they are not such good designs.

(3) A spoon-shaped metal peg has also been tried. This has a broad curved end, with an opening in the centre ; a hole is dug with the blade ; a small bundle of twigs is placed through the opening ; the peg is buried, and the earth well stamped in. It is said to give a very firm hold.

Pegs should always be driven at an angle with the ground, with the point towards the animal, and to their full extent. If the soil is of such a light nature that the pegs draw easily, two pegs, one behind the other, will increase the holding power. The further peg should be quite buried in the ground, as shown in the figure (Fig. 23).

When no pegs are available, a bundle of twigs should be tied at the end of the head rope and buried crosswise at a depth of one to two feet according to the nature of the soil, and the earth well stamped in. This will give a very firm hold.

If it is necessary to picket horses by a head rope only, this may get much twisted by the animal walking round and round. A makeshift swivel to prevent this may be provided by a tent rope fid (Fig. 24).

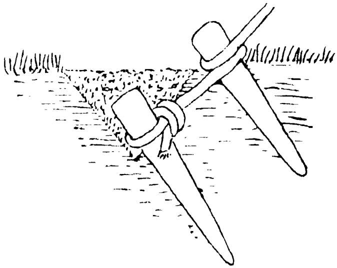


FIG. 23.

The most frequent and serious cause of injury to horses picketed by head and heel ropes is from getting their hind feet over the head rope or picket line. Horses that feel any irritation about the head and neck scratch themselves with their hind feet; if the head and heel ropes are not sufficiently tight, they can bend the head round, and reach up a hind foot to meet it for the purpose.

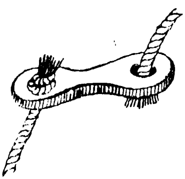


FIG. 24.

In doing this the foot not infrequently slips over the head rope or picket line, and, finding himself pinioned, the animal struggles in the wildest way, gets cast, and before he can be released may be, and sometimes is, seriously injured. It is better that he should be securely tied, even if this compels him to undergo some slight discomfort, rather than be given the opportunity to put himself out of action at a time when his services are most needed.

Other methods of securing.—A swinging picket is occasionally used by officers for their chargers, and is made by running a head rope with log attached through a swivel or movable ring on the top of a picket post between 3 and 4 ft. high. If this plan is adopted, the head rope must be no longer than previously described, and the log quite heavy enough to take back the slack when the horse changes his position.

Another method is to employ a smooth pole six or seven feet high, with a loose ring, of larger diameter than the pole, fixed by a short strap to the cheek piece of the head collar. The ring is placed over the pole, up and down which it slides as the animal's head is raised and lowered. It is a useful way of securing a biter, as it limits the movement of the head, while permitting all necessary freedom.

A double head rope is often used with the object of gaining extra security or limiting the side movements of the head. A peg is driven two or three feet on each side of the horse's head, and a rope fixed to each from the cheek pieces of the head collar. It is a favourite method in India, and a suitable one where stallions have to be dealt with.

A single foot shackle, fastened on the pastern of one fore foot, and attached to a peg by a short length of rope or chain, is a convenient way for single horsemen, on detached duty, to secure their mounts. The peg must be driven flush with the ground, or the horse lying down may be injured; the plan makes each man independent, and the necessary equipment is portable and light. It has been said that horses so tied are likely to strain their pasterns, but the assertion cannot be sustained by fact, and once they are accustomed to it animals so secured stand as quietly as with any other mode. The disadvantage is that serious injury is liable to result if an animal breaks loose.

The movements of horses may be restricted in several ways, all of which are occasionally useful in camp, but in order to employ them with safety and success it is necessary that the animals should be used to such methods of restraint, or confusion, and possibly accident, will result. Where stallions are to be dealt with, they are not always applicable.

(1) *Coupling when saddled.*—Place the horses head to tail; tie the reins of each round the back stay of the rear arch of the other's saddle.

(2) *Heads in a circle.*—This can be carried out
- (i) by tying the head rope of each to the head collar of the next until a complete circle is formed;
- (ii) by tying each head rope to a metal ring about 18 in. in diameter carried for the purpose. Fodder can be placed in the centre, and as no two horses pull in the same direction they remain stationary.

(3) *Knee-haltering.*—The head rope is carried from the lower ring of the backstay of the head collar to the forearm just above the knee, where it is tied just tight enough to

prevent it slipping down the leg. The best knot for the purpose is a clove hitch, with a half hitch as a keeper to stop it slipping. With horses accustomed to the method, the rope may be tied loosely below the knee, or round the pastern. The length of rope required is enough to let the horse get his mouth on the ground and no more. Even with this small amount of liberty, some can travel at a surprising pace when attempts are made to catch them. Knee-haltering is the best method of securing horses when grazing, and they are easily accustomed to the restraint it entails, though they may resent it at first.

(4) *Hobbles* may be used to connect a fore and hind, or both forelegs, the amount of movement possible being regulated by the length of the rope connecting the hobbles.

Thin horses should be placed at the end of the line next the forage.

Vicious animals are better apart from others, as they disturb them when feeding and resting. Sacks of sand may be tied to the heel ropes of kickers in lieu of pegs, and this sometimes stops the habit.

Cribbers should be secured by a foot shackle only, so that they have nothing to bite upon.

Feeding.—The general principles of feeding should be adhered to as far as circumstances allow, and the special notes on feeding on the march are also applicable to life in camp (*see* p. 147); it is only necessary here to add details not previously given.

Hay.—The use of hay nets should be universal; without them, hay, always wasteful, becomes doubly so in wet and windy weather. The mesh should be such a size that a small quantity only can be pulled out at once, and they should be secured to the picket line by each end. If nets are not to be had, hay should be fed in small quantity, and frequently renewed, each fresh supply being tucked under the picket line. This is very necessary in prolonged wet weather. If the rain is not continuous, it is better to withhold hay altogether till the shower is over.

To avoid waste, trusses of hay should only be broken on a tarpaulin or inside a wagon, and the hay should be well separated and shaken up prior to filling the hay nets. The seeds or buds and short pieces will then be saved to augment the chaff ration, instead of dropping through the nets.

Chaff should be used as much as possible when it can be got. The place where it is chopped must be well protected from wind, by sod banks, hurdles, or tarpaulin stretched round posts. If the hay supply is large the trusses can be arranged round the chaff machine for this purpose.

Nosebags require frequent cleaning; they should be removed as soon as the horse has done feeding, and turned inside out to dry. Patterns which have a wide bottom are to be preferred to narrow ones, as the feed gets caked in the ends of the latter. Special large bags are used where chaff or hay cake is fed, and a very useful substitute may be made from a sack. When nosebags are not in use they should be turned inside out and hung up.

In order to prevent the spread of contagious disease it is advisable to mark the nosebags with the animal's number.

Grazing should be afforded at every opportunity, and for this purpose knee-hobbling is the best plan to adopt. The horses should not be herded in a ring, but allowed to advance gradually over the grazing ground. The horse guard should take their own horses saddled, so that they can rapidly round up the mob when required.

Grooming.—Except for the removal of mud and dirt, horses in camp do not require so much brushing as when stabled, since, owing to exposure, the skin is not so active, changes in it are not so great, and scurf does not accumulate so fast, whilst the slight extra greasiness which will be present is a natural protection against cold. On the other hand, a good wisping stimulates the general circulation, increases the output of the oil glands, and produces a comfortable warmth in the skin which cannot but be appreciated by the animal and always improves the appearance.

Clothing.—When rugs are used they should be secured round both breast and quarters; the latter is especially necessary, or the sheets blow over the horses' heads and may stampede them, in addition to depriving them of the desired warmth. Surcingles shrink rapidly when wet, and must not be strapped tightly at night or when raining; a dewy night will shrink them as much as a shower. Neglect of this precaution will cause sores from the increased pressure of the pad on the back. When the weather is wet but warm, the horses are better without clothing; but if the wind is bitter and the rain cold, blankets may be left on. Rain does not hurt horses, the grease of the skin renders it waterproof, but if the wind is cold as well, it tells on their condition, unless they get extra food.

Protection from weather.—Overhead cover is not of the greatest importance to horses, but protection from wind is absolutely essential. In cold, wet, and windy weather horses like to stand with their tails to it, and will try and screw themselves round if not so placed; but in mild or hot weather they should be head to the breeze.

Wind screens may be easily made of turf walls or tall, wattled hurdles, placed to windward of the lines, but roofed shelters of a temporary nature should not be erected for this purpose unless they can be so solidly constructed as to be quite safe in any storm, or grave loss may result. Roofed shelters should be provided with wind screens or walls to prevent draughts.

Protection from the sun is desirable in very hot countries, and in this case any light structure may be employed as shelter during the day, while the horses can be constantly watched and quickly removed. At night they should be picketed in the open. The shade of trees can be utilized if flies are not too troublesome, and the numnah or blanket may be placed over the loins.

Horses stand dry heat better than damp, and the amount of exertion they are capable of undergoing in hot countries is much affected by the quantity of moisture in the atmosphere. If it is great, there is profuse sweating, even when standing under cover, and over-exertion is liable to bring on heat stroke. Great judgment should therefore be shown when working horses under such conditions, and every opportunity given them to assuage their thirst.

Eye fringes are very useful, both as a protection from sun and flies. They may be made of leather or string, and buttoned or stitched on to the browband. Detachable fringes of string are the most convenient; they do not get hard and curly from exposure to sun, like the leather ones, and they can be removed for cleaning.

Every effort should be made to keep away *flies* and *mosquitoes*, particularly in tropical countries, as they are often responsible for the spread of disease, and cause great annoyance to animals. Smoke fires in the lines are sometimes helpful. Their breeding grounds, such as manure heaps, should be dealt with.

Stampedes.—Horses are liable to panic, and may stampede for what appear to be very trivial causes. Sudden storms and noises of any nature, thunder, lightning, hail, rifle shots; the presence of loose horses, especially stallions; wild animals passing through the camp, swarms of bees or flies, and grass fires in the vicinity are all known causes, but on other occasions the reason has not been apparent. If a large body of horses suddenly dash in one direction, probably nothing will hold them; but a strict supervision over the picketing, and the presence of the men at the horses' heads, when the occasion can be foreseen, are the best means of averting the disaster. The horses should not be allowed to get loose on the way to and from the watering place, and stray animals of every sort should be prevented from entering the camp.

Loose horses should not be chased by mounted men with a view to catching them; a little corn in a nosebag will attract most of them and enable them to be caught. The sounding of "feed" on the bugle will also often stop a stampede in the early stages.

Anti-bomb traverses should be 6 ft. high, 3 ft. thick at top, and 7 ft. thick at bottom. These then act as efficient wind screens in addition to giving protection against bombs.

Where revetting material is not available they can be made either (*a*) with plain earth covered with any rough turf procurable, in the form of an Irish bank, or (*b*) with alternate layers of earth and dung well pressed down and finally covered with road scrapings, clay if available, or earth. If the fresh dung is properly covered with earth sods, flies will not breed in it.

Anti-bomb traverses should be erected so as to leave a passage 8 ft. wide behind the horses, and proper provision should be made for drainage of storm water.

The plan should be spit locked on the ground before commencing work, and battens or posts and string used to keep the work in progress level.

The sanitation of the lines demands constant attention. The natural lie of the ground should be taken advantage of to get rid of storm drainage, and small clean-cut drains made in suitable direction to assist in its rapid removal. All rubbish should be cleared from the lines, and the standings kept quite level, in order that the horses may take a proper amount of rest, which they will not do if the ground is very uneven. For this purpose the free use of sand will be found of advantage; it fills in the hollows which are inevitable when the camp is occupied for any time, soaks up urine, and keeps the lines dry.

Disposal of manure.—Dung and other refuse should be removed regularly, and to a considerable distance from the lines, as it attracts flies, and is one of their favourite breeding places.

The site selected for the dung heap should be levelled, sprayed over with oil and surrounded by a trench filled with Cresol solution.

The dung should be tightly packed.

Dung 4 days old should be raked out and placed on top of fresh dung, by this method the temperature of the dung heap is raised and the eggs destroyed. The trench filled with Cresol solution serves as a death-trap for any larvæ crawling away from the intense heat produced in the dung heap.

Manure can also be disposed of by burning on the ground supported by a heap of hay wire, or on a cone of empty tins to the centre of which air is admitted by tunnels, and a central chimney made of perforated tins set end-to-end.

Manure incinerators may also be constructed with light rails placed upon bricks or Cresol drums.

Flies will not breed in dry dung, and desiccation kills their eggs. This being so, in hot, dry countries manure can be utilized for making litter roads and exercising tracks in heavy sandy soil. It can be used as a covering in a sandy kraal and may prevent animals eating the sand.

Incinerators and refuse pits or heaps should be down-stream from the camp, to avoid any chance of contaminating the water supply.

CHAPTER VII.

SADDLES AND SORE BACKS—COLLARS AND SORE SHOULDERS.

Structure of the Back.

Excluding epizootic diseases, it would be difficult to find any cause of inefficiency among army horses equal to that produced by saddle injuries. It will always be so, if insufficient attention is paid to the question of prevention, and few realize the extraordinary damage which may be inflicted in a very short time by an ill-fitting saddle or collar.

It is quite reasonable, in the face of past experience, to ask the question whether the class of injury we are about to deal with can be prevented to any great extent, or whether it is not one of the penalties paid for having domesticated the horse.

The question can be dismissed at once. It is a common, but not always necessary penalty; and its frequency is enormously increased by ignorance, indifference and want of intelligence, singly or combined.

In the ordinary course of things, it was not intended that horses should carry a weight or pull a load, or some special protection would have been given them, whereas the construction of the back is such that it lends itself to injury, and invites trouble by the very peculiarity and delicacy of its organization.

In fact, it may at once be stated, as our text throughout this chapter, that the basis of a sound scheme for the *prevention of injuries* from saddles and harness can only be laid down by a *knowledge of the structure of the parts*. All else is guesswork. There is probably no other branch of animal management where a knowledge of the structure of the body is so essential to a clear conception of the subject.

The spine is composed of a chain of bones, each link moving on the one in front of and behind it. It is true the movement is limited, but small as it is, it is of the utmost importance.

The movements of the spinal chain are upwards, downwards, and from side to side; these may be easily illustrated; the spine arches upwards when a horse "buck jumps," or backs, it becomes depressed under the influence of weight, it moves from side to side when an animal turns to the right or left, and especially in the "bending" lessons of the riding school.

Knit closely together as are the eighteen links comprising the back, it may be readily appreciated, from the above fact that this movement on each other, slight as it is, is of supreme importance.

When we come to speak of the weight which horses are capable of carrying, the necessity for spinal movement must not be lost sight of, as influencing the question.

The spine is distinctly arched, it rises from the neck bones, and falls again towards the hind-quarters. The object of this arched arrangement is to secure strength, and is infinitely more marked in the spinal column of man than in that of the horse. Man from his construction is essentially devised for carrying weight, for in this respect a vertical spine is far

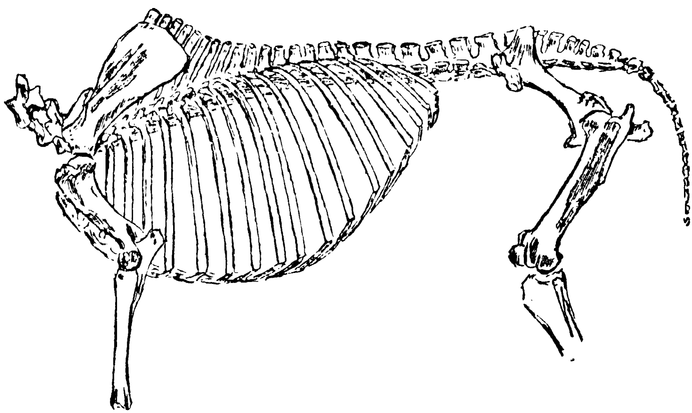


Fig. 25.

stronger than one which is horizontal, the arch-like construction is also more marked, while finally some of the individual links in a man's spine are actually larger than those of the horse.

The back and loins are frequently mixed up in the mind of the ordinary person, but it is essential for our purpose that they should be sharply differentiated. *The back bones extend from the last bone at the neck to the last rib ;* the loins lie between the last rib and the quarters. It is true that a great deal of the backbone is out of sight, being covered by the blade-bones ; *the portion of back which is visible reaches from the play of the blade-bone to the last rib*, and *this is the part which is of so much interest in saddle fitting*.

At this point it is desirable to compare what has been stated with Fig. 25, which shows the skeleton of the trunk, the arching of the spine from the root of the neck to the hind-quarters, and the amount of the back which is hidden by the blade-bone.

A reference to this figure shows that throughout the whole length of the spine may be seen a bony process which grows from the upper part of each link in the chain. The processes in front are very long ; and their summit forms the withers ; those behind are short and broad ; the front processes look backwards, those behind look forwards.

The upper part of the bony processes form the ridge of the backbone. They do not represent the spine proper (the links of which are more deeply seated), but they represent the only part of the spine which can be examined and felt, and they are the seat of all the bone trouble which may be found in a bad sore back.

The subject will be alluded to again, but the fact cannot be learned too early, that *these bony processes are not intended to bear weight ;* they represent, as we have expressed it above, the only part of the spine which can be examined and felt, but the spine proper is deep-seated and covered with flesh.

If the bony processes belonging to the spine are exposed to pressure, even be it ever so slight, the parts at once become inflamed.

A reference to Fig. 25 shows the ribs apparently growing out from the backbone ; as a matter of fact the head of each

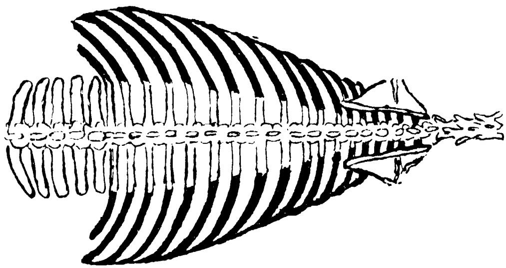


FIG. 26.

rib is let into a joint formed between every link in the spinal chain, and the object of this joint is to allow the ribs to move. The diagram also shows that the ribs in front are let into the breastbone, while those behind are lashed, as it were, to each other. These latter are called the false ribs. The former let into the breastbone are the true ribs.

The true ribs are stout and straight, the false are thinner and curved. The curving and arching of the ribs increases from front to rear, so that the chest is narrowest between the two front ribs, and widest between the two last.

This progressive increase in the width of a horse from front to rear is best seen by looking down on the back from above (Fig. 26), when the wedge-shaped appearance becomes very apparent. Fig. 27 shows a vertical section through a horse's body just behind the play of the shoulder, and another section (Fig. 28) taken in front of the loins. There is nothing diagrammatic in these; they represent actual sections from the same horse, and give a good idea of the difference in shape.

A true rib is stronger than a false one, and has much less movement. Advantage is taken in saddle fitting of its being fixed into the breastbone.

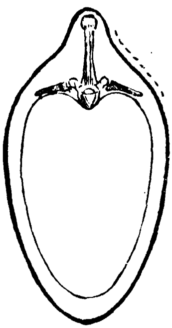


FIG. 27.

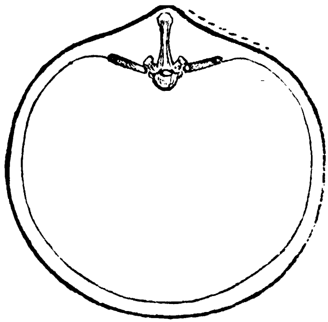


FIG. 28.

The ribs move with each act of breathing, the movement, roughly speaking, being forwards and backwards. The ribs in front move very little, those behind move very freely.

When a saddle is placed on the back, it rests on the ribs; it is on the ribs, and not on the spine, that the weight is actually carried. This fundamental fact must be committed to memory early, it is the basis of all saddle fitting. The rear ribs carry the weight on their upper surface, and may be seen indicated by the dotted line of Fig. 28. *The front ribs being stouter, and fixed into the breastbone,* can carry weight not only on their upper surface, but also on their side (Fig. 27); *if it were not for their being fixed into the breastbone, a girth could not be used.*

Turning now to the loins, we find this part is composed of five bones, which in several respects resemble the links of the backbone, but they are larger, and have growing out from them at right angles a thin long process such as the backbone does not possess, but there are no ribs. On the length of the transverse processes just described depends the width of the loins. A horse which is narrow in the loins cannot carry weight. *Yet although the loins are not intended to support weight, and no saddle should ever rest on them,* they have a function to perform which will be alluded to later.

The forelegs of the horse are not fitted to the body by means of a joint, but are attached to the trunk by means of large masses of muscle. The trunk is therefore slung between

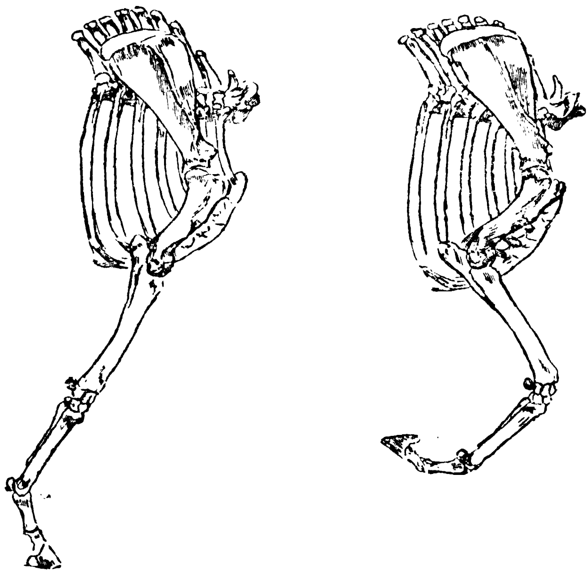


FIG. 30.

the forelegs, and in this respect differs considerably from the hind legs, which are secured to the body by muscles, and a large cup and ball joint. The muscles which fix the forelegs to the body are plastered over the sides of the ribs to which they are firmly attached; the upper bone of the foreleg, the so-called blade-bone, is shaped something like a fan in order to lie flat on the surface of the ribs.

When the foreleg moves the blade-bone moves; **its range of motion is greater near the shoulder-joint than above;** the movement of the blade-bone is forwards and backwards, but if Figs. 29, 30, and 31 be looked at, it will be easy to observe that while the handle of the fan is going forward, the fan itself is travelling backwards and *vice versa*. The movement is on the same principle as a see-saw.

Attention must be paid to this fact, as it will be apparent from an inspection of Figs. 29–31 **that if the blade-bone is travelling to and fro, nothing which is placed on the back in the form of a saddle should ever press upon it or interfere with its movements,** otherwise the length and

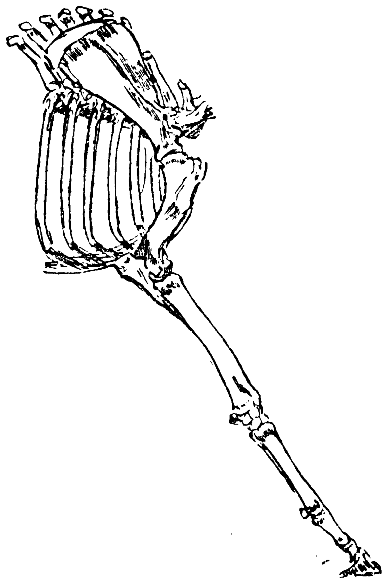


Fig. 31.

safety of the horse's stride will at once be affected. So vital is this question that we shall refer to it in greater detail in dealing with the use and function of the different parts of the back.

On referring to Figs. 27 and 28, it will be obvious that the triangular space which lies between the processes of the vertebræ and the ribs must in the living animal be filled up with muscle. A large slab of muscle runs the whole length of the back; beginning at the loins it fills up the triangular space formed by these vertebræ, and continuing its way along the back fills up the space between the vertebræ and ribs.

It is on this muscle that the saddle rests ; from a saddle fitting point of view it is the most important muscle of the body. Fig. 32 shows the superficial muscles of the back after the skin has been removed.

The use of muscles is to bring about movement, and those which lie along the back have for their special function the lifting of the forepart of the body—as, for example, in jumping. This, of course, is an exaggerated example of the use of the muscles of the back and loins, but conveys the correct idea of the forepart of the body being lifted ; this lifting, though only to a slight extent as compared with the above, is constantly occurring during progression, and maintains the proper equilibrium of the body.

If the skin be dissected off the back (Fig. 32) the muscles do not at once come into view ; beneath the skin is a thin, tough yellow elastic layer of material which spreads like a sheet over the loins and back and envelops the muscles, which it hides from view. It is there for the purpose of additional strength, but it is this layer of material which contributes so considerably to the surgical difficulties in treating bad backs, as it prevents matter pointing to the surface while affording it every facility for burrowing in all directions. It is true this point is only of interest to the surgeon, but the horseman would do well to bear in mind that injuries to the back, from the very anatomical arrangement of the part, all tend naturally to get worse instead of better, and are from the beginning complex, slowly healing injuries which cannot be hurried in their cure.

Up to this point we have described the bones and muscles of the back, we have now to clothe the part with skin, and deal in an elementary way with the structural peculiarities of the latter.

There are two skins, an outer composed of scales possessing very little sensation and no blood, and an inner which is highly sensitive and full of blood-vessels. There are many other differences between the inner and outer skin, but for our purpose these distinctions are sufficient.

Owing to the hair and the colour of the skin the blood can rarely be seen in a horse's skin the same as it can in a man's ; but it is there, flushing the parts now more, now less, depending on the temperature and other local conditions. It is only in the pink skin of horses with white heels that the blood-vessels can be seen, giving the part, especially under the influence of exercise, the bright, ruddy appearance seen in the active skin of a man at work. The vessels in the skin which carry the blood are hair-like in diameter and innumerable. Their structure is so delicate that very little pressure is sufficient to keep the parts empty, as can be easily demonstrated on one's hand; the white mark which follows temporary pressure on the back of the hand is due to the minute blood-vessels being emptied of their blood; as soon as the blood once more enters the white mark disappears. The influence of this question of blood in the skin will be fully dealt with later.

The outer or scaly covering of the skin is mainly for the purpose of protection; it protects the delicate parts beneath, and as it gets worn away by friction is replaced from below. Ordinarily the production of scales is equal to the wear and tear, but when friction causes wear and tear to predominate over production, injury arises and the sensitive parts beneath are then exposed. A rub to a back, a gall to a shoulder, are illustrations of excess of wear and tear over production, and represent the simplest form of gall.

The shape of a back depends entirely on the shape of the bones which compose it. Looking again at Fig. 25, bearing in mind how deeply the spine is situated, it is evident that the curve of the spine is represented by the bony processes previously described. When these are short, the back tends towards flatness, as in the donkey; when they are long, the withers are high and the ridge of the back prominent. These processes also determine the slope of the withers, long processes mean high withers, low processes mean thick low withers. The slope of back enormously influences the production of injury, and nowhere is this better seen than in the case of the withers. No horse with high lean withers should find its way into the Service for saddle purposes, and the opposite extreme of low thick withers is nearly, though not quite, so objectionable.

Long backs are a source of weakness, and as a rule they are poorly developed, while their length is in itself a weakness; such backs are frequently associated with long narrow loins, one of the greatest faults a troop horse can possess. **The loins can hardly be too short and can never be too wide.**

Backs vary as much in shape as any other part of the body; if careful measurements are made it is surprising how few have the same shape and size of back, yet a broad classification of backs may be made; here, for instance, is a table in which the extremes are shown:—

High withers.	Low withers.
Short backs.	Long backs.
Hollow backs.	Roach backs.
Wide backs.	Narrow backs.

And between these extremes any degree may be met.

FIG. 32.—THE SUPERFICIAL MUSCLES OF THE BACK.

A short back is a sign of strength, it is associated with a short wide loin, and provided the back is long enough for the saddle, the broad general statement may be made that it cannot be too short.

A long back is a weak back, it is associated with long weak loins and flat ribs, and its muscles are usually poorly developed.

High withers are generally associated with good action and front, but when excessively high it is not uncommon to find the back hollow, and such a one is unfit to carry weight under military conditions. High withers are always lean, narrow, and razor like; the horse that possesses them is always in danger of injury, for, as we have previously mentioned, the ridge of the back, which includes the withers, is incapable of sustaining pressure.

Low withers may be associated with low, clumsy action; when the withers are very low there is a compensation present in their width, they are always very wide. A wide wither is nearly as troublesome as a high one, not for the reason that it gets pressed upon, but owing to the fact that it is liable to be pinched.

Hollow backs are associated with high withers and high loins. It is a useless back for a military horse, as owing to its curve the saddle is unable to get a level bed on the back, and only the front and rear extremities bear on the back, with the result that injury follows.

A roach back is the converse of a hollow one, and is always a sign of great strength; but as the hollow back is very comfortable for the rider, the roach back is most uncomfortable, and such a horse may soon tire a man out.

Wide backs are those which possess a good arch to the ribs and afford a good wide bed for the saddle to rest on; it is an essential formation for a soldier's horse, though excessive width must be avoided, as the saddle will work forward on to the neck.

Narrow backs are due to ribs possessing defective curvature; the ribs are too straight, and in consequence there is very little bearing surface for the saddle, and what back there is has a slope like the roof of a house, while the sides are flat. A flat-sided horse, besides carrying his saddle badly, is deficient in stamina and soon succumbs to fatigue.

The appearance of muscle generally and how it is strengthened has been previously described (*see* pp. 3, 169), and the muscles of the back (Fig. 32) are now specially considered, not from the point of view of the anatomist or surgeon but from that of the hygienist.

A saddle must not rest directly on any of the hard

structure of the back, be it spine or ribs ; it must only rest on those parts well clothed with muscle, and the only part of the back so clothed is the angular space formed by the ribs and processes of the vertebræ (*see* Figs. 27, 28) ; the dotted line represents where the saddle should bear.

In saddle fitting the muscles of the back act as a buffer to the bones beneath, and so prevent injury ; where a part of the back has no muscle to protect it, there the saddle cannot rest, or, if it does, injury results.

The importance of having well-nourished back muscles is very great ; where they are large and well developed the parts beneath are sufficiently protected, where they are impoverished and weak the animal is in hourly risk of injury.

When horses are working hard and are underfed, one of the first places to show muscle waste is the back. The muscles, previously convex, now become concave until well-marked gullies form along either side of the spine, while the ribs previously hidden are now in view and can be distinctly counted. The whole shape of the back is altered ; it is as if some new structure had taken the place of the old, and all this is explained by the melting of the muscles on the back bringing the skeleton beneath into view.

It is this metamorphosis of the back which has to be so anxiously watched on service. It is this which renders all previous saddle fittings useless, for the impoverished back is as different from the well-nourished one as anything can possibly be ; it is as though the skeleton to the living subject were compared.

We dwell upon and emphasize this question of back muscle ; it is the foundation of a clear conception of sore backs and their causes, and it is the basis of all preventive measures.

We have previously mentioned something of the structure of the skin, but have now to deal with certain features in its construction which influence, to a considerable degree, the production of sore backs. We have described the blood-vessels in the skin and how readily pressure acts in keeping these vessels empty ; the illustration which was given being the white mark on the back of the hand after pressure with a finger.

The lay mind does not readily grasp the fact that quite a considerable portion of the blood of the body is circulating, in the skin, and that one object of this is to ensure the rapid renewal of the skin, which, being exposed to friction, would soon wear away to the sensitive parts unless constantly replaced. There are other functions the blood and the skin perform, but these are not germane to our subject and may be neglected.

If the blood supply of any part of the body be cut off, the part dies. Whether it dies rapidly or slowly depends upon the thoroughness with which the blood stream has been cut off: if complete, the death of the part will only be a matter of a few hours; if incomplete, it may take a few days. This statement holds good whether it be the question of a limb or a small piece of skin on the back.

Pressure will kill any of the tissues of the body; a leg may be completely amputated, skin, muscles, and bone, without the use of a knife or saw—a simple piece of elastic cord will do in the course of weeks what a knife can do in a minute or two. The pressure of the cord cuts off the blood supply, the part dies, and is gradually cast off.

The limb amputated by an elastic cord is an exaggerated example of the influence of pressure; for the purpose of the subject we are considering we have not to think of any pressure greater than that produced by a man's weight, or of any structure dying as the result of this pressure other than those found in the back.

The skin of the horse's back is subjected to pressure when the man mounts, and in consequence less blood circulates through it than before. The greater the weight imposed the greater the pressure on the skin, and with every increase in pressure less blood is circulating through it.

It is safe to say that the pressure is never quite the same at any two points over the back; it is greater here and less there, depending upon the fit of the saddletree, so that we never expect to see the whole length of the skin of the back die as the result of pressure, but only those parts where the tree has been particularly ill-fitting and the pressure the greatest.

It is obvious that so long as there is a good deep muscle bed beneath the skin the chances of completely cutting off the blood supply are very small; as the muscle becomes reduced in bulk the saddle is brought day by day nearer to the skeleton, and the unyielding saddle on the one hand and rigid bone on the other very soon complete the destruction of the skin.

The muscle of the back may be regarded in the light of so much extra stuffing in the saddle, it saves the bones and skin from injury; it takes the jar and concussion, and forms an elastic cushion for the saddle to rest on.

This point having now been made clear it is easy to understand the harm which arises through horses being hour after hour under the saddle with no relief from their burden.

Continuous pressure will kill anything. The weight of a drop of water in course of time wears away a stone, and continuous pressure, quite irrespective and apart from bad saddle fitting, will wear holes in a horse's back. The most perfectly fitting saddle that it is possible to conceive will cause sore backs if worn for hours and days together with no relief from pressure.

The value of this lesson will be again referred to in speaking of prevention, but the fact that long continued, unrelieved pressure will invariably cause sore backs cannot be too distinctly borne in mind.

It might be supposed that the weight of a horse's body was equally distributed over his limbs and that the hind and fore limbs supported the same weight.

This is not so. The fore limbs carry more of the body weight than the hind, and the amount which they carry is influenced by the position of the head, which, if held high, relieves the forelegs from weight, and if depressed increases the weight.

Nor is the rider's weight equally distributed over the limbs; nearly two-thirds of it comes on the forelegs and only one-third on the hind.

The place on the back where a horse carries his saddle depends on his shape. With low, thick withers the whole tendency of the animal's movements is to drive the saddle forwards, and, as we shall see later on, nothing but a special mechanical contrivance can prevent this taking place.

But no matter what the shape of the horse may be, the saddle has always a tendency to work forwards.

This may be explained by looking at any back, which shows that there is a small though distinct fall from the loins to the play of the shoulders; besides this there is the weight of the rider, which must be an important element in determining whether the saddle will maintain its position or be carried forward.

Nothing, however, influences the question so much as the shape of the ribs; if these are unduly curved and prominent, suddenly expanding behind the brisket, it is impossible for a girth to get a grip on the skin, and the saddle soon finds its way on to the base of the neck.

It might be thought that if the natural tendency of a saddle is to work forward, the same must hold good for a numnah, saddle-cloth or blanket placed under the saddle. But the fact is otherwise; these have a natural tendency to work backwards and come out at the rear of the saddle, and that, we think, is explained by the direction of the hair, the blanket or numnah slipping with the hair and not against it.

Whatever the explanation may be, the facts remain that the tendency of a saddle is to work forward and of a blanket to work backwards, and one of the functions of a girth is to prevent this occurring.

The working forward of a saddle is a serious evil. We have previously referred to the blade-bones and their movements, but the time has now arrived when these must be studied with a little more detail, so that we may fully realize what are the disadvantages of blade-bone pressure.

At every movement of the forelegs the blade-bones are working to and fro; when the foreleg and shoulder advances that portion of the blade-bone in front of the saddle goes backwards, on the principle of the see-saw movement previously alluded to, and conversely when the blade-bone in front of the saddle is travelling forward the foreleg is passing backwards.

Blade-bone movement is of the utmost importance; if a saddle be so fitted as to interfere with it the stride of the horse is shortened, he becomes tired before his time, and, further, being unable to properly get the leg forward, he stumbles.

To ride on a horse's blade-bones throughout a long day's work is to ask him to perform his work at a mechanical disadvantage, and to imperil the safety of his knees, a fact which must be remembered in considering the correct position for the saddle.

SADDLES.

It is intended here to consider saddles as a whole and not refer to any particular type, excepting where such reference is necessary. It is thought that in this way the subject can best be considered, as no matter how saddles may differ in detail, there is a certain unity of type existing.

The arches.—The framework of a saddle consists of two arches, one in front and one behind the rider, each arch resting upon and secured to two bars placed parallel to each other, through the medium of which the rider's weight is distributed on the back. This description holds good whether we are speaking of the racing saddle of the twentieth century or the saddle hanging over the tomb of Henry V in Westminster Abbey.

Two arches are used so as to ensure the spine is not pressed upon, and two bars are used by which the arches are kept in their place. Here we have the conception of a saddletree, the principles of which have never undergone a change; finality was at once reached so far as the general idea of protection of the horse's back was concerned.

The more weight which is carried on the saddle, the stronger it has to be, and a stronger saddle is a heavier saddle. The question is often asked: Why is not a military saddle like a plain saddle and as light as one? The answer is that such a pattern could not carry the impedimenta, nor could a lightly constructed saddle possibly stand the strain to which a military saddle is exposed. It is obvious that the more weight it has to carry and support, the stronger it must be, and that the first step towards a light saddle is a light load.

The arches of a saddle are made of wood or metal, or a combination of these. Metal is used in all military saddles.

Wooden arches strengthened by metal are used in all plain saddles and many others which for necessity might have to be impressed into military service in time of war—for example, the so-called Colonial saddle.

The front arch forms the pommel, the rear arch the cantle; both pommel and cantle may be high or low; they are made

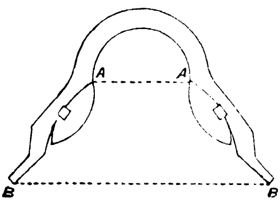


FIG. 33.—Front arch of the saddle showing the places from which the various measurements are made.

high, especially the cantle, when bulky material has to be carried on the saddle.

The strain on a front is greater than that on a rear arch, for the reason that, owing to the shape of the horse's body, the saddle is really resting on a wedge (*see* Fig. 27), and this with the weight of the rider is constantly exercising an outward strain on the arch. This strain is greatly increased where the fit is defective and excessive weight carried.

A steel arch is very strong and not likely to yield under ordinary strain, though it may break from the violence to which military equipment is often exposed. Iron arches, especially if flat and not angle iron, are very liable to open under ordinary strain, and this causes them to be condemned for military purposes. In a wooden arch it is the gullet plate which breaks, generally through a rivet hole.

It must be evident that in whatever way the front arch fractures, the risk of wither injury is considerable, but, as a matter of fact, the arch rarely breaks, and though wither injury is common, it is only occasionally due to this cause.

The important points to attend to in an arch, apart from its strength, are :—

1. its height.
2. its width.

Nearly the whole of the wither injuries met with in the Service are due to one or the other of these causes. Either the arch is not high enough or it is too narrow ; sometimes there is a combination of these evils, but more frequently they are single and an injury from a narrow arch is more common than that from a low arch.

The subject of injuries has yet to be dealt with in detail, but to prevent misconception it is desirable to state here that most of them are the result of bad fitting, loss of condition, or other service conditions rather than errors in manufacture, such as the above remarks might appear to suggest.

When the front arch extends below the side bars, the extension is known as the "points," and these are intended to help the girths and prevent the saddle from heeling over. They appear unnecessary, and are not present in the Modern Universal Pattern Military Saddle.

The rear arch is made of metal in all modern military saddles ; in plain saddles and those of the Colonial pattern it is of wood strengthened with steel.

The tendency for a front arch is to spread, but with a rear arch the tendency is to sink under the weight of the rider, and in consequence most military rear arches are supported by backstays to prevent this occurring. Like the front arch, it must be high enough to clear the spine, but the question of width is by no means so important as in the front arch, while the strength of material is equally important.

The side bars.—The side bars are that portion of the saddle which rests on the back, and to which the front and rear arches are secured.

Side bars are generally made of wood, and are given a twist in the making which enables them to be adjusted to the curves of the back.

Side bars may be made of metal, but these are not in common use ; wood, be it either for a military or plain saddle, is the substance generally employed. If Figs. 27 and 28, which show the shape of the vertical section of the body beneath the front and rear arches, be looked at, it will be obvious that the shape of bar suitable for one is unsuitable for the other, and, speaking broadly, we may say that while the side bar in front tends to be upright, behind it tends to be flat. This difference in shape is accomplished by giving the bar a twist in the process of manufacture.

We have dwelt on the fact that all horses do not have the same shape of back, yet most side bars are so alike that one cannot be distinguished from another.

This fact has caused attempts to be made to manufacture self-adjusting side bars, so as to enable them to take the curve of different shapes of back, and follow the alterations in shape which result from loss of flesh.

Such mechanical contrivances are not required in civil life for reasons which we cannot enter into here, but for military saddles would be of the highest value; and their general adoption is only a matter of time.

The function of a side bar is to afford a firm support for the arches of the saddle and to distribute the weight over the back.

Bearing in mind the weight-bearing region, viz., from the play of the shoulder to the last rib, it is clear that over this surface the side bars should rest evenly, squarely, and without undue pressure at any one point.

Such is the theory; the practice, however, is very different, arising from difficulties which are not always capable of control, especially the exigencies of military life.

Let us, however, assume a theoretically possible case, viz., the side bars of a saddle moulded and fitted to a horse's back in such a way that they bear evenly over the whole surface. This will take some patience to accomplish, but it can be done by taking a mould of the back and working from it.

A saddle so fitted distributes the pressure evenly all over the surface of the side bars, but only so long as the back remains in the same condition as it was at the time of moulding. Should muscle waste occur the bars no longer fit; should the muscles of the back become larger and fuller, the same result follows; unless, therefore, the same condition is maintained, the care and time occupied in moulding the bars to the curves of the back is thrown away.

In practice we have to be satisfied with something which falls far short of the ideal, but is the nearest approach which is practicable.

This is just as marked in fitting a plain saddle, where, in fact, little or no attention is paid to the curves of the side bar —the fit of the saddle and distribution of weight being assured through the medium of a pannel stuffed with horsehair and flock.

If the side bars for military saddles were no longer than those used in plain saddles, their management would be greatly simplified, but it is considered necessary that they should project beyond the front arch and behind the rear arch, in order to assist in carrying the man's impedimenta. That part of the side bar projecting beyond the front arch is termed the "burr," and little reflection will show what a serious obstacle it may prove to the fitting of a saddle, and to the locomotion of the horse.

Taking the latter as being the most serious objection, it is evident from our account of the movements of the blade-bone, that a "burr" to the side bars is calculated, unless great care in fitting be adopted, to press upon the shoulder-blade and prevent the free extension of the limbs. If a horse cannot get his forelegs carried to the front with freedom, he becomes tired earlier than he should. His shoulder-blades are encased in a veritable strait-jacket, if a pair of side bars are pressed into them by a tight girth and the weight of the rider.

It can be no matter for wonder that under these conditions he may even fall when tired, and, under any circumstances, may constantly stumble and trip.

No weight should be imposed on the blade-bones; free and uncontrolled backward and forward movement is essential. The movement of the human ankle is a very fair comparison to the movements of the horse's blade-bones, and we can have no difficulty in realizing what the result of interfering with the free play of the ankle would be if we caused a wooden splint to project over it.

Indeed, in more than one case, the human foot and its management forms a very close parallel to the horse's back and saddle. There are certain parts of the sole of the human foot incapable of bearing weight, as there are certain parts of the horse's back so incapable. The fit between the sole of the boot and that of the foot should be perfect and ideally smooth. So should be the fit between the side bars of the saddle and the back. The least undue pressure on any part of the sole of the foot, caused by a wrinkle or even knot in the sock, will produce injury, and so will corresponding slight irregularities in the fit of a saddle produce a sore back. Any boot will not fit any foot, and any saddle will not fit any back. The comparison might be extended, but the point is secured if, instead of comparing the human foot and boot to the horse's foot and shoe (with which there is not a single point in common), we compare it to the horse's back and saddle, in which the parallel is remarkably close, while the comparison is valuable as an addition to one's common sense in applying practically the ideas here laid down.

The play of the shoulder-blade and the hollow behind the blade-bone are important landmarks in saddle fitting, and the side bar should lie in the latter and extend from there to the last rib. In spite of "burrs," a saddle may be so fitted as to occupy the position indicated without pressing on the blade-bones, and the question will be dealt with later.

The projecting portion of the side bars behind is known as the "fan"; it is given an upward sweep in the manufacture of the side bar, but with many backs this is insufficient to carry it clear of the loins.

It is the loins and not the back proper which get injured by the fans, the injury being produced by friction. To understand this, we must glance at the movements of the loins during locomotion.

Attention has previously been drawn to the fact that the forelegs are not fastened to the body by means of any joint, and very little observation will show how close the blade-bones are to each other at this upper part; in fact, if a hand be placed over the withers, the palm is in contact with one blade-bone, while the fingers are touching its fellow (Fig. 26). Now, with the hind legs, a large joint secures each to the body, and these joints are several inches apart. In other words, while the forelegs above are set on close together, the hind legs are set on some distance apart.

The influence of this is to produce a rolling or side to side movement in the loins, with the advance of each hind leg. This movement can be better felt than seen, and is at once obvious if, when mounted, the hand is placed behind the saddle.

When the fans of the saddle rest on the loins, the friction produced by this rolling action produces injury, and the shorter the horse's back, the greater the chance of injury, as the fans then more completely cover the loins. By care in fitting, it is comparatively simple to overcome this cause of trouble (*see* Fig. 35).

There are certain classes of back which especially lend themselves to injury by both "burr" and "fan." For instance, a hollow back is certain to be injured by both ends of the side bar, and the reason of this is evident.

A horse with thick, low withers, with blade-bones comparatively wide apart, is peculiarly liable to injury from the "burr."

When muscle waste becomes established, the edge of the blade-bone at the play of the shoulder becomes more and more evident, as the long muscles of the back melt away, until it stands up like a new growth.

Under these conditions, the "burr" will press on it and do injury, as the muscles of the back having wasted there is nothing to keep the saddle off the blade-bone.

Another type of back liable to injury from the side bar is the roach back, and it is evident that the position of the injury to which it is liable is just the reverse of that produced in a hollow back. In the roach back it is the centre of the side bar, rather than the extremities, which cause the trouble. On this point, further reference will be made in speaking of the cause of injuries.

The remaining point to notice about the framework of the saddle is the distance the two side bars are apart. In a plain saddle they are comparatively close together. We now know that the side bars must be kept sufficiently far apart to allow them to clear the side of the withers when the blanket, numnah or pannels are placed under the saddle. The distance which side bars are kept apart depends entirely upon the width of the front arch. Where the bars are close together the side of the wither gets pinched, especially when horses lose flesh, so that it is almost impossible to have the channel between the bars too wide.

One great reason for this is that circumstances necessitate a blanket should be carried under the saddle—perhaps two; and if the distance between side bars is insufficient, the thickness of these blankets will cause the side bar to rest on the side of the withers, for it is obvious that the tendency of a saddle blanket and numnah is to fill up the interval between the side bars.

The seat and flaps.—We have so far considered the framework of the saddle, viz., the two arches and side bars. These comprise the essentials of a saddle, and if they fit—or to put it perhaps more accurately—if these are big enough, and in any way resemble the surface on which they are to rest, the other parts of the saddle become mere accessories, for example, the seat, flaps, pannels, etc.

The seat is a convenience for the rider; a blanket laid over the tree of the saddle would do as well, provided there was very little back waste. The seat is a part of the saddle which, so far as it relates to the man, does not here concern us, but it may be a source of injury to the horse, if through the leatherwork stretching or stitches giving way, it comes down on to the spine; it is obvious that this is only likely to occur through loss of condition or its equivalent, so far as saddle fitting is concerned, viz., thin blanket or pannels. The strain on a seat is considerable, and in order to support this bridge of leather, there is introduced under it a sling of webbing which runs from arch to arch, and so takes off very largely the strain on the leather.

Seats are strained by other methods than riding: a tight overgirth is one of the chief causes of seats sinking.

Flaps to the saddle, like seats, are not a necessity, but a convenience—a blanket would do as well. The saddle flap is rarely the cause of injury, and we may therefore dismiss any further consideration of it.

The material which goes between the saddle and the back consists of blanket and numnah, or blanket and numnah pannels. The ordinary Service method consists of numnah pannels strapped to the side bars, and blanket.

Pannels.—Those on a plain saddle consist of a bag made of leather and serge, stuffed with flock and horsehair, but in military saddles they have been long discarded. In face of the fact, however, that all types of saddle are used in war, including those with hair pannels, it is necessary the subject should receive some consideration at our hands.

Pannels stuffed with hair have one very great advantage, viz., that in course of time they get moulded to the shape of the horse's back, and adjust themselves to all irregularities. This is the explanation why so little attention is paid to the fit of a plain saddle; so long as the front arch is wide enough, the saddler does not trouble his head any further, but depends upon the hair in the pannels completing the fit, which it most certainly does. This adjustment of pannels to the shape of the back is very noticeable; the stuffing in a new pair of pannels will with very little work settle down, so that the pannel becomes reduced in thickness; and while the settling down is taking place the two bags of hair are being moulded to the peculiarities of the back, and the saddle made to fit through its pannels instead of through its tree.

Theoretically this is wrong in principle, though it certainly works out in practice, and may, therefore, be defended; but for the pannel, the civil saddle would be a constant cause of sore back.

Pannels have their weak points, they may be too bulky or too thin, the stuffing may have become hard, lumpy, or even caked if sweat has passed in. Until every soldier knows something of saddlery, it is fair to urge that a pannel requires a saddler to deal with it, whereas there are other means much simpler, such as a blanket, which a soldier may adjust for himself. No doubt it is owing to this that pannels have disappeared from the regular service of the army, as their alterations can only be effected by a trained man.

Pannels are made of felt (numnah) and fitted to the side bars; by themselves they are insufficient protection to the back. They must be used with a blanket, and are then useful. Strips of numnah of varying lengths may be usefully employed in making a saddle fit; two, three, or more layers may be cut out, kept together by a stitch or two, and bound to the side bar. This will be again referred to in dealing with sore backs, for which purpose strips of numnah are of the greatest value.

Blankets.—A blanket beneath the saddle is a most admirable method of protection. It does not lend itself like a pannel to graduated variations in thickness, but, on the other hand, it can be dealt with by a person without any instruction in the trade of a saddler, and the changes he can effect by altering the method of folding may be brought about in a few minutes.

A good thick blanket is economy, a thin blanket an abomination; a good blanket folds, a thin blanket wrinkles; a good blanket saves a back from bruising, and lasts some time; a thin blanket has a short life, and is never satisfactory when horses are losing condition.

The great recommendation of a blanket is that so many useful adjustments may be made by alterations in its folding when a back becomes worn or injured, and this will even be the chief recommendation of a blanket under a military saddle. In fact, a blanket is the only means of immediately replacing artificially the amount of flesh a horse loses, and so enables us not only to prevent the ribs from becoming bruised through the whole weight of the rider being brought closer to the body, but also to keep the arches of the saddle clear of the spine. It must not be forgotten that every ounce of flesh lost on the back brings the saddle nearer to the delicate parts below, and increases enormously the liability to injury.

Is the saddle blanket to be used as a horse blanket? We are aware that this question has been authoritatively settled in favour of the one blanket performing both services; but it appears to be opposed to all experience.

No ordinary human skill or foresight can prevent some blankets working off in the night, getting under the horse's feet, and becoming torn, muddy, and wet. All these are inseparable from the use of any cover for a horse's body, and especially one which has to be kept on without a proper body roller, and often without a pad. It frequently happens that, having found from experience the most suitable method of folding a blanket, a stitch or two is placed in it to keep the folds in position; this may be a most useful expedient, but is of no use if the blanket is also to be used as a horse cover. There can be no doubt that in practice the saddle blanket cannot, for the reasons stated above, be used for two distinct purposes, but that reason and experience dictate a saddle blanket shall remain a saddle blanket.

If a blanket be placed under a saddle, especially one with bare side bars, it gradually works out behind; to prevent this a numnah pannel is fixed to the side bar, which gives it a grip.

The saddle blanket is not a square: the length is about five feet nine inches, the width four feet ten inches. The method of folding usually adopted in the Service is to make two folds giving four thicknesses of blanket.

The length of the blanket is folded first, then the width, this gives two folded edges and two raw edges.

The blanket folded measures about two feet ten inches by two feet five inches.

The thick folded edge is placed in front, the folded edges on the off side and the raw edges on the near side and rear of the saddle.

There are several methods of dealing with the blanket, which will be referred to in the section on sore backs, but the general principles may be conveniently noticed here.

1. The blanket must be slightly raised off the withers and backbone and be flat on the back without wrinkling.
2. The more folds placed in a blanket the more the channel between the two side bars of the saddle is filled up. In consequence of this, pressure is exercised upon the spine and withers, which may get pinched and inflamed. If it is necessary to place many folds in the blanket, they should be put under the side bar and not under the arches, the blanket being folded from each side and not from the centre. In this way the channel of the saddle is not filled up; by any other system it is.

When speaking of the front arch, the necessity of it being wide enough to admit the blanket, and whatever else may be placed under the saddle, is to be emphasized.

No more folds should be placed in a saddle blanket than are necessary.

What thickness of material shall be placed beneath the saddle? This is governed by two conditions (*a*) the amount of flesh on the back, (*b*) the amount of work a horse is performing. Assuming that the conditions are Service conditions, viz., a moderate amount of flesh on the back and an immoderate amount of work to be performed, then the golden rule is to have ample material beneath the saddle in order to prevent the parts becoming bruised through heavy weight and long hours. Weight transmitted through a thick blanket and good numnah is distributed; that which is transmitted through a thin protection is concentrated.

It is most desirable there should be as few layers of blanket beneath the arches as possible ; the necessity for this has previously been dealt with.

A blanket may be folded six layers throughout, by folding first in three and then doubling it.

Channel fold.—Three layers under the arches and six under the side bar is obtained by laying a blanket folded in three layers across the back and then turning up one extremity and placing it under the side bar, but not carrying it up so high as to fill in the arch ; three under the arches and nine under the side bar is obtained by folding up both ends twice.

In putting nine layers under the side bar, it must not be forgotten that the ribs are left very exposed, and that there is nothing to prevent the ribs from being bruised by the girth attachment and girth buckles.

Nine layers of blanket under the side bar can only be required for horses losing muscle, and where the back waste is great, there may not be sufficient to keep the saddle at its proper height above the spine. In such cases twelve layers may be employed, but it is better to use hay, grass, straw, rushes, and such like, placed between the folds of the blanket under the side bar, rather than twelve layers of blanket.

The disadvantage of having too many folds under the side bar, apart from the risk of the ribs being bruised, is the difficulty of keeping them in position, unless the blanket is stitched at one or two points.

One man can fold a blanket, but for channel folds it is better done by two ; the folds are then made with greater regularity, and there is less chance of a blanket being placed on the back with wrinkles in it.

Numnahs are generally made of felt, though leather has been tried. The use of a numnah is not to make the saddle fit or render it soft to the back (incidentally it does both), but its function is to absorb the sweat. This is where the leather numnah failed ; it was not absorbent, and in addition presented the disadvantage of becoming dry and hard under the influence of sweat.

The girth.—Various considerations cause the Service girth to be made of leather, rather than webbing, cord, or raw hide. The last three, however, may have to be used and are excellent as long as they last.

A soldier's saddle has to be kept more firmly girthed up than a civilian's, owing to the greater weight, much of it top-heavy. To avoid undue oscillation this weight has to be steadied, and a girth too tight for a hunter may be absolutely necessary with a troop horse.

In order to give further assistance in steadying the weight, the girth, instead of being secured to a central attachment, is buckled into straps which come from either end of the saddle. This V attachment is an immense advantage where great weight is concerned.

The girth passes around the brisket, and owing to the shape of the latter, it lies in a kind of hollow formed by the brisket and belly. Some briskets are so shaped that no hollow place exists for the girth, and with such horses the girth works forward against the elbow owing to the brisket running up instead of down. Under ordinary circumstances it is the edge of the girth pressing against the brisket which keeps the saddle back; if the girth gets no such purchase against the brisket the saddle goes forward.

A brisket which runs up towards the elbow instead of down, is frequently associated with a prominent arching of the rear ribs and a big spreading belly. This is a hopeless combination with an ordinary girth, and means that the horse must always carry his saddle on his neck.

String, raw hide, and webbing girths act by the facility with which they catch not only the edge of the brisket but the skin; with a hide or string girth portions of skin project between the strands, which have a steadying effect, but especially there is the grip which a narrow material like string has over wide material like webbing.

This action is frequently imitated in leather girths by splitting them into laces, and a split leather girth is a regulation one.

One of the great difficulties with a girth is to prevent it getting harsh through sweat and dirt, and this particularly applies to a leather or hide girth; yet under ordinary circumstances it is not the harshness of a girth which causes it to gall, but rather the bodily shifting forward of the saddle, by which the edge of the girth is dragged forward behind the elbow.

Girth galling is either a question of condition or of make and shape. A horse that persistently galls is one with wide arching ribs, elbows close to the sides, big belly and shallow brisket.

The prevention and palliation of girth-galls will be considered later.

Fitting the Saddle.

It has not been found possible in speaking of the structure of the saddle to avoid making some reference to its fit, but this section is specially devoted to a consideration of the fundamental principles of saddle fitting.

There are six axioms in saddle fitting never to be forgotten. They constitute the essence of the whole subject, and when they are applied intelligently, saddle fitting becomes almost an exact science :

1st. The withers must not be pinched nor *pressed* upon.
2nd. The central line of the back must have no pressure imposed upon it.
3rd. The blade-bones must have free and uncontrolled movement.
4th. The loins are not intended to carry weight.
5th. The weight must be imposed upon the ribs through the medium of the muscles covering them.
6th. The weight must be evenly distributed over a surface which extends from the play of the shoulders to the last rib.

In rule 1 the word " pressed " is placed in italics ; there are many who know the withers must not be pinched, but there are many who do not realize that something far short of pinching is sufficient to set up disease if long continued.

In fitting a saddle, that size which is nearest to the horse's requirements is selected. There are several sizes to choose from, and in making the choice the *bare tree* with numnah pannels is tried on the back.

Having been placed on the back, the front arch resting in the pit of the shoulder, the following points are looked to :

The arch and seat should, if possible, be clear of the spine. This is not always possible with horses possessing high withers, but it is desirable in order to ascertain the fit of the side bars.

The front arch must be wide enough to admit the hand on either side of the wither.

The side bars must bear evenly on the back, or as nearly so as can be obtained. The points of the tree must be wide enough apart to clear the ribs.

The side bars must not be too long. At this stage it is no use looking to blade-bone and loin pressure ; these can only be avoided when the blanket is placed under the saddle. All that can be done at this stage is to make sure the edge of the side bar is not pressing into the withers or ribs, and that the arches are wide enough.

It cannot be too often insisted on that a numnah or a blanket reduces the width of a front arch, and narrows the saddle across the top of the side bars.

The blanket is now folded, placed on the back and the saddle on the blanket. The blanket is pressed up well into the front arch, and before girthing up it should be noticed whether the " burrs " are off the shoulders and the fans off the loins ; if they are not the thickness of the blanket beneath the *side bars* must be increased by turning it up on either side. The girths are now pulled up and a man placed in the saddle.

The fit of a saddle can never be determined without seeing a man in it; parts may appear out of harm's way when no weight is in the saddle, which are brought dangerously close under the pressure of a man's weight.

The first thing to ascertain is the freedom from wither pressure; the hand must readily find admission beneath the blanket over the top and along both sides of the withers. To increase the severity of the test, the man should lean forward,

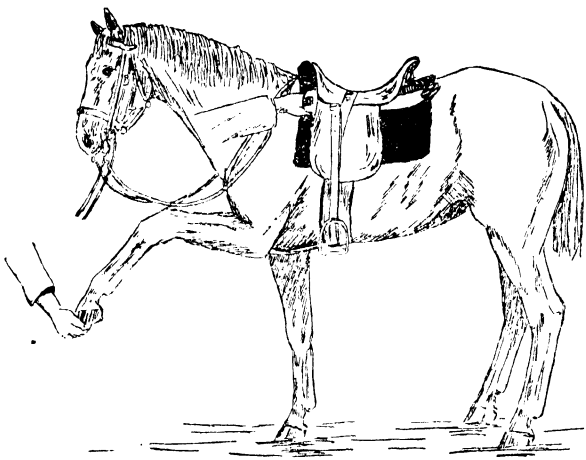


FIG. 34.

and the examiner must not be satisfied with anything less than the introduction of the entire hand.

The next thing is to ascertain freedom from blade-bone pressure. This is done by passing the hand beneath the "burr" to the play of the shoulder; if there is pressure it is only with difficulty it can be introduced. Assuming the hand can find its way in, the foreleg is advanced by an assistant (Fig. 34) to its full extent, and this should be possible without pinching the fingers of the examiner behind the blade-bone and side bar, even with the man leaning forward. If the fingers are pinched the blade-bone will also be pinched, and the saddle must be raised by placing either a pair of numnah pannels on the side bar or an extra fold of blanket. Both blade-bones are, of course, tested.

The fans are now tested for loin pressure; with the man leaning back in the saddle, the flat of the hand should find ready admission between the fans and the blanket.

Should the saddle under examination be in possession of hair pannels, and these found to be pressing on the shoulder-blades or loins, the hair must be forced backwards out of the part by means of an awl, and the part of the pannel corresponding to the " burr," or " fans," stitched across to keep the hair from re-entering (Fig. 35).

Assuming we have remedied all the above defects, the saddle should be ridden in, say, for half an hour, and the next step is to ascertain whether the pressure of the side bars is evenly distributed ; this can be learned in the following way.

The saddle is carefully ungirthed, and lifted from the blanket without in the least disturbing it. The blanket will

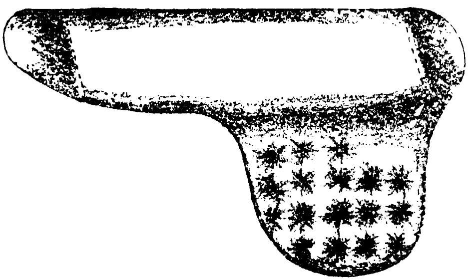


FIG. 35.—View of pannel with the stuffing arranged to keep pressure off the blade-bones and loins.

be found to bear the imprint of the side bars, and an examination of this depression shows at a glance whether they are pressing evenly from top to bottom and from front to rear.

The examination has to be rapidly made, as the blanket through its elasticity soon loses the impression of the side bars and the mark of the latter becomes obliterated.

The most usual places to find excessive pressure are at the top edge of the side bar behind the front arch, and the bottom edge in front of the rear arch, and if there is a deeper impression on the blanket in these situations than in any other portion of the bar, it may accordingly be said with certainty that the pressure is not evenly distributed and that the parts of the back corresponding with the more marked impressions are receiving an undue amount of the weight. This with a horse in condition, or with a good blanket and numnah, may not necessarily mean a sore back ; but it certainly means a sore back should the horse lose condition or the blanket or pannel be thin and the tree be thus brought nearer to the bony framework.

This irregularity in the fit of the side bars may be remedied by the introduction of pieces of numnah to fill up the space between the side bars and blanket. With very little practice these pieces of felt may be cut to the required shape and thickness; some edges will need to be almost as thin as a knife-blade, and other parts will require adding to.

Once the pieces of felt have been cut they must be secured in position. In peace this can be at once done with glue, but in the field they may have to be tied on, or, what is better, bound in position by means of a piece of thin leather (basil) which envelops the side bar at the required part and can be laced with string across the top.

These strips of felt are capable of effecting the most radical alterations in the fit of a side bar; the method has the value of simplicity and requires no trained workman; finally, it can be carried out in a very few minutes.

It must never be forgotten that no matter what care is taken in the fitting and alteration of saddles, such fitting is only applicable to the "condition" the horse is in at the time. On active service the saddles require looking to every day. They should be inspected just as regularly as the feet are. Every weak point in the fit of a saddle in a squadron should be known, and the remedy already arranged for should trouble arise. In no other way is it possible to bring horses through severe work with whole backs.

No allusion has been made to any form of side bar other than the rigid one of beech, and but a limited reference to pannels; both these points may be touched on briefly, as they represent the direction in which progress will in future be made, and in which advances are most urgently needed.

Adjustable side bars, owing to the arrangment of their mechanism, are capable of taking the curves of the back automatically. They possess the immense advantage of automatically regulating their parallelism to the back, and so the weight carried is always equally distributed.

It must have occurred to many reading this section that pneumatic pannels would solve the problem of what to place under the saddle, as they would effect an enormous saving in concussion to which the spine is at present exposed, and largely reduce weight. Such pannels have been made and used, but there is a natural timidity to trust a horse's back to the security of a rubber patch, though the provision of an air cushion is an ideal conception for a pannel.

Granulated cork has been tried for filling pannels, but anything of a granular nature has a tendency to work in one direction instead of keeping its position, though this can to an extent be provided against.

Sore Backs: How they are Caused, Prevented and Remedied.

Under the term "sore backs" is included all injuries inflicted on horses by the saddle, whether such injury affects the back proper or the withers; for the purpose of description, a clear line must be drawn between these, as the causes operating in producing injuries to the withers are not causes which injure the back, and *vice versa.*

The first thing to learn is that the position of a sore back is not an accidental circumstance, but is the outcome of a definite cause. If we appreciate the value of this axiom, and know the causes operating in producing the various injuries, it is possible to recognize almost by glancing at a sore back the actual cause operating in its production (Fig. 36).

The knowledge that in nearly every case of injury the cause can be clearly determined is valuable information, for *if the cause is removed, the effect ceases.* If the cause of a sore back is known and it can be removed that sore back will not recur, and, moreover, in the majority of cases, the cause being removed, the horse may perhaps be able to continue at its duty (under conditions which it is the object of this section to impart), and thus hardly lose a day in the ranks.

Every sore, every injury, every abrasion on a horse's back is due to a certain definite cause, which if removed produces no further effect. Let this be taught to non-commissioned officers and men, and encourage all ranks to bring at once to notice every rub, no matter how slight.

This must be instilled into the mind of every one who has to do with a horse. The old system of punishing a man whose horse had a sore back led to concealment of trouble, and, moreover, in at least 90 per cent. of the cases was unjust.

Faults in saddling.—At this point it may be desirable to consider the question of a man's ability to give a horse a sore back. Prejudice dies very hard, and there are probably still many people who speak of a man giving his horse a sore back when the fault lies with the saddle or the condition of the horse.

The previous position has been something as follows:—a horse gets a sore back or a girth-gall; the man is told the fault lies with him, either bad saddling, or rolling in his saddle, and as a punishment he has to walk. It is quite right that he should walk, but as a necessity, and not as a punishment. The fault very rarely lies with the man.

The term " bad saddling " is also used far too loosely, and it is well that some definition of it should be given, always bearing in mind that there is a marked distinction between bad saddling and defective fitting ; the soldier is responsible for the former, the officer for the latter.

Here is an example which may help to define responsibility. A horse meets with an injury to the withers, due to the arch of the saddle resting on the spine ; this is defective fitting, for which the officer is responsible. A horse meets with an injury to the withers, due to the blanket resting on the spine, and not being pressed up into the front arch and fixed there by the strap. Such an injury is bad saddling, for which the rider is responsible.

It may be convenient to classify bad saddling :—

1. The blanket not properly folded and raised off the backbone.
2. The loose end of any strap getting in between the blanket and skin.
3. Any portion of the rear pack resting on the spine, or even only *touching* it.
4. The sweat flap of the girth—or in pannelled saddles, the pannel flap—getting turned in when putting the saddle on in a hurry, thus forming a thick ridge which gets pressed into the side and produces injury.
5. A horse is badly saddled which has either a loose girth or a tight surcingle. Apart from actual vice, the above comprises all the bad saddling which is possible.

Men are spoken of as rolling in the saddles, and this rolling is regarded as a cause of sore back. By rolling is understood, not the behaviour of a drunken man in the saddle, but twisting, turning, " lolling " and general uneasiness of the rider, which twists the saddle on the horse's back. It is seldom the actual cause of a sore back, but it gives the horse considerable inconvenience, and increases the load he has to carry, for the twisting causes a displacement of the balance of weight to occur, resulting in more weight being carried on one side than the other.

This wearing out of a tired horse by a tired man is effectually met by at once dismounting the man, and letting him lead his horse. After he has done some distance, his tired riding muscles will have regained their tone, and he can then remount.

In long marches, men get tired or cramped through being hours in one position, they twist and turn in the saddle, lean forward, or quit their stirrups and let their bodies sway about. The wholesome corrective for this is dismounting the men. In a long march every man should walk and lead his horse for a portion of every hour, this prevents "rolling," and secures the important advantage of allowing the blood to circulate freely through the skin.

Irregularities occurring on the line of march should be detected by the officer. If a man injures and wears out his horse by rolling about in the saddle, he is to blame, for he should have at once detected it, and applied the remedy.

These things can never be seen unless looked for, and if all the officers of a squadron ride at the head of it, their backs are turned towards what is occurring. Where horses are concerned nothing can take the place of the eye of the master. The troop officer should ride in no fixed position on the march : first on one side of the column, then on the other, now halting and letting his horses pass him, now riding behind and looking at them from the rear. Such supervision repays itself a hundredfold, while the moral effect cannot be over-estimated.

General causes of injuries.—Every injury to back, shoulders or other part of the body due to saddles, harness or collars, is brought about by one of two means, or a combination of the two, viz.—

1. By friction.
2. By pressure.

No matter whether the injury consists of a few hairs rubbed off, or a swelling on the withers the size of a child's head, the cause is as above.

From what has been said in dealing with the structure of the back, no difficulty will be experienced in understanding how friction or pressure acts : the one wears away the part by rubbing, the other by partly or entirely cutting off the blood supply.

It has been shown that no living tissue can stand continuous pressure, not even when a relatively soft and light body is inflicting it let alone a mechanism of steel and wood like a saddletree.

That a certain power of resistance to both friction and pressure exists is undoubted ; a horse in hard condition can stand much more of either than one in soft condition.

The evil of soft condition is more readily shown by friction than by pressure. It is remarkable how little friction the soft horse can tolerate.

The tolerance of both friction and pressure is characteristic of the horse in hard condition, and we see the same in the well-trained man, who is very difficult to bruise.

Condition enormously influences the production of sore backs, and condition may be of three kinds:

1. Hard condition, such as we meet with in the full-fed, hard-worked horse.
2. Poor condition such as is met with in the horse under-fed and over-worked.
3. Soft condition, well seen in the fat horse who has done no work.

No. 1 takes a lot of friction and much pressure, but Nos. 2 and 3, though at opposite poles, behave as if conditions were identical. In No. 2 the vitality and resisting power are lowered through hard work and insufficient food; in No. 3 there is a good deal of vitality, but of a fluid kind; it soon evaporates, while of resisting power there is none.

In every function of a horse's life the question of condition presents itself. It influences lameness and sore backs, it is the basis of staying power and resistance to disease.

It may be said that there is no part of a saddle which is not capable of producing an injury, though it is certain that some parts produce it more frequently than others.

Wither injuries.—The withers are the most frequent seat of injury at the present day, and there are several causes in operation to account for this.

An injury to the withers may be on the top or on the sides; the class of wither most commonly affected is the high lean one or the short thick one.

Wither injuries are caused by the following:—

1. The blanket resting on the spine.
2. The front arch of the saddle being narrowed and filled up by too many folds of the blanket, aggravated, perhaps, by a saddle too narrow in the arch. This is especially evident in a horse with thick withers.
3. Loss of "back muscle," by which the entire saddle is brought nearer to the bony framework. This is especially evident in a horse with high withers.

All the above are aggravated by the weight carried; the heavier the man—perhaps it should be said the heavier the load—the greater the damage inflicted. The more unequal the balance of weight carried the greater the risk of injury; where the balance of weight is disturbed, the saddle heels over towards the heaviest side; but for the withers it might completely heel over, as the withers act as a break and in consequence suffer.

For this reason, if for no other, men should be made to sit in a firm and erect manner in their saddle. Every turn or twist of the body causes the saddle to heel over, and if either 2 or 3 in the above table are in operation it aggravates matters.

And so with the balance of the kit carried ; if more is being carried on the near than the offside the saddle naturally heels, and if there is a tendency to 2 or 3 it is increased. This matter of the balance of weight is so important that it will be referred to again.

What are the remedies for the above sore backs ?

No. 1 is obvious ; the blanket merely requires to be raised.

No. 2 : Here the number of folds in the blanket must be reduced under the arch and increased under the side bar. This can be readily done by folding the blanket in three in the usual way, laying it over the back so that the ends hang down, and then folding up the blanket from each side so as to bring several folds under the side bar but no more under the arch, and if the saddle is still not high enough, to put on extra numnah pannels. If in the field, straw or long coarse grass may be tied on to the side bars, and straw pannels thus made. The most perfect straw pannel can be made from a bottle protector after dividing the string which ties up the narrow end. These are quite readily kept in position on the side bars by string.

The methods adopted in dealing with No. 2 are also suitable for No. 3. Loss of back muscle is replaced by pannels of numnah, strips of numnah, extra folds in the blanket under the side bar (but not under the arch), straw pannels, or even straw placed in the folds of the blanket.

Anything which will raise the saddle to its proper height above the spine, make a soft bed for it to rest on, and so take the place of the natural muscle bed which has wasted away, will prevent further injury to the withers.

After effecting these alterations they must be seen and inspected. No opinion can be given without seeing the man in the saddle ; he should be made to place both hands on the front arch, and bring his entire weight to bear on it before he can be perfectly assured that no further injury is possible.

It must not be supposed that every injury on the top or sides of the wither is necessarily due to the cause we have named, but they represent probably 98 per cent. ; the remainder is made up of such causes as the seat sinking and touching the spines of the back, or even resting on them through an insufficient amount of material being beneath the side bar ; the loose end of a strap getting under the arch, a badly fitting horse-rug, and similar rare conditions.

Injury from surcingles.—An injury to the middle of the back over the spine occurs through trying to keep numnahs or blankets on the back with the overgirth without a pad. The pressure is sometimes so severe as to kill a piece of skin the size of a half-crown. Nothing can be used as a roller unless it has a pad on it. As a fairly useful makeshift, some hay passed under the surcingle on either side of the spine so as to keep it off the ridge of the backbone may be used with advantage.

Injury from seat.—The middle of the back may also be injured through the seat and its supporting webbing stretching and then sinking. This can be remedied by lacing up the webbing tighter.

Injury under rear arch.—Injuries in connection with the rear arch and the portion of blanket which it covers are not very common. From the rear arch itself no injury is inflicted, but the blanket may cause inflammation if allowed to come down on the back and get tightly stretched over the spine. The remedy to apply in the above case is very obvious.

Injuries due to not strapping the rear pack high enough is a fault which is quite unpardonable. It can be seen at a glance whether the spine is free from pressure, and if not, this should be brought under " careless saddling," and made the subject of punishment. In those cases where the pack comes down as the result of loss of condition, no further strapping up is possible. Such cases should be dealt with by placing more folds of blanket under the side bar or by putting on strips of numnah pannels.

The loose end of a baggage strap will do nearly as much harm as the kit resting on the spine.

If saddles be used for military purposes without a cantle, or with a very low one, a rear pack can only be carried so long as the horses are in good condition ; after that it must be cast aside, for no pack can be carried behind with a low cantle and impoverished condition.

Injuries from side bars.—These are determined by their position beneath the bar and may occur at any point throughout its length or breadth.

There has previously been occasion to deal at such length with the matter of side bars and their fit that there is no necessity to do more than indicate the means to adopt to prevent further injury.

Injuries from the " burrs " or " fans " are met by folding the blanket shorter, and putting more folds under the side bar. The most careful examination must subsequently be made with the man in the saddle, to ascertain that these parts are free from pressure (Fig. 36).

Injuries from the upper edge of the side bar pressing into the wither can, as a rule, only be met by obtaining a larger size of tree. If compelled to use the same tree, place strips of numnah along the *lower edge* of the bar in sufficient number to raise the upper edge off the back. The blanket must be so folded as to increase the number of folds under the side bar and reduce those under the arch; this helps to make the arch wider.

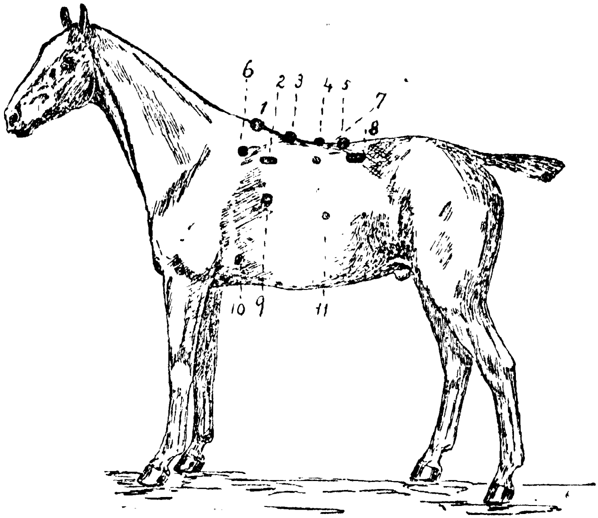


FIG. 36.

1. Injury from front arch.
2. ,, ,, narrow arch.
3. ,, ,, roller or seat sinking
4. ,, ,, riding bare-backed.
5. ,, ,, rear pack.
6. ,, ,, burrs.
7. ,, ,, side bars.
8. Injury from "fans."
9. ,, ,, sweat flap or girth attachment.
10. ,, ,, girth-gall.
11. ,, ,, sword or carbine bucket.

Injuries due to the lower edge of the side bar pressing into the back almost invariably occur in the region of the rear arch. They may be dealt with by a process the reverse of the foregoing, viz., strips of numnah fitted along the *upper edge* of the side bar and an increase in the number of folds of the blanket.

In putting on these strips of numnah they require adjusting and care. The side bar should be marked with chalk to ensure they are secured in the right place, and the edge of the numnah should be shaved moderately thin.

Injuries due to side bars being too curved occur about the middle of the back, and the curve cannot be reduced, so the only thing is, to fill up both ends of the side bar with strips of numnah, shaving them off to nothing as they approach the centre. More than one strip may be required at the extremities; in this, as in all other building-up operations with numnah, the personal equation of the operator, his capacity for grasping requirements, and his resourcefulness, make all the difference between success and failure.

With pannelled saddles it is comparatively simple to deal with alterations; they generally consist of more stuffing, which only a trained saddler can fit, though it is quite simple.

With a side bar too curved, more stuffing would be placed fore and aft of the pannel. With one pressing on the blade-bones or loins, the stuffing is taken out of the end of the pannel and the part stitched across to keep it empty (Fig. 35).

With the edge of the side bar pressing into the back, the stuffing is adjusted so as to raise the impressing edge, but this is not a manœuvre easy to effect in a pannel. It is better to place strips of numnah along the side bar (exactly as in the saddle with no pannels), and then fit the pannels on over them.

There are injuries caused by side bars which are liable to present difficulty; they are generally found on the back opposite the position occupied by the rear arch, but an examination of the side bar reveals nothing calculated to give rise to a sore an inch or two in diameter.

It is a bad place for an injury; in fact, excepting the withers, it is the worst seat of trouble. What is the cause? The cause is the want of proper adjustment in the balance of the weight carried. Some men incline more to one side than the other; many men ride with the near stirrup leather longer than the off, and all this means a disturbance in the balance of weight carried. But this is not the disturbance referred to, but rather to one which is permanent and constant in its action, while the above are irregular and intermittent. A sword and shoe case on the near side of the saddle will not balance the rifle on the opposite side. A nosebag and feed added to the weight of the sword will help matters, but when the feed is eaten the rifle again causes the saddle to heel over, and to press the side bar more deeply into the back.

There are few things which require more attention than the question of the balance of weight, pound for pound, ounce for ounce. There should be the same weight on the offside as on the near. In fact, to secure this adjustment it would even be better to add weight to the light side to bring matters into equilibrium, so important is it that the weight on a horse's back should be equal on either side of the spine.

The proper adjustment of weight is not a difficult matter, but the patching up of a back injured as we have described is far more difficult. In pannelled saddles a chamber can be made (p. 210), and the sore accommodated ; in those saddles possessing only a blanket this cannot be done, and short folding of the blanket becomes necessary.

When a chamber is made in a pannelled saddle it is essential that nothing (such as a numnah) should be worn between the back and the chamber, or else the injury is aggravated.

In determining side bar injuries and how caused, the bare tree should be placed on the back, but held at such a height above it as will correspond to the thickness of the numnah pannels and blanket. If this precaution be not adopted, the side bars will occupy a lower position on the back than they did when the blanket and numnah were beneath, and the localization of the cause of the trouble will be wholly wrong. For example, suppose a back is examined which has been injured by the upper edge of the side bar: on placing the bare tree on the back it will be found that the upper edge of the bar is an inch below the injury on the back ; but if the tree is raised at a sufficient height to allow for the thickness of blanket and numnah pannels, the upper edge of the side bar will then correspond with the wound.

The fans of the side bar are capable of inflicting injury on the loins, the result of friction. The rolling action of the loins, previously described (pp. 179, 180), causes friction between them and the side bar. Very little contact suffices ; the hair, as the result of friction, is shaved off as closely as if done by a razor, and over a patch the size of the palm of the hand. Occasionally the matter ends there ; the oval-shorn patch remains, but undergoes no further change ; if, however, the rear fans press on the loins with more force than is sufficient to shave the hair off, the next stage is a crop of pimples, heat and swelling, and the loins become extremely tender.

The remedy for the above-described state of affairs is very simple, the principle being that the fans are to be kept off the loins, either by extra folds in the blanket, or a numnah pannel. The thickness of either of these must not be such that the fans are raised off the loins to such a height that the hand may find ready admission beneath them when the man is in the saddle and leaning back.

This is also a case where the blanket should be folded shorter.

So far, the injuries described have been mainly due to the saddle itself, but there are others caused by the appendages of the saddle, viz., the girth, rifle bucket, shoe case, and rear pack.

Girth-galls.—*Girth-galls have been referred to (p. 186)* in dealing with the influence of make and shape in the production of saddle injuries. As there noticed, the horse with the shallow uprunning brisket, especially if associated with bulging curved ribs, is sure to girth-gall; his saddle works forward, as there is nothing to keep it in its place, and apart from other inconveniences, the elbow gets galled from the friction of the edge of the girth.

Horses will also gall that are in soft condition: it is one of the first troubles affecting a remount on beginning its military training, but ceases as soon as he improves in condition. This should be borne in mind, and girths not structurally altered under the impression that these are to blame; all that is necessary is to put a piece of sheep-skin or inner motor tube around the girth until improvement in condition sets in.

Many horses learn the trick of keeping their chests distended with air when they are being girthed up, or, as it is commonly expressed, " blowing themselves out."

The object with which this is done is to avoid being tightly girthed up; such horses should always have their girths tightened after the man mounts, and all, as a rule, require the girths tightening after they have been out a little time.

Especially is this the case on the line of march, for under these circumstances the horses are carrying a greater weight, and it is of the utmost importance it should rock as little as possible. A loose girth for a soldier's horse is on this account a great mistake.

We must always remember that a saddle is never girthed to a back as tightly as it seems; when a man's weight is in the saddle the girths at once become slacker.

The action of string, hide and canvas girths has been discussed (p. 186). The service girth of leather appears to be the only one calculated to stand the necessary wear and tear. It gets hard from sweat, and looks a very unpromising thing when used in this condition, but, as a matter of fact, little or no trouble arises from a leather girth, and this is due to the fact that it is kept well dressed with the grease from the horse's skin, and though rigid when put on it soon softens under the warmth of the skin.

The most troublesome of all girth-galls is that which arises from malformation, viz., the shallow brisket, and arched ribs, and if such horses are used for riding purposes, the only way to keep the saddle in its place is by strapping the girth back; this is carried out as follows:—

The surcingle is placed under the seat towards the rear arch, and passed obliquely under the belly and buckled, the buckle being under the shoe case; the saddle girth being loose, the centre cloak strap is taken and passed between the girth and the skin covering the briskets and then under the surcingle, which should be about a foot from the rear of the girth, or even further back than this (Fig. 37). The saddle girth can now be drawn back as far as is considered necessary to avoid the injured surface; when this is accomplished the girth is drawn tight. The surcingle is also tightened, but only sufficiently to prevent it from being drawn forwards. With this contrivance it is impossible for a horse to girth-gall, and impossible for a saddle to slip forward.

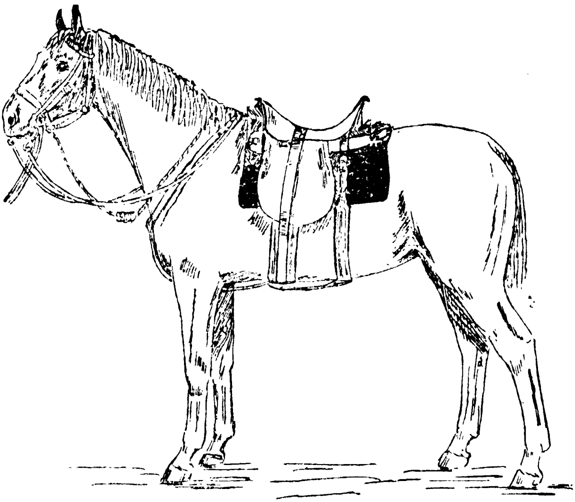


Fig. 37.

The use of a V-shaped girth attachment is a considerable gain to the troop horse, but the point of junction of the V is always a source of trouble; a metal union appears to be necessary for strength, but a metal plate, ring, or studs at this point are a possible source of trouble, especially if a blanket be so folded as not to afford sufficient protection to the sides. Nor must it be forgotten that the cause of trouble is aggravated by a tight surcingle or overgirth. The action of this is to press the metal connexion deeper into the side, and in some cases a tight overgirth is the sole cause of trouble.

To prevent the saddle slipping back the front strap is shortened, to prevent it slipping forward it is lengthened.

Conformation has an effect; the flat-ribbed horse suffers more than the other. The remedy is simple: one or more pads of numnah under the attachment, depending upon the horse's conformation, will prevent any further bruising of the sides, while the overgirth must be left slack.

Quite apart from the metal attachment on the V-shaped girth, injury may arise from the buckles on the girth. It is easy to ascertain the cause of this injury, as the abrasion corresponds to the holes in the girth straps. The remedy is simple: a pad of numnah above the injury and girthing the horse two holes lower on the affected side will be found sufficient.

Injury from the rear pack.—Injuries from the rear pack are among some of the most severe inflicted; the part affected is the ridge of the spine where there is nothing covering the bone but skin, and in a very short time an injury may be inflicted of sufficient severity to lay the horse up for weeks. No matter what is carried behind the saddle the golden rule is that it should be concave towards the spine in order that nothing may touch it. The nature of the material carried must determine what degree of bend can be given to it to make it concave towards the spine. For instance, when a picket peg is seen laid across the rear fans and carried next to the horse's back the golden rule for carrying a rear pack is either unknown or forgotten.

Bearing in mind what we have said about muscle waste, it must be evident that a rear pack which is clear of the spine when the horse is full of muscle may rest on the backbone when he loses flesh. A horse with a roach back is at all times more liable to this class of injury than one with a back of ordinary shape.

It is obvious that the danger of carrying material behind the saddle is enormously increased by using a saddle with a low cantle; in fact, it may at once be said that low cantle saddles, such as find their way into military service under the stress of war, should never be used for carrying a rear pack when the animals have lost muscle. No matter what may constitute the rear pack, it should be so fitted that when the man is in the saddle and leaning back the closed hand should find easy admission between the pack and the spine, and on the march and on service this point should be looked to every day. A single glance riding behind the men will at once tell the trained eye whether everything is satisfactory.

A rear pack must not be slack in its attachment to the cantle, but firm and immovable; all buckles must be on top and in sight, for a buckle resting on the spine is a real source of trouble, while the loose end of a strap is productive of considerable injury if it finds its way under the numnah. All buckles and free ends of straps must be in view.

There is a time-honoured custom in the Service not to remove saddles while the backs are hot, but to loosen the girth and let the back dry with the saddle on. Sometimes the saddle is taken off and merely the blanket left on, and this is the right method. Every endeavour should be made to dry backs as soon as possible. If wet backs are exposed to the air it is not uncommon for many small swellings to form, which, as a rule, go down in a few hours, but occasionally become fairly permanent and get rubbed.

In some parts of the world, like South Africa, no care is taken to prevent hot and wet backs being exposed, and no harm results; but the conditions of atmosphere are very different from what is found in Europe, the air being dry and evaporation rapid. In Europe we think it a good precautionary measure not to expose the backs until the men are ready to dry them.

As horses get in hard condition the sweating under the saddle becomes less until finally hardly any moisture can be seen. This is a useful guide to the hard condition of troop horses.

A sand bath for both horses and mules after being on duty is an excellent thing; the animals roll and refresh themselves, and in this way, among other advantages, dry their own backs.

How to Examine a Sore Back.

Sore backs may be classified into those affecting the ridge of the backbone, viz., the withers and spine, and those occurring on the skin covering the muscles which lie on the top of the ribs. To put it in another way, there are sore backs affecting primarily the bony structures, and others which only affect the soft parts; the former are incomparably the more severe.

A very little experience will show that sore backs appear to group themselves in certain definite positions, and these positions are not accidental but the outcome of certain definite causes.

So marked is this that with experience it is possible to tell the cause of the injury by its position on the back, and to forecast the part of the saddle which produced it. But the inexperienced should be careful to avoid this system, as there are few things so deceptive as to judge by the eye alone the position on the back which any portion of the saddle lies opposite to. No one can be convinced of the difficulty without previously making a simple observation.

Take a horse with no saddle on and mark on the back with a dab of wet pipe-clay the position of the rear arch where it rests on the side bar, or the position the stirrup leather passes through, or indicate on the side the place where the two girth straps meet or the shoe case rests.

It is astonishing how large the error will be when the saddle is put on the back and the actual spot compared with the suggested one.

The rule, therefore, is never to guess at the cause of a sore back, or order alterations to be made in a saddle without seeing it on, and convincing oneself that no error in position exists.

Here is a table showing the causes of sore back, which should be read in conjunction with Fig. 36, where the position of the injuries is given.

Dealing first with *injuries on the ridge of the spine :*

1. A low arch or blanket resting on the withers, No. 1.
2. A narrow arch compressing the withers, No. 2.
3. A seat resting on the spine, No. 3.
4. An injury through men riding thin horses bare-back, No. 4.
5. Rear pack touching the spine, or the loose end of a baggage strap or buckle. In plain or Colonial saddles a rear arch may rest on the spine, No. 5.
6. In the position No. 3 occurs an injury in connection with the roller worn with a blanket. The injury is invariably due to the roller being too tight. Grooms in a private stable pull the body roller tight to keep the blanket in its place, and if the pad of the roller is old, the roller itself comes down on the spine and produces injury.

   In those blankets where the roller is stitched to them and no pad used, the stitching which confines the roller to the blanket may be sufficiently coarse to produce injury. More frequently it is due to the roller being too tight, and this will occur on the picket line after a heavy dew. In such cases the roller is so tight as to be unbuckled with great difficulty.

   When the saddle surcingle is used to keep on a blanket, it is a common source of injury ; it is always so tightly drawn that if without a pad, it cuts its way into the skin and if with a pad, the latter so soon flattens under compression that the surcingle is not kept off the spine.

   No surcingle should be used without a roller, and if none is available, straw, grass, hay, or stable rubbers should be placed under it, close to the spine on either side, so as to save the ridge of the spine.

Injuries on the back below the spine may be due to:—

7. the burr of the side bar resting on the blade-bone, No. 6;
8. the upper edge of the side bars pressing into the back, through the front arch being too narrow;
9. the lower edge of the bar pressing into the back, No. 7;
10. dead continuous pressure and thin pannels or blankets;
11. the "fans" resting upon the loins, No. 8;
12. the sweat flap of the girth, or (if pannels are worn) the pannel flap, getting accidentally bent upwards when saddling up in a hurry or in the dark, No. 9;
13. the pressure of the girth attachment with its studs, which causes an injury in the same region; this is caused by tight girthing, but especially by tight over-girthing. It may be produced by any pattern of V-shaped girth, or by the buckles on ordinary girths, though, as a rule, when the latter occurs, it is due to thin pannel flaps.

From what has been said, it is obvious that the cause of a sore back can only be determined by seeing the saddle on. It is most desirable that saddling should be done by the man who rides the horse, for in that way we are more likely to see matters as they occurred. Everything being in position and the girths loose, the hand is passed palm downwards to the seat of trouble, and when the wound can be felt with the tops of the fingers the hand is turned over, the palm now being upwards and the fingers resting on that part of the blanket or pannel opposite to the injury. The place should at once be marked by chalk or pencil. An examination must then be made of everything in the region of this mark, especially of the saddletree.

It frequently happens that the position of a wound on the back is such that the hand cannot be passed to it in the manner just described. In such cases the wound has some simple colouring matter applied to it in the form of an ointment—a little vaseline or lard will do admirably—and the saddle carefully placed on the back. The part corresponding to the injury will in this way be accurately indicated.

The same process should be employed in order to indicate the exact position of a chamber.

Where pannels are used, whether for riding or pack saddles, the leather surface is a wonderful help in determining the cause of injury, for the leather takes the imprint of the tree with all its irregularities, so that a study of the outer surface of a pannel tells a tale which can be read by the trained eye quite easily.

Even the surface of the blanket in contact with the saddle-tree carries, as we have seen, the imprint of the tree for a few minutes after the saddle is removed and gives time for its inspection.

What the imprint on either pannel or blanket tells is this: it shows beyond all doubt whether the pressure of the bar is evenly distributed from front to rear and from upper to lower edge. If, at some places, a deep depression exists, while at others the imprint of the bar is scarcely seen, then it is evident that the weight is being carried on those points where the depressions exist, and the part of the back corresponding to these may in consequence be found damaged. The careful study of saddle imprints is a wonderful help in determining the cause of trouble.

Pack Saddles.

The general principle of pack saddle construction is much the same as that of a riding saddle, viz., a front and rear arch and a pair of side bars. The metal arches are much stronger than in a riding saddle, and provided with a pair of hooks to which the load is attached.

Pannels are invariably used with pack saddles; nothing can take their place. They are large, square in shape, and stuffed with horsehair, the lining being of serge or linen. The girths are two in number, and in order to keep the saddle in its place going up or down hill, a breastpiece, quarter-piece and crupper are used. The breastpiece and quarter-piece (breeching) should hang from their supporting straps as nearly horizontal as possible and at such a height as will not impede the free action of the limbs or breathing.

The crupper should be no tighter than is necessary to keep the saddle from shifting forward.

The weight of all this is considerable; the unloaded equipment is a load in itself, the pack saddle being about one-quarter of the total load. How far this is absolutely essential is a debatable point. In countries where pack transport is a general feature, light pack saddles are not unknown. But it must be remembered that the military load is something very different from that of merchandise; it is either a concentrated weight such as a pair of ammunition boxes or a machine gun, or it is a bulky load like entrenching tools, tents, men's kits, etc., and such loads require a strong saddle.

Transport animals for pack purposes are usually mules and ponies, and the selection of either of these is a matter of considerable moment. In the question of fitting and subsequent safety, the mule with a straight back, low withers, and upright shoulders is an ideal formation for a pack saddle, and the make and shape of a number of mules' backs are not liable to great variation. With ponies this is otherwise, and their variations in formation are nearly as considerable as in the horse.

The general principles of fitting a pack saddle differ very slightly from those for the horse saddle. The spine must be entirely free from pressure, the saddle must bear on the top of the ribs, the side bars should not rest either on the loins or the blade-bones, though for obvious reasons more of this is permissible in the mule than in the horse and pony. The load should be kept as steady as possible, for which reason two girths at a little distance apart keep the saddle firmly in its place. The girths are passed under the chest.

The thick wither of the mule is frequently a difficulty, the arch of the saddle in many cases not being sufficiently wide to admit the pannels without the withers getting squeezed. In fitting pack saddles this is one of the essential features to attend to, and the one which most frequently is found defective.

Of equal importance with a good wide front arch is a pair of well-stuffed pannels. The amount of stuffing depends on the amount of muscle on the back, but assuming the back is well and liberally clothed with flesh the pannels still need well stuffing, as their function is not only to prevent the back from getting bruised but to endeavour to convert a dead weight into an elastic one.

It is unnecessary and undesirable, if the animal is short in the back, to stuff the pannels for the full length; in this way shoulder-blade and hip injuries may be avoided, the latter being particularly common.

The length of the back from the pit of the shoulder to a hand's breadth in front of the point of the hip should be the length of the bearing surface of the pannel. More than this is harmful. This fitting can be effected by marking off the length on the pannel and stitching it across (*see* Fig. 35), after having previously pressed the stuffing out to the required distance at each extremity.

If a pack saddle is—

(1) Wide in the front arch and sufficiently high,
(2) with pannels stuffed to correspond with the length of the back,
(3) thick enough to form an elastic bed;

this is all the fitting required.

It is not intended that the side bars should be fitted as in the horse. There is no such thing as securing the fit of the tree other than the above condition respecting the front arch. The tree of a pack saddle is a mere matter of convenience to hang the load on; the essential feature is the pannel, and to this it is impossible to pay too much attention. The fitting of a pack saddle is therefore much simpler than that of a riding saddle.

Injuries from pack saddles.—The injuries resulting from pack saddles are of the same type as those caused by riding saddles and brought about in the same way, viz., dead continuous pressure or friction. In this way are produced inflamed withers from narrow arches, blankets pressing down on the spine and pinching the withers, injuries under the side bar the result of thin pannels and too many hours under heavy loads; injuries to the shoulder-blades and hips due to the pannels being too long, all of which are remedied by removing the cause. But the load itself may be a source of injury, some of the projecting impedimenta may wound the withers or neck, other portions sticking out behind may inflict injuries on the hips, oscillation of the load will bruise the back through actual concussion, while a want of equilibrium will cause the saddle to heel over and cause injury to the withers and ridge of the back.

These causes are all capable of control; no load should project in such a way as to touch any part of the body; an animal should be capable of trotting and turning to either hand without being interfered with by the impedimenta, and both these tests should be employed when in doubt. Transport animals should not, of course, trot, but mules may be employed carrying entrenching tools and such like, and must on occasion be able to move quickly. A trot finds out many defects, and the attitude of the body is so different from that of a walk that parts which appear out of harm's way at the latter pace are found to be dangerously close or even touching at the trot, and especially is this true of the neck. The oscillation of the load is due to bad packing, a web surcingle should envelop the entire load and keep it secure to the animal's body and so avoid swaying.

A want of equilibrium in a load is a most serious source of trouble, and one which a few moments' attention would rectify. If an animal has a pack of 100 lb. to carry it is certain he will carry it with more ease, less expenditure of energy, and with less risk of injury if it is so disposed that 50 lb. hang on either side of the body than if one load weighs 52 lb. and the other 48 lb. When the difference in weight is 10 lb., or even 20 lb., the risk of injury is enormously increased. Badly arranged loads, or what is more common, the thoughtlessness of soldiers, largely account for this want of equilibrium; when all the odds and ends left on a camping ground are hung indiscriminately on the nearest mules, and the baggage guard hang their rifles on any available projection in the load, the disturbance of balance can be readily understood. Of such supreme importance is the matter of load equilibrium that it would be far better to add a stone or a packet of sand to the light side rather than permit unequal loads to exist; but as a rule this is unnecessary, the picketing gear, nosebag, etc., of the mule is always available for small adjustments. The transport animals of an army should be regarded as worth their weight in gold, no care or supervision can be too great or too strict. The eye of a transport officer cannot be everywhere in a column extending for miles, but arrangements should be made for dividing it into sections for the purpose of supervision, which latter must be constant and unremitting, taking cognizance of badly fitting harness, saddles, badly adjusted loads, overdriving, unauthorized loads, ungreased wheels, flogging, and other irregularities which go to swell the unenviable lot of a transport animal.

At this point it may be convenient to briefly enumerate the conditions which are essential in loading pack transport.

1. The load should be carried as far as possible over the tops of the ribs and as little as possible over the sides of them. Every endeavour should be made to avoid compressing the sides, for not only is the load carried at a disadvantage if placed low down, but it interferes with the breathing.
2. A very high load is disadvantageous as it sways backwards and forwards during progression.
3. No load should touch an animal's body; if it extends in front of or behind the pack saddle it should be quite clear of the shoulders and hips.
4. Loads cannot be too flat; the flatter they are the closer they lie to the saddle and the less oscillation.
5. Loose girths are a serious evil, so also is a slack surcingle; the former allows the saddle to oscillate, the latter permits the load to sway.

The alterations to a pack saddle which has produced injury are not difficult. From what has been said it must be determined whether there is any fault actually present in the saddle, or whether it is a case of unskilful adjustment of the load. For our present purpose we shall assume the saddle is at fault, though the latter is, perhaps, more common.

Injuries to the withers can only be from the arch being too low or too narrow; the former is rare, the latter common, although both are very liable to occur if a blanket is used under the saddle. A low arch damages the top of the withers, a narrow arch pinches the sides. There is no other remedy for the latter but to change the saddle for one wider in the arch.

Chambering pannels.—All injuries arising from the side bars or load are remedied through the pannel, either by increasing the stuffing if the pannels are thin, or by chambering them. A chamber is a depression in the pannel intended to take all bearing off a tender or injured place. It is a method of the highest value, but requires intelligence to direct its utility.

It seems a mere truism to say that a chamber must correspond to the position of the injury, yet one of the most common faults in connection with them is that they do not correspond, or not with that accuracy which is essential. They are required to protect the wound and the tender region around it, and this can only be secured by most careful fitting. A chamber badly placed is more than useless.

The position of a chamber is ascertained by looking at the mark of blood on the pannel; or if there is no stain the injury should be lightly covered with lard or vaseline, the saddle put accurately in its place, girthed up, and then removed. The mark on the pannel tells all that is required to be known. The part is then indicated with pencil for the guidance of the saddler, and his work consists in stitching around this mark, after having first removed the stuffing completely from the area, and finally pushing the stuffing up against the stitches, so that a concavity is formed as deep as the pannel is thick.

A chamber can be made in a few minutes by any one with sufficient intelligence to push a needle through leather; as a rule it is left to the saddler, but only the technical work should fall to an already fully occupied artificer. Every non-commissioned officer connected with transport should be able to chamber a pack saddle, and have the needful appliances by him.

The stitching around the chamber must be sufficiently close to prevent the stuffing finding its way between the stitches into the chamber, and the hair must be pressed well up against the stitches in order to keep the chamber deep.

A chamber once made requires looking to daily; every time the saddle is taken off it should be inspected to ascertain that the sore is not pressed upon, for the tendency of all pannels is to become thinner, under compression, and as they get thinner the chamber gradually becomes obliterated or nearly so. It would not be possible to make a useful chamber in a thin pannel without adding stuffing.

Pannels naturally settle down more when they are in a new state than after they have been in use some time; the compression a new pannel undergoes has to be seen to be appreciated; the hair gradually works itself into a close felted cake, and to prevent this going too far pannels are occasionally pricked up with an instrument like an awl; this can only be done by a saddler.

The golden rule in dealing with pannels should be never to interfere with them unless they require it, for a pannel soon takes the impression of the part on which it rests, and in this way adjusts itself to the slope of the back. To disturb this unnecessarily would be a mistake.

Caking occurs on the pannels through wet and accumulation of filth from the skin, and in consequence they get dry and hard. They can be cleaned by drying, brushing, and beating lightly with a stick.

In order to prevent dirt or grit working down between the pannel lining and the skin, it is advisable to join the two pannels with a strip of canvas or leather sewn to the upper edges of each pannel. This canvas or leather runs the length of the saddle and covers the backbone.

Collars and Sore Shoulders.

It will assist considerably in understanding the horse's requirements in collar fitting if we study very briefly the shape of the shoulders and the movements they undergo.

Movement of shoulders.—We have seen (p. 168) that the shoulder-blades are constantly moving backwards and forwards. For the purpose of collar fitting we have to bear in mind that while one shoulder is coming forward, the other is going backward, so that at no time is the collar resting on a perfectly parallel surface—such as the two shoulders at rest represent—but always on an oblique one. This backward and forward movement produces considerable oscillation in a collar, which may readily be seen by leading a horse along with the collar lying on the shoulders. This oscillation, the result of the movement of the shoulders, is a most important point to remember if we are to understand how collar injuries are produced.

A horse with an upright shoulder is comparatively easy to fit with a collar, especially if the draught place is wide; but an animal possessing oblique shoulders is difficult to fit, for the part is fine, there being no draught place, and the tendency is for the collar to rise on the shoulders when the horse puts his weight into it.

No matter what shape a shoulder may be, the collar invariably rises when in draught, though with upright shoulders only to a limited extent.

Necks and shoulders vary in shape and size depending on the amount of condition present ; this, as will be seen presently, is the key-note to collar fitting and the prevention of injuries. Some horses are very thick at the crest of the neck, others are thin ; some have the neck so hollow from side to side that it can almost be felt through, whilst others have the muscles large and well developed.

Where the draught is placed.—We know that the weight imparted to a horse's shoulders in draught should be evenly distributed over the anterior surface of the blade-bone ; owing to the movements of the shoulders, the collar should fit so closely that but little oscillation is possible between it and the parts beneath. Collar injuries are nearly always the result of *friction ;* this is the great distinction between them and injuries to the back, which are nearly always the result of *pressure ;* our object, therefore, is to reduce the friction to a minimum.

When a horse throws his weight into the collar, the latter rises on the shoulders, especially in draught up hill, hence the necessity for having the throat of the collar away from the neck so that no undue pressure is caused. A collar too deep, viz., too long, rises unduly on the shoulders and extra friction is produced.

Fitting a collar.—In fitting a collar the following are the points to attend to. The collar should lie easily on the shoulders ; no effort should be required to force it into its place—such would be an indication that it is too narrow, and the sides of the neck would suffer. We should observe that it rests evenly on the shoulders from top to bottom ; no see-saw motion should be present, which would indicate that the centre of the body contained too much stuffing. The top part of the collar just in front of the withers should admit the flat of the hand between it and the neck.

The next important step in fitting is to ascertain that the collar fits closely to the side of the neck without pinching ; between the inside of the collar and the neck should be a space which will admit no more than the flat of the fingers, and this space should be found from top to bottom. It will often be observed that the required space exists above, but from the lower third of the neck the space between it and the inside of the collar is so great that it may admit a cricket ball ; in other words, there is too much play. Nothing is more certain than this will produce injury if the animal be called upon to perform heavy and continuous draught work. The secret in collar fitting is to *stop all lateral movement between the* *collar and the side of the neck* if shoulders are to be kept sound; on the other hand, pinching the side of the neck is to be avoided. To test the amount of lateral movement in the collar, take hold of the points with one hand and steady the collar on the shoulders; with the other hand take hold of the throat, then work the collar from side to side, but still pressing it against the shoulders. The amount of play can now be seen. If above the shoulder-joint it amounts to as much as two inches, the collar is too wide; in some cases it is as much as 4 or 5 in.

The next thing to be considered is the depth of the collar. From the foregoing it is clear that a collar too deep is a positive evil, one not deep enough may be a source of very serious trouble. To test the depth of a collar, insert the flat of the hand between the throat of the collar and the horse's neck; if deep enough the hand and wrist should find ready admission; anything more than this is unnecessary.

There is one more point to be examined before our fitting is complete, and that is in connexion with the after-wale. When a collar has been in wear for some time the body becomes flatter; this flattening allows the edge of the after-wale in heavy draught to overlap the body of the collar and cut the skin of the shoulder. We shall again draw attention to this condition, and at present only note that on pressing the collar closely against the shoulders a careful examination of the after-wale should be made just above the point of the shoulder to ascertain that it is nowhere near the skin.

To summarize these points in fitting a collar:—see

1. that it does not rest on the neck in front of the withers;
2. that it bears evenly over the shoulder-blades;
3. that the space between the inside of the body of the collar and the neck will admit the fingers and nothing more;
4. that the depth between the throat and the neck will admit hand and wrist.

New collars.—A new collar is worse than a new saddle, because it is only by a certain amount of wear that we can expect this contrivance of leather and straw to adapt itself to the shape of the surface on which it has to rest; for this reason great care should be exercised in the use of new collars until they have adjusted themselves. The issue of new harness, especially new collars, to troops proceeding on service should, if possible, be avoided.

To assist a collar in getting into shape, advantage may arise from the following procedure, viz., to thoroughly wet the collar by leaving it in water for an hour or two and then putting it on and working the horse steadily, taking care that its shape is not altered while drying.

Housing straps.—For very good reasons military collars are made to open at the top; this, however, is a loophole for trouble, as the "housing strap" which brings the sides together often stretches to such an extent that the collar is not properly closed, and the crest of neck in consequence gets pinched. Saddlers often depend on the hames for keeping the collar closed.

Hames.—Hames should be fitted to the collar, if necessary by heating them; they should fit accurately into the space between the fore- and after-wale. Care should be taken in this fitting that the attachment for the trace is neither too high nor too low, and further, that the outline of the collar is strictly followed in the hames or else the fit is imperfect. If the hames are too straight, a collar, which, without them, fitted well, will now be found too tight. When hames are fixed the rigidity of the collar is considerably increased, and the points are brought much closer together; it is on this fact that, as we have said, saddlers often depend for keeping the collar closed. But it will be found that the hames only close the collar at the points and not behind; this can only be effected by a good fitting housing strap; the latter cannot be too tightly drawn. Especially is this the case in pole draught as the chains straining on the collar cause considerable strain on the housing strap, especially going down hill or in pulling-up on the level. For this reason the most common injury in pole draught is to the neck in front of the withers, and few horses escape the mane being worn away at this part, as the result of the continuous friction of the collar. In consequence we strongly urge the necessity for all collars being so stuffed as to cause no pressure on the neck (*see* Fig. 38).

Size of collars.—The following description of the collar is taken from the "Handbook for Military Artificers":—

Collars, Neck.

Neck collars are of two patterns:—

1. Those for ordinary draught horses.
2. Those special to heavy transport horses.

The first-mentioned range in size by ½ inches from 20 inches to 25½ inches—the others by 1 inch from 23 to 27 inches. The latter differ from the former in having a wider bearing surface at the "draught," and also in having an additional lining of basil, with flock for stuffing added to the usual body side.

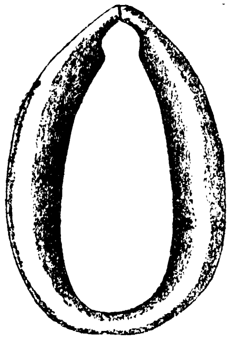


FIG. 38.—Rear face of a collar, with body stuffed in such a way as to keep it off the crest of the neck and avoid injury No. 1.

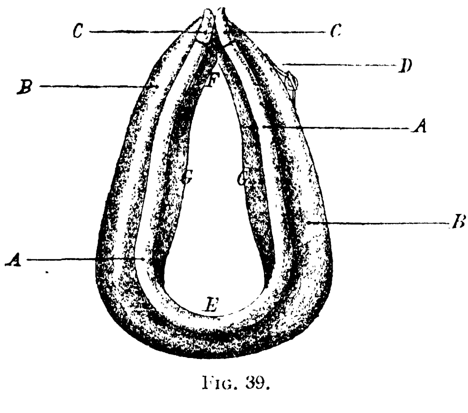


FIG. 39.

Names of the parts of a collar.—The technical names of the various parts of a collar are as follows :—

A. Fore-wale.
B. After-wale.
C. Caps.
D. Strap.
E. Throat.
F. Neck.
G. Bodyside.

The size of the collar is determined by measurement from E to F.

Injuries Produced by the Collar: How they are Caused and Remedied.

Collar injuries are caused by friction.—As previously mentioned, collar injuries differ from saddle injuries in one essential, viz., one is caused by friction, the other by pressure. If we have to work a horse with a sore back we must remove the pressure; if we have to work a horse with a sore shoulder we must stop the friction. There is one well-marked exception to the rule given, and that is the injury caused to the neck in front of the withers; this is almost invariably a gall, the result of *pressure.*

Position of collar injuries.—Reference to Fig. 40 shows the position of injuries produced by the collar; they are numbered

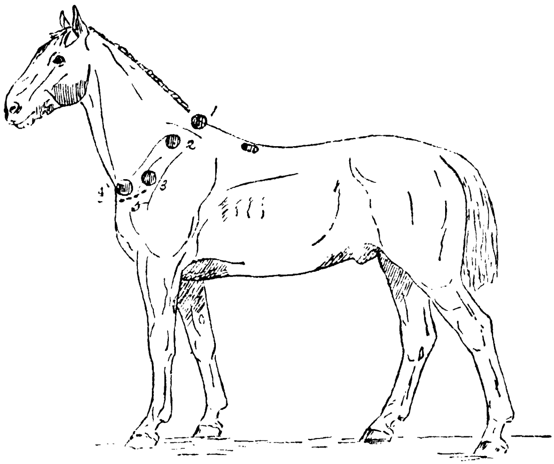


Fig. 40.

from 1 to 5. No. 1 is the gall to which we have just alluded. It is an injury giving rise to extreme pain, so much so that the animal can only be examined with great difficulty; not uncommonly the skin dies and a piece comes away as in a sore back. It is the only approach to a "sitfast" that is met with in collar injuries, and for the reason previously specified, viz., pressure. This injury is more common in pole than in shaft draught, and is caused by the strain inflicted on the neck in pulling up or in going down hill owing to the pull of the pole chains, aggravated by a loose housing strap. The injury may occur on perfectly level roads, and is then often due to carelessness on the part of the driver in shortening the pole chains too much and so throwing the weight of the pole on the horses' necks. The pole should not rest on the neck, but be perfectly free to move up and down, and the chain, though taut, should not lift the pole an inch.* A tight wither strap, by drawing back the collar, may also cause an injury to the neck.

If collars are stuffed as in Fig. 38, this injury may be prevented, or a metal pad may be worn between the neck and the collar. These so-called "wither pads" are undoubtedly excellent, though, of course, they cannot prevent injury when the full strain comes on the neck. In the Belgian system of pole draught, the strain of going down hill or pulling up is not imparted to the collar but to the breeching, which by being carried all round the horse, and attached to the pole chains, throws the strain on to a part calculated to take it, viz., the hind-quarters.

Injury No. 2 is almost invariably due to a tight collar, especially in horses with very fleshy necks; the remedy is simple—remove some of the stuffing or stretch the collar. In stretching a collar it should be borne in mind that there is a risk of damaging it, especially at the throat. It is no use stretching a collar without altering the hames; if these are too straight the collar will continue to pinch.

Injury No. 3 is practically always due to a loose collar, viz., one too wide; it is a very common gall and frequently occurs under the point of draught, viz., the attachment of the hames; it is a difficult injury at times to deal with. The remedy is to plug the collar and so make it narrower; all movement in the collar is to be stopped according to the directions previously given. Sometimes injuries occur at this part which appears to be well behind the collar when the latter is fitted; in these cases it is generally very much too wide, and if pulled over towards the injury will be found to touch it.

Injury No. 4 is caused by a loose or a tight collar; the whole neck for about five inches is very tender, and the appearance of the collar is indicative of the cause. The remedy is to make it narrower with strips of numnah, or wider by wetting it and stretching it on a block. We should not forget that stretching a collar shortens it.

Injury No. 5 occurs just above the shoulder-joint, and is almost invariably due to the raw edge of the after-wale touching the skin. Such collars are generally old, and the stuffing having settled down allows the after-wale to cut into

* The pole here referred to is that of the general service wagon.

the skin, though this may not be apparent until the horse is tested in draught, when it can at once be seen. At other times the cause of the injury can be determined by simply pressing the collar on to the shoulder, when the after-wale may be seen to touch. The remedy is either to re-stuff the collar, or, if there is no time for this, to cut off the edge of the after-wale close up to the lacing.

Sometimes an injury occurs in the region of No. 5, but above the edge of the after-wale. This is due to the friction of a wide collar, and the remedy is to deal with it as in No. 3.

The nature of collar alterations.—It will be observed that the alterations of a collar resolve themselves into making it narrower or making it wider. We have made no mention of chambering a collar or putting pads beneath it to protect a sore place, because experience shows that the remedy is frequently worse than the disease; a chambered collar will always be unsatisfactory, and placing a pad beneath a collar is the most harmful practice known.

Pads beneath collar are harmful.—The pad alluded to is a small pillow-shaped body containing hair and covered with leather; it is attached to the collar by straps.

When it is considered how necessary it is that the whole weight in draught should be evenly distributed over the shoulder, there can be no difficulty in understanding what must follow by putting one or more pads under the collar; the draught comes on them entirely, and the damage inflicted is scarcely credible.

Horses may be worked with sore shoulders if collar be fitted.—Shoulders which have been injured will heal, many of them during work, if the proper alterations have been effected, and if they continue to rub it is proof that the alteration is not satisfactory.

This point must not be misunderstood. It is not advised that a horse should be worked with an altered collar when the shoulders are acutely inflamed; but after the acute inflammation has subsided, it may be possible to put that animal to work, when the collar has been properly adjusted, without waiting for the complete healing of the wound.

We have spoken of shoulder injuries as if the collar were always at fault; for all practical purposes it may be considered so, but there are cases where injury has occurred and the collar apparently fits well. Such will always happen when horses are soft and wanting in condition, and experience teaches us that as the skin hardens the tendency to gall is abolished.

Alteration to be accurately made.—Never allow a collar to be sent to the shop for alteration without the saddler seeing it on and marking the alteration required. It is astonishing how saddlers and collar-makers trust to their eye; nothing is more unreliable. Further, they will carry out the most elaborate work without ever thinking of trying the collar on to see how they are progressing, and whether the alterations are on the right lines. No attempt should be made at finally completing the alteration until the collar has been seen on; it should be fitted in the unfinished state.

Effects of loss of flesh in collar fitting.—When horses lose flesh as the result of work their collars become too large for them both in width and depth, and injuries are frequent.

Shortening of collars.—To shorten a collar under these circumstances is a great mistake, for if it is shortened to fit when the animal has very little on its neck it is certain that it will be much too short for him when he has put on flesh again; besides, a collar once shortened can only be lengthened with difficulty. Yet collars which are too long allow of considerable play, and play means friction. The horse losing flesh must not be allowed to wear a long collar, it should be artificially shortened to prevent damage, but it should not be cut. In the same way loss of flesh means a collar too wide; to stuff a collar under these circumstances means that it is too tight when the horse puts on muscle, and yet a wide collar is a source of friction and injury. Here again we must reduce the width, not actually by stuffing, but artificially, in a manner described below.

Apart from the reasons given against stuffing and shortening the collars of working horses, there is the waste of material, the loss of time entailed by a man having to shorten and re-stuff collars, and in a fortnight's time having to try and make them longer. While the collars are undergoing this course the horses are idle, yet the most completely satisfactory alteration can be carried out in a few minutes without interfering in the slightest degree with the collar itself, and without stopping the horse's work.

How to reduce the width of a collar.—The method is this:—To make a collar narrower, mark the region with chalk, and observe how much too wide the collar is; a strip of numnah is cut the desired length and the edges shaved off; three or more leather thongs are put through the edge of it, and the whole tied round the body of the collar, the hames passing over the thongs keep the numnah in its place. If the collar is still too wide another strip of numnah is put in at the desired place with the edges shaved off, and this is repeated until the desired amount has been introduced to stop all lateral movement. Some saddlers like to stitch the numnah strips in, or to use straps and buckles instead of leather thongs; it is quite unnecessary, though perhaps neater in appearance.

If a collar is too deep it can be altered in the same way by raising it on the shoulders to the desired height, and strips of numnah inserted—just below where the collar opens—until it is retained at its proper height on the shoulders. These numnah strips are, of course, put in on both sides, and so arranged as not to interfere with the neck.

Such is the simple, expeditious, and absolutely satisfactory way of altering a collar when horses are performing hard work. By adopting these measures horses may be kept at duty which would otherwise have to be thrown out of work. It may be spoken of as the "false collar" process.

The alterations which we have next to speak about are permanent ones, such as arise in the fitting of collars for the first time.

Plugging collars.—The body of a collar is filled with straw—preferably rye straw. This is introduced into the leather receptacle by means of a piece of iron known as a collar-fork or collar-iron; piece by piece the straw is wetted and forced into the body of the collar, until the required amount has been inserted. This process is termed "plugging," and we have nothing more to say about it than that it is to be reserved for collars on first being fitted, and subsequently fitted later should the body of the collar wear thin. It is a permanent process and should never be adopted when horses are in hard work and losing condition, as it entails too great a call on the saddler's time, is not so satisfactory as the numnah strip, and the whole of the extra stuffing has to be removed when the horse regains flesh. In fitting a new collar the place should always be marked where the extra stuffing is to be placed, and before the collar is finished off it should be again tried on the horse to see that it is perfectly satisfactory. We must bear in mind that a collar can only hold a certain amount of straw, and that when considerable additions have to be made to the stuffing, the part must be re-lined to admit of it.

In shortening a collar, a certain amount on either side where it opens is cut off. Collars should never be shortened for horses out of condition; it is not only a waste of labour, but waste of material. Collars can only be re-lengthened after shortening at the cost of much time and trouble.

Where the strain comes on collars.—The greatest wear and tear on a collar is in the throat, which not uncommonly breaks, and the collar when opened and tested will twist in almost any direction. Saddlers look upon this breaking at the throat as a very serious matter, but if the leather-work is sound the part can be repaired. A collar torn in the throat is generally an indication of age, and, therefore, possesses other sources of weakness, but it may also occur from bad usage.

Breast Collars.

The simplest form of collar which can be worn is that which passes around the shoulders, and is known as a breast collar or breast harness.

The term breast is not correct, as the shoulders, and not the breast, are the points from which the work is done, but the term is a convenient one and in general use.

We have pointed out that the ordinary neck collar oscillates during progression from side to side; the breast collar does not oscillate, but has a sawing action. Sawing is obviously a greater source of friction than oscillation, and in consequence the make and fit of breast collars must be such as to present a perfectly smooth surface next the horse's skin. Neglect of this precaution is soon evident, even a projecting *stitch* is capable of doing great harm.

A well-made breast collar is wide, the lining being wider than the leather-work on which the draught comes. Further, the lining must be as one whole piece without seam or stitch, and this is effected by taking a piece of soft leather and folding it; the inside fold goes next the skin, while the outside one is used for the purpose of the attachment of the breast-piece proper, which is a thick piece of leather provided with buckles, dees, etc.

Such a collar is supported on the neck by a strap, frequently lined with felt, but in spite of this galls on the neck are frequent, owing to the friction to which the part is exposed. This strap works up and down, and either requires a metal or leather shield on the neck to move over, by which means all friction is avoided. The metal shield used by wheel horses of artillery is perfect for this purpose.

In most varieties of breast harness the pole chains pass directly through a link on the collar, and the length of the pole chains must be such that the horses can get into their collars fairly and squarely; in other words, the pole chains must not be too short. At the same time they must not be so long that the pole is unacted upon when the animals hang back on the breeching.

Breast collars, pole chains, supporting straps, etc., are by no means easy things to fit, especially in a general service wagon, where pole chains have to be employed.

The artillery wheel horse has two straps passing over the metal shield on his neck, viz., one for supporting the pole, no pole chains being used, and the other for supporting the breast harness.

The fitting of the latter strap in all patterns of breast harness requires great attention, owing to the friction it produces; it must neither be too long nor too short. If too short the strain in draught comes on the neck, if too long the draught place falls below the point of the shoulder. Especially does this question of short supporting strap require the most careful and continuous attention in mule transport. With this class of animals even the trace supporting strap, which passes over the back, is frequently so short that the strain of draught comes on to the back, while nothing is so common as the breast harness supporting strap being so tight that the strain of draught comes on the neck!

Chafes and injuries from breast harness are frequent. With badly made, narrow, hard, breast collars, lined or unlined, the friction resulting from the sawing motion is capable of inflicting great damage. With the present artillery pattern of collar, with its large lining of soft leather, there is no trouble whatever.

To work a horse injured by the ordinary breast harness, the only course open is to raise or lower the collar so as to get it off the injured spot, but the disadvantage of this proceeding has been dealt with above.

CHAPTER VIII.

THE FOOT AND SHOEING.

In a state of nature the hoof is sufficiently hard, and grows with rapidity enough to withstand the wear caused by the animal's weight when travelling over natural country. The shape of the hoof and quality of its horn differs according to climate and soil, and in hot countries, where it becomes hard and dry, animals may be worked to a considerable extent without shoes. On roads, however, the natural growth of the hoof is not sufficiently hard, or rapid, to keep pace with the extra wear entailed by carrying or drawing a load, and to prevent them getting footsore, it is necessary to shoe working horses with some substance harder than horn.

A rim of iron has been found the best for the purpose up to date, and our object when attaching it to the hoof, is to cause as little damage to the natural structure as possible, and yet secure it firmly. This chapter will deal with the structures of the foot and their natural functions ; will discuss shoes, and nails ; will point out how our purpose may be best effected, and show what errors to avoid.

Structure of the Foot.

The bones.—Buried in the centre of the foot and surrounded by the soft, sensitive structures which produce the horn of the hoof, are the small bones which form the last joint of the leg. They are the " coffin " (pedal) bone, and the navicular bone ; and with the lower extremity of the short pastern (coronet) bone, which reaches below the level of the coronet, they form the foot (pedal) joint.

The coffin bone may be described as a pyramid, the back of which has been hollowed out, and the ground surface slightly arched. It is a remarkably porous looking bone, an appearance due to the large number of blood-vessels with which it is provided, each of which is accommodated in one of the minute holes covering its surface. Its actual position in the hoof is clearly shown in Figs. 41–42. It is wedged into the toe of the foot, and although its sides (wings) extend some distance further back than the central portion, it leaves the back half of the foot practically free from any bony foundation.

The navicular bone.—The small, shuttle, or boat-shaped bone is placed across the back of the central part of the coffin bone, where a narrow, smooth surface for it to lie against may be seen.

The rounded end of the coronet bone meets the large, smooth surface on the top of the rear slope of the coffin bone, and rocks to and fro on it as the foot is moved.

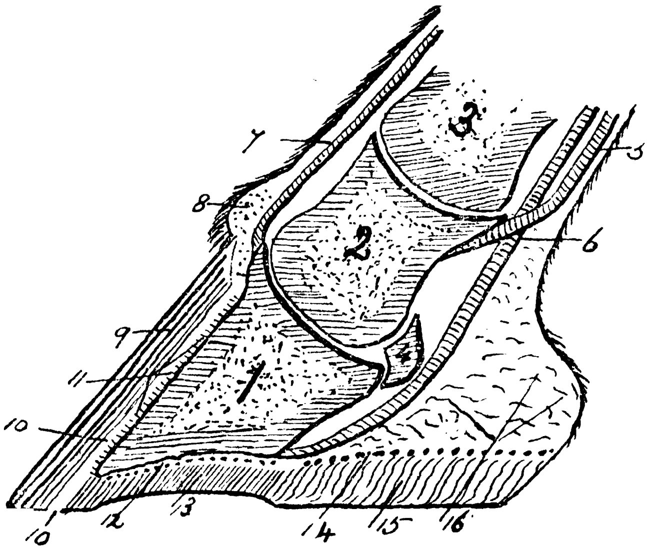


FIG. 41.—Diagram of section through centre of foot.

1. Pedal bone.
2. Short pastern bone.
3. Long pastern bone.
4. Navicular bone.
5. Perforatus tendon.
6. Perforans tendon.
7. Extensor tendon.
8. Coronary band.
9. Wall.
10. White line.
11. Fleshy leaves.
12. Fleshy sole.
13. Horny sole.
14. Fleshy frog.
15. Horny frog.
16. Cushion of the heels.

A highly polished layer of gristle covers those parts of the bones which meet each other, and the whole joint is bathed in " joint oil " to make it work smoothly.

The cartilages.—Attached to and extending from near the top of the coffin bone on each side, continued all along its edge, and curving round the heel beyond, there is a large springy piece of gristle (*the lateral cartilage*) (Fig. 42). In a fine-skinned horse its outline can be clearly seen, extending along the sides of the coronet, and its "spring" may be easily demonstrated by pressing hard on its edge at the heels.

Ligaments of considerable strength pass from bone to bone; holding them firmly in position, yet permitting all necessary movements.

Tendons.—Starting from muscles in the arm above, these run down the limb, both in front and behind, and are attached firmly into the bones. In front there is only one, which is spread out on the pastern and the top of the coffin bone; behind there are two; one reaches under the coffin bone and the other is fixed to the sides of the coronet bone.

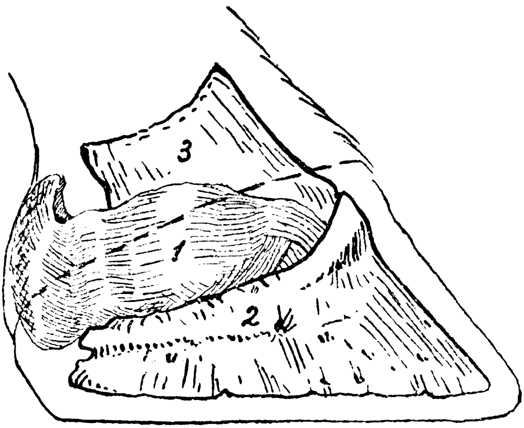


FIG. 42.—Diagram to show position of lateral cartilage.
1. The lateral cartilage. 2. Pedal bone. 3. Short pastern bone.

The fleshy structures.—At the back of the foot, filling up the space which lies between the wings of the coffin bone and lateral cartilages, is a thick tough, elastic pad which converts the whole of the back of the foot into a firm, soft cushion, sometimes called the "frog pad" or "cushion of the heels" (Fig. 41, 16).

Round the coronet, and forming the bulge which is noticeable in this region, is another thick but narrower strip of the same nature (the coronary band) (Fig. 41, 8); while beneath the pedal bone is a similar though thinner layer (the fleshy sole) (Fig. 41, 12).

The surfaces of the coronary band, the fleshy sole and fleshy frog are covered by innumerable small, finger-like projections, which give them a velvety appearance; and it is from these little points that the horn of the hoof grows.

The outer surface of the coffin bone is covered by a series of fleshy leaves (laminæ), five or six hundred in number, the edges of which, running from top to bottom of the bone, present an appearance like the leaves of an uncut book. These fleshy leaves dovetail in a very intricate manner with the horny leaves, which are found arranged in a similar manner around the inner surface of the wall, and form the

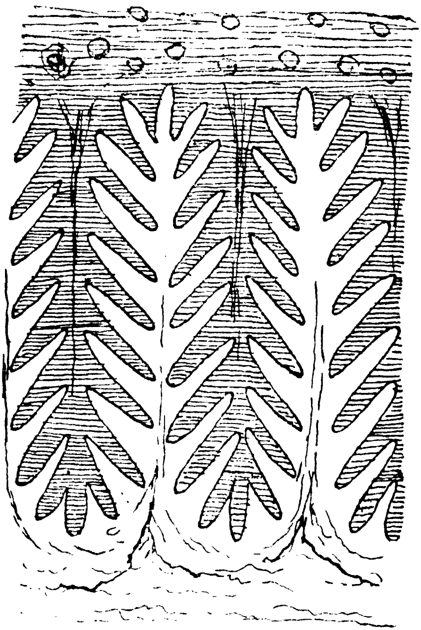


FIG. 43.—Diagram to show the method of junction of horny and fleshy leaves. Horn shaded.

chief bond of union between the fleshy and horny parts of the hoof (Fig. 43).

The blood-vessels of the foot are extremely numerous; they permeate the bones and fleshy parts to such an extent that, in the living animal, the foot may be said literally to swim in blood; and it is a matter of common knowledge that trivial wounds in this part bleed with the greatest freedom.

The nerves of the foot are distributed with equal profuseness, and although the hoof itself is not sensitive, the slightest touch on its surface is felt by the animal.

The hoof.—Horn, wherever it grows, is the same in structure, and consists of a hard, tough, gluey substance, in which is embedded a number of hair-like tubes. It may differ considerably in consistence, some varieties being almost as hard as a brick; and others as elastic as indiarubber; a difference largely due to the amount of moisture which the individual specimen contains. This moisture is contained in the tubes; all horn has a certain quantity in its composition, and its presence produces that toughness which always characterizes a healthy growth. The horn of the hoof, whether originating from the coronary band, fleshy sole or fleshy frog, grows in

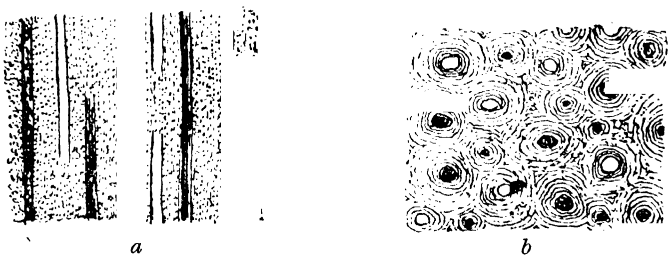


FIG. 44.—Longitudinal (*a*) and transverse (*b*) section of horn. Some of the tubes are empty, some filled with débris.

the same direction, namely, sloping downwards and forwards, at the same angle that the toe makes with the ground.

The wall is that part of the hoof which is visible when the foot is on the ground (Fig. 45). At the extremity of the heels it bends sharply back, and runs forwards for a short distance, this recurved portion being called the "bar." The upper edge of the wall, at the coronet, is thin and soft, and its inner side is hollowed into a groove which accommodates the coronary band. Below this groove the wall is uniformly thick from top to bottom at any given point, whether toe, quarter (side of hoof), or heel be examined. From the toe, however, the horn gets gradually thinner towards the quarters and heels, but where it turns round to form the bars it again suddenly thickens and then gradually thins off to nothing as it runs forward (Fig. 45). The inner side of the wall, including the "bar," is lined by a number of horny leaves, corresponding in arrangement with the fleshy leaves which cover the coffin bone, and dovetailing with them. The outside horn of the wall is extremely hard, but it gets softer and lighter in colour as the leaves are approached, and on the ground surface of the foot, the relative position of these, *i.e.*, the junction of the wall and sole, is marked by a distinct "white line." Around the upper edge of the wall is a thin, rough-looking band which runs all round the hoof to join the horn of the frog; it is very prominent and white when the foot has been soaked in water.

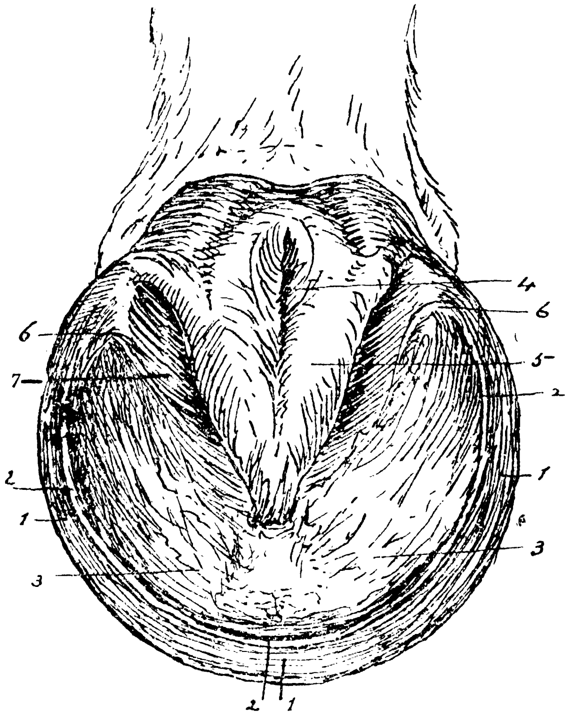


FIG. 45.—Under surface of foot.

1. Wall.
2. White line.
3. Sole.
4. Cleft of frog.
5. Frog.
6. Angle of heel.
7. Bars.

The wall grows from the coronary band; each of the minute fleshy fingers previously mentioned being the starting point of one of the tubes and the surrounding horn substance which binds them together.

If untouched, being neither worn nor cut, the horn of the wall will grow on indefinitely, and the rate of growth at the toe being greater than at the heels, it will soon become disproportionately long and may then be a cause of stumbling.

The sole conforms in shape to the under surface of the pedal bone, its outer edge resting on the ground, from which it is slightly arched towards the centre. Viewed from the ground surface, it is roughly crescent-shaped; the circumference being embraced by the wall, the points clasped and held firmly in position by the bars, and the space between them filled by the frog. In the living foot the sole and wall appear firmly united, but a prolonged soaking of the dead hoof will cause complete separation at the "white line," which is then clearly seen to be a continuation downwards of the horny leaves. The horny sole grows from the fleshy sole, its fibres slanting in the same direction as those of the wall, but, unlike the latter, on attaining a definite length varying from a quarter to about three-quarters of an inch, they separate from the parts above, and shell out of the hoof. This natural provision prevents overgrowth of the sole, which therefore requires little attention from the farrier. The horn of this part is softer than the wall, but harder than the frog.

The frog is a thick, wedge-shaped piece of horn, fitted point foremost into the space between the angles of the heels. Its centre is the seat of a marked depression, the "cleft," the depth of which, in the shod hoof, is often exaggerated into a deep crack. The horny frog grows from the fleshy frog above it; like the wall its fibres are continuous, and do not shell out as do those of the sole. Its consistency should be that of firm indiarubber, tough, and very elastic.

Functions of the Parts.

The bones, as in other structures, give solidity, and form an internal scaffolding on which the soft parts can be securely based.

The cartilages, extending as they do beyond the wings of the pedal bone and curving round the back of the foot, are evidently designed to contain and support the elastic cushion of the heels; and, while they are sufficiently rigid to prevent undue bulging of the parts, they are springy enough to yield to changes of form when under pressure from the weight of the horse, and return to their original position when this is removed.

The tendons, acting as ropes on which the muscles above pull, alter the position of the bones for the different movements required. The one in front (the extensor) straightens the column of bones and slightly turns up the toe, for forward movement: those at the back (flexors) bend the bones on each other, to allow the leg to be raised.

The blood supply is so bountiful that, in addition to giving nourishment to the foot, it acts like a water bed, helping to equalize the tremendous pressures to which the whole structure is constantly subjected, and keeping the bones and sensitive parts contained in the hoof buoyantly supported, like a big ship in a little dock.

The junction of the fleshy and horny leaves (Fig. 43) is the means by which the hoof is securely attached to the sensitive parts. The strength of this firm yet flexible union is extraordinary; it is sufficient to sustain the animal's weight, and the structure can only be separated for the purpose of demonstration, by partial cooking or prolonged soaking. Each main leaf, horny and fleshy, is covered with secondary smaller leaves which branch at an angle from it, and these dovetailing with their opposites, give extreme strength: the great number of the secondary dovetails gives a section of this junction the appearance of a number of interlacing feathers.

The wall provides complete protection for the sensitive leaves and coronary band; it embraces the sole, and by means of the bars rigidly secures it in position; and its ground surface, in conjunction with the flat, outer edge of the sole, supports the weight of the horse.

The supporting power of the wall, held firmly in position as it is by the dovetailed leaves, is sufficient to bear the horse's weight; it is possible to pare out the sole to such an extent that no part of it bears on the ground or shoe and still the animal is able to stand. This fact, however, is no argument for depriving him of part of the bearing surface which is naturally adapted for sustaining the body weight, and the practice of paring the sole is consequently forbidden.

The sole protects the sensitive sole, and its naturally flat outer edge takes a bearing on the ground or shoe, and helps the wall to sustain the body weight. On a perfectly flat, hard surface the arched central portion of the sole does not come in contact with the ground, but sustains the weight from above and takes a bearing from below only when the going is soft.

Owing to its habit of growth, explained above, the untouched, healthy sole has a somewhat rough, flaky look, and a misapplied zeal for neatness of appearance may result in it being pared smooth and thin. This is nothing short of criminal. The interests of all concerned—horse, owner, and farrier—demand that the natural protective thickness of the sole be left intact.

The white line (Fig. 45) denoting the position of the horny leaves, and consequently of the sensitive leaves which dovetail with them, shows the farrier the thickness of the wall. This knowledge is all-important to him in driving nails. Taking into consideration the slope of the hoof and the thickness of the wall, he can accurately estimate the angle (" pitch ") at which the nails must be driven so that they will give secure hold without going so near the sensitive parts as to cause injury by " pricking " or " pressing " them.

The frog.—The frog assists in bearing the animal's weight, in giving a non-slipping foothold, and in saving the foot from the effects of concussion. In a horse that has been running unshod at grass the foot will present a natural bearing and it will be seen that the frog no less than the wall and that part of the sole immediately within the white line, is in wear. This is the bearing we imitate when preparing the foot for shoeing, but when the shoe is applied we see that it has become modified. It is impossible to raise the wall with half an inch of iron and still have the frog on the ground when working on road surfaces and to this extent the functions mentioned above will be qualified. In soft " going " and over broken ground the frog, in the shod foot, will be in full wear and function.

The effects of concussion are minimized as follows :—When the leg is extended for a step forward, at whatever pace, the toe is slightly turned up and the heel comes to the ground first. The weight of the body then passes over the foot, and as it does so, the pastern is bent downwards and backwards, the cannon, knee and arm are kept straight, and the angles made by the shoulder bones vary as the weight passes. The elastic angles made by the pastern and shoulder at each end of the limb greatly lessen the shock, as compared with that which would be sustained by a rigid, upright column, and they are greatly assisted by the structure of the back of the foot. Here, as previously stated, there is no bony foundation, but two springy cartilages, a thick cushion of elastic material between them, and an indiarubber-like frog beneath ; and this is the part which first makes contact with the ground at each stride. The frog is squashed downwards and forwards giving a firm hold, and both it and the cushion above bulge out a little as the weight is imposed, and aided by the cartilages regain their shape when it is removed. The whole mechanism acts like a non-skidding, pneumatic tyre to the body, excepting that it does not wear out from constant use.

The movements of the hoof when the foot comes to the ground, and the weight of the body passes over it, are very slight ; and for the practical purpose of shoeing, may be disregarded. There is a slight bulging round the coronet, where the horn is thin and soft, and a little widening of the heels. This latter may be readily appreciated by looking at a well-worn shoe, when a bright spot will be observed from the constant rubbing to and fro at this place. It is not, however, a movement which has to be allowed for in shoeing, as it does not extend as far forward as the heel nails.

Make and shape of feet.—Looked at from the front normal forefeet are rounded at the toe, which makes a slope of about 50 degrees with the ground; the inside is rather more upright than this, and the outside rather less so. When the ground surface is viewed, the outer edge makes a rather bolder curve than the inner, the heels are wide and the frog big and full, with its point perhaps slightly turned to one side from hard thrusting on the ground. Both feet are alike in size and shape, any deviation being rare, except as an index of disease. The hind feet are not so round as the fore, they are more pointed at the toe, which is also more upright, and they are narrower all over. On true made legs the feet are placed quite straight and square when the animal is standing naturally. A hind foot is often rested, but a fore one never, except when painful; it is then stuck out in front of the other to relieve it of the body weight (pointing).

"Flat" feet are large in circumference, very sloping, with, as a rule, low heels, flat soles which are sometimes thin, and a large, prominent frog which alone saves them from rapid destruction. When such feet are marked by "ridges" or "rings" of horn from unequal growth they are sometimes called "oyster" feet.

"Mule," "boxy," "narrow," or "club" feet are the opposite of "flat," and are characterized by smallness, uprightness of the wall, high heels and little frogs.

"Long," "fleshy" feet are those in which the toe is unduly long and cannot be reduced to normal proportions without risk of injury.

"Weak heels" are those in which the rate of horn growth is very slow; a formation often found in flat feet.

The thickness and rate of growth of horn varies within the widest limits in different animals. Nine months can be taken as an average time for newly formed horn at the coronet to reach the ground. Some walls grow so rapidly that a considerable amount must be removed punctually every month, others scarcely require touching. As the horn grows forwards at the same slope as the toe, this part usually gets unduly long sooner than the heels, but in exceptional cases the latter may show a quicker growth. The thickness of soles may vary considerably, some being like a board and others so thin that pressure with the thumb will "spring" them.

Care of Unshod Feet.

In hot climates, where work is mostly on unmetalled roads and the horn of the hoof is hard and dry, animals may be worked without shoes. Mules work well under these conditions, but horses as a rule are only left unshod behind.

As a general rule it is not advisable to work draught animals without shoes.

When animals are worked unshod great care must be exercised, and the following points should have careful attention :—

1. The feet inspected regularly by the farrier and the ground surface of the wall slightly rounded off with the rasp to prevent breaking and splitting of the horn.

2. The heels lowered or the toes shortened if required in order to keep the hoof to its proper proportions.

3. The animals trotted up periodically to ensure that they are not foot-sore. If the action is pottery, shoe up for a time to allow the feet to grow. After sufficient growth has taken place the animals may again be worked without shoes.

4. Especial care is necessary during wet weather and when animals are worked on macadamized or gritty roads, as the horn wears down very rapidly under these conditions.

5. A set of shoes fitted for immediate use maintained for every animal.

Preparation of the Foot.

Farrier's tools are classified as " shoeing tools," for preparing the foot and nailing on the shoe ; and " Forge tools " for use at the fire and anvil in shoe " turning."

Shoeing tools.—The shoeing hammer, for driving nails and twisting off their points when driven through the hoof, has a very strong, curved claw for this purpose. The make of this claw is of importance ; it must be able to grip and easily twist off the point of the nail, which may, by a sudden movement of the horse, wound the smith's leg unless bent over or removed.

The buffer, made of steel about five and a half inches long, has a blunt chisel at one end for cutting " clenches," and a point at the other for punching out " stubs," or broken nails.

The rasp, three-quarter coarse cut and quarter file cut, should be 16 in. long and of the best quality. Shorter rasps add to the man's work, and a level surface for the shoe is not so easily obtained by their use. With a good rasp the smith can do nearly everything required in the preparation of the foot for shoeing.

The drawing knife has a curved blade with a bent-over end. It was designed to pare out the sole when that was considered a correct method, but its use is now limited to cutting off rags of horn and taking out small pieces of wall for the clips. Beyond this, in regularly shod feet, it is rarely necessary.

Pincers, with wide opening, sharp jaws, are used for levering off the shoe, drawing nails and to assist in clenching up.

Overgrown feet, such as may be found in batches of horses running unshod for long periods on soft soil, are lowered by special *hoof cutting pincers* or a *toeing knife*. These are not required in regimental forges, but are most useful in hospitals, remount depots, and on service.

The preparation of the foot for shoeing.—Presuming that the hoof is of normal proportions and regularly shod, the shoe is removed and as much horn as has grown since the last shoeing is rasped off; the comparative length of toe and heel being accurately preserved and the bearing surface for the reception of the new shoe kept quite level. Any flakes of horn which are evidently just coming away from the sole may be pulled out, and any markedly ragged pieces of frog cut off, but no paring of the sole, or slicing of the frog, is permissible. The most vulnerable part of the foot lies between the wings of the pedal bone and embraces the navicular bone. From Figs. 41 and 42 it will be seen that this corresponds with the back of the hoof, and it is imperative in preparing the foot that the wall at the heels is not weakened by undue rasping. In the past this has sometimes been advocated in a fruitless attempt to get the frog of the shod foot on the ground. We have already shown that this is impossible.

Faults of preparation :—

(1) *Overlowering of the wall.*—Skill and experience are the only safeguards against this, and, as in other details, the smith has to trust his eye and hand. It is not a usual error with skilful workmen, and as a rule only occurs the first time a newly-joined horse is shod, after which the man knows how much can be safely removed. Flat, spreading feet are most likely to suffer in this way.

(2) *Uneven bearing surface*, from overlowering one side as compared with the other. A fault only found among learners or due to carelessness.

(3) "*Stumping up*" or "*dumping*" *the toe.*—This is a serious fault. If the toe requires shortening it should be done by rasping the ground surface and not the front of the wall. If the latter is practised, it narrows the bearing surface of the foot, and by

rasping away the hard, outer horn, exposes the softer, moister layers beneath, which then become brittle. When an attempt is subsequently made to drive nails into the brittle horn, this splits and breaks off, so that the shoe may be lost. Dumping is very occasionally necessary with flat feet in order to get the nails high enough up the wall to give a secure hold.

(4) *Paring the sole.*—This was formerly considered a correct procedure. The horn was carefully pared until it "sprung" under the pressure of the farrier's thumb. The naturally thick, protective sole was thought to be detrimental to the elasticity of the foot and was therefore pared until it yielded on pressure. The soft horn of the pared sole rapidly became brittle and dry, just like that of the dumped toe ; and a mixture of clay and cow dung was then plastered into it at night, to keep the foot "cool." A continuance of the two last practices resulted in the horn becoming so brittle that a run at grass or standing in clay was sometimes necessary to make further shoeing possible. The practice is now, as far as the army is concerned, altogether discarded, and with the best results.

(5) *Paring the frog* is another relic of the past, now prohibited. The frog was, for some reason, regarded as a delicate organ which would be injured from contact with the ground, and had to be saved by removal. The result was, as in the last two operations, disastrous, and resulted in shrivelled, thrushy frogs which gave no assistance in distributing concussion, and were themselves liable to bruise from any unevenness of the road.

(6) *Opening the heels* is another term for cutting away the bars, in order to make the heels look wider. It weakens the heels, ultimately causes them to contract, and is rightly prohibited.

(7) *Over-lowering the heels* is a common fault due on the one hand to an exaggerated idea of frog pressure and on the other because the inexperienced farrier finds it easier to rasp away the horn at the heels than at the toe. By over-lowering the heels not only are the heels weakened but more weight is thrown on the tendons and ligaments, and lameness may result.

The above described errors in preparation still flourish in some quarters outside the army, and may often be observed in newly-joined horses. There is no doubt that to the unthinking observer a neatly dumped foot with a smoothly pared sole, opened-out heels, and symmetrically trimmed frog, has a more attractive appearance than the natural, strong, somewhat rough-looking hoof, with its flaky-looking sole and rather ragged, prominent frog, and for this reason such practices flourish. The insidious nature of these evils also aids in their continuance, for so strong is the hoof that it is only after a year or two of persistent abuse that their effects are apparent. Then, however, the dry brittle wall, into which nails can be driven with the greatest difficulty, the high-arched easily-bruised sole, the thrushy, shrivelled frog, the narrowed heels, and pottering gait, tell their own tale, and end by shortening the animal's useful life. It is worthy of note in this connection, that all unnecessary cutting and paring of the hoof increases the smith's difficulties, and only the most skilful workmen can shoe persistently ill-treated feet with any success.

In speaking of the structure of horn, it was noted that the moisture contained in the tubes gave it the quality of toughness. This moisture is most abundant in the young, soft horn, and becomes less and less in the outer and older portions. Rasping the outside of the wall, paring the sole, and cutting the frog, nails unskilfully driven necessitating withdrawals, permits its escape and produces brittleness; these operations should therefore be confined to the narrowest possible limits.

SHOES.

A detailed explanation is here given of the various terms used in connexion with the different parts of shoes generally, and reasons for and against their adoption are also stated where necessary.

The whole of the substance of the shoe is called the "*web*," and the width of the web, "*cover*," *e.g.*, a wide-webbed shoe, is frequently spoken of as having "plenty of cover." From the toe to the heel on each side is a "*branch*." The terms "*toe*" and "*heel*" sufficiently explain themselves, and the "*quarter*" is that part between them on each side. The surface which is in contact with the foot is the "*bearing*" or "foot surface," and it may be either flat or "*seated*."

Seating is the hollowing out of the bearing surface, opposed to the sole, so that a seated shoe bears on the wall alone (Fig. 46). A "*saucer*" shoe is one in which the seating is so extensive that only the outer edge of the wall takes a bearing.

The object of seating is to take pressure off the sole, and when this is flat it becomes a necessity, but as the sole of the healthy foot is slightly arched, except at its outer edge, it is not requisite in the great majority of cases. In practically all heavy draught horses, however, seating of the fore shoes is the rule, presumably in order to legislate for all classes of feet by one pattern of shoe. A seated foot surface cannot offer as solid and extensive bearing as a flat one, and for army purposes should be avoided. Dirt gathers between sole and shoe, and in deep ground it is more likely to be sucked off.

As a rule, the heels of seated shoes are left flat, no alteration being required in this situation.

Fullering is a groove on the ground surface of the shoe in which the nail holes are placed. Nail holes which are not in

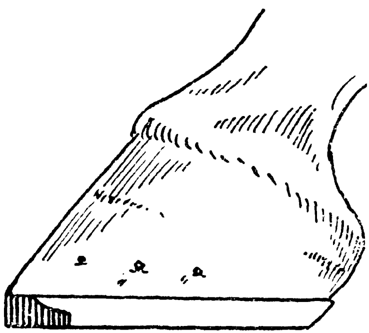


FIG. 46.—Diagram to show bearing (in section) of a seated shoe.

a fullering, but are pierced through the whole thickness of the web, are called "*stamped*." A double fullering may be seen on some patterns, the second groove lying towards the inner edge of the web, and not containing any nail holes; this pattern is known as a "Rodway" shoe. The arguments which have been advanced in favour of fullering are:—(1) that by breaking the broad, smooth surface of the web into two narrow edges it gives a better foothold and so prevents slipping; (2) that it can be made the exact shape of a section of the nail used, thus ensuring perfect fitting of the latter, and further, that the farrier can see whether the nail is accurately fitted or not; (3) that it makes the shoe lighter.

That two narrow surfaces will, under certain conditions, give a better foothold than a broad, smooth one is, no doubt, correct, but they will wear out quicker and the other advantages claimed will not stand examination. A nail supported on two sides by a fullering cannot be so secure as one supported on all sides in an accurately "stamped" hole. It certainly cannot make the shoe lighter than it otherwise would be, for no metal is removed in its making. There is one distinct drawback to fullering from a workman's point of view, viz., that to correspond accurately with a nail head it must be deep and narrow. In altering machine-made shoes, this deep groove easily gets closed in at the top, and unless the man is specially careful to re-open it subsequently, the nail head cannot be driven home, the neck no longer fits all the way down, and when the shoe is part worn the nail head becomes loose and the clench "rises." If a farrier makes a fullering, he makes it wide and shallow, so that the broken surface for increased foothold is obtained, and the danger of

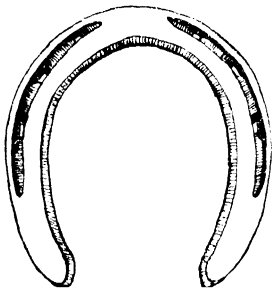


FIG. 47.—A plain toe fullered shoe.

nails not being driven home avoided. A reason why all heavy machine-made shoes are fullered is, that the manufacturers find it impracticable to stamp nail holes by machinery through metal over a certain thickness, and it is therefore unavoidable in such shoes. Fullering may extend all round from heel to heel, or be confined to the region of the nail holes, leaving the toe and heel "plain."

Calkins.—With the object of giving a better foothold to heavy horses with a load behind them, calkins are usually made on the outer or both heels of the hind shoes. A calkin is produced by turning down the heel at right angles, and the projection being forced into the ground by the animal's weight, gives a good grip. When calkins are fitted to the outer heel of the shoe only, the inner heel is narrowed and thickened (wedge heel), so that it brings them level, and with the same object the toes of calkined shoes are similarly thickened. The object of using a "wedge heel" on the inner branch is to lessen the chance of "brushing."

Plain shoes are those in which the ground surface is flat.

Concave shoes have the inside of the web hollowed out, so that the ground surface is narrower than the foot surface.

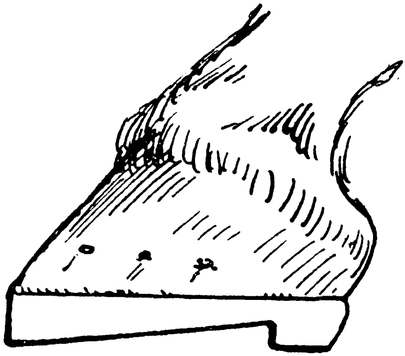


FIG. 48.—Shoe with calkin and thick toe.

The advantages claimed for the concave pattern are: that it is lighter than a plain shoe of similar thickness; that in deep going it does not create so much suction, is therefore less liable to be lost, and makes lighter work for the horse. It is

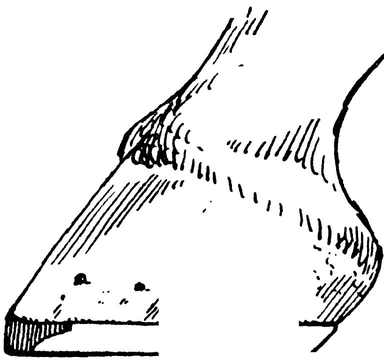


FIG. 49.—Diagram to show the bearing (in section) of the concave shoe.

however, obvious that it is not likely to last quite so long as a plain shoe of equal width throughout. The concave pattern is in general use for hunters, and its advantages for this particular type are evident.

"*Knocked-up*," or "*Feather-edged*," shoes have the inner branch of the web considerably narrowed from the toe to the heel, and at the same time slope inwards under the hoof. They are used for horses which "brush."

When the animal turns the toes out from the fetlock the knocked-up side is also made deeper than the other, with the object of throwing the weight on the outside of the foot and so straightening the leg at the fetlock, when the body weight is on it.

A ¾-shoe is one from which an inch or two of the heel (usually the inner) has been removed. This type of shoe is sometimes used to relieve "corns" from pressure, and also to prevent brushing in animals with turned-out toes.

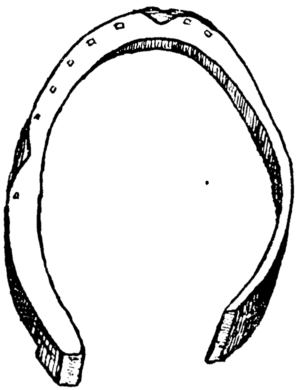


FIG. 50.
A feather-edged shoe.

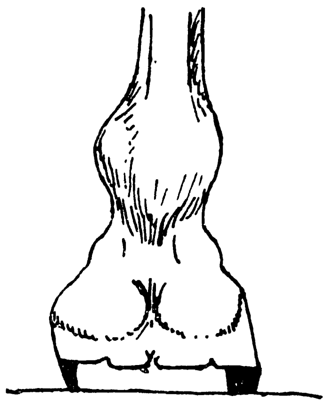


FIG. 50A.
Diagram to show feather-edged shoe applied. Back view of foot.

Clips.—In order to prevent the shoe from being forced backward or moved from side to side, "clips" are drawn from the web, either at the toe or quarter, and a small piece of horn is removed from the edge of the wall for their reception. Usually all machine-made shoes are fitted with one central toe-clip on front shoes, and on hind shoes with either a similar clip, or one on each side of the toe. For horses that kick, an outside quarter clip is often fitted in addition to the one at the toe. It is customary in England to give riding horses clips at each side of the hind shoes with a view to avoid the chance of over-reaching, but it is doubtful if any advantage is gained. In any case, the clips should be as small as possible, with a good stout base, so that they will stand any strain likely to be brought on them. Many light horses can certainly do without them at all.

It will be noticed that although patterns of shoes are numerous, all variations from the plain-stamped shoe, with a flat foot surface are, with the exception of "seating," due to alterations of the ground surface. An examination of shoes which are half worn, but still on the animal, will show that whatever the original pattern of the ground surface it usually becomes a flat one some time before the shoe is worn out, and the horse nevertheless continues to work satisfactorily.

Nails.—The use of machine-made nails for horse-shoes is now so universal that the hand-made variety need not be alluded to. Frost nails are, however, still made by hand. The size of nails is denoted by numbers which correspond to the number of pounds per thousand which the particular nail weighs; *e.g.*, 1,000 No. 6 are supposed to weigh six pounds. As a matter of fact, the actual weight is always greater than inferred by the number. The back of the nail is flat from head to point; on the face, the head, shaped like an inverted cone, slopes to the "neck," where it joins the "shank." The "point" is really a bevel on the face of the nail, and its direction helps to bring the nail out of the hoof when driven.

Good nails, which are made of the best Swedish iron, must be stiff and solid enough to drive without buckling or splitting, and yet ductile enough to prevent the possibility of their snapping short when the points are being wrung off. This last is a very serious fault, for if the shank breaks too short there is not sufficient left to clench up, and the nail must be withdrawn, and a fresh one re-driven. Their ductility is tested by fixing them in a vice and twisting them, corkscrew fashion, or bending them to and fro a couple of times, while their stiffness is demonstrated by supporting the ends, and suspending a weight from the shank.

Nails are described as "rose-headed" and "countersunk"; rose-headed nails are those in which the head of the nail does not enter the nail hole. The pattern is no longer used in England for horse-shoes, but still survives in southern Europe and the East generally.

Countersunk nails are either "half" or "full" counter, the heads of the latter being the bigger and wider. The head of this pattern being completely embedded in the web, gives a very firm attachment, and if the holes correspond actually they cannot wear loose.

The number of nails which should be used to secure the shoe is "as few as possible." Every nail cuts through a small amount of moist, tough horn, which, below its tract, becomes dry and brittle. As the horn grows forwards, the nails of each new shoeing make fresh holes just above and behind the former ones, and increase the brittle area; the fewer nails then, the better. The size of nails used should be proportionate to the shoe, and no larger than necessary, for the broader the shank the more horn it cuts. For similar reasons, nails should not be driven higher than will give a secure hold. These rules must be given a common-sense interpretation. A horse losing a shoe on a journey is likely to do much more harm to his unprotected foot than would be caused by an extra nail or a little high driving, and both may be necessary in particular instances, of which an average smith is a competent judge.

The number of nail holes in a shoe bears no particular relation to the number of nails necessary to hold it securely. In many machine-made shoes a large number of holes are punched so that the best positions may be chosen for driving the nails.

The Making of the Shoe. Forge Tools and their Uses.

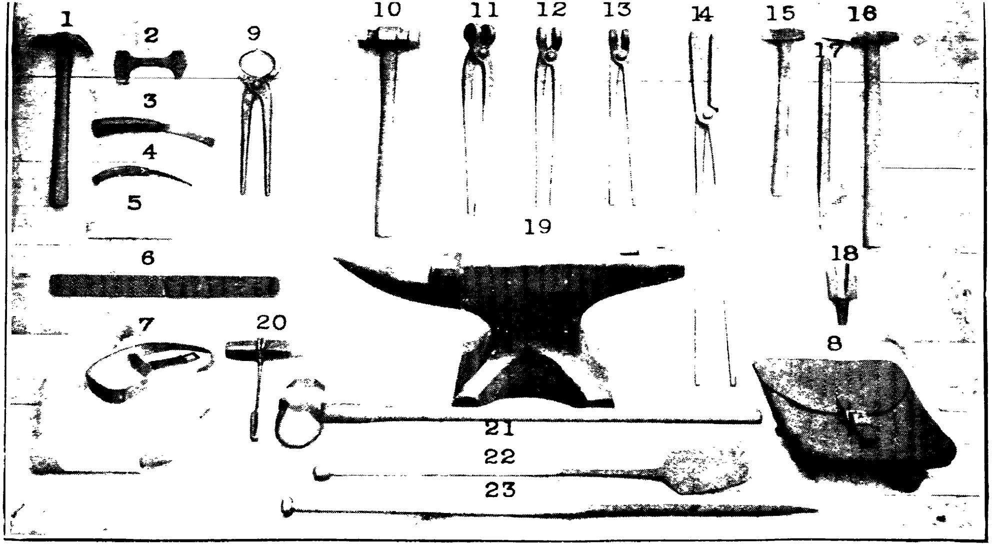
The anvil has a square body, with a sharp rounded "beak." It should be so heavy and solidly fixed that a strong blow on the beak will not move it. On the body metal is placed for "welding" and "drawing" into bar; on the beak the drawn-out bar is "turned" to shoe-shape. On the surface of the body are two holes, the larger for the reception of the shanks of the "tool" and ½-round "cutter," and the smaller for a "nail-cutter."

The fire tongs have long handles and, when new, very long jaws. In practice the jaws vary in length as the metal gets burned away in use. The length of handle is to let the man manipulate the metal without having to get too close to the fire. The farrier's *shovel* is called a "slice."

The shoe tongs are shorter in handle and jaw, the latter being of different widths. Those which shut close for grasping narrow bars are called "inside," as opposed to the wider "outside" tongs, which are for handling thick moulds. It is with these tongs that the smith manipulates all hot metal at the anvil.

The turning hammer or hand hammer, is used by the smith at the anvil. It weighs about 4 lb., has one flat and one convex face, and the sides are usually somewhat angular for the purpose of drawing clips. With one striker to help him, the smith uses this hammer to assist in welding, but with two strikers he merely beats time on the anvil, and by the strength of his beat indicates the force he requires them to put into each blow.

[To face p. 242.



1. The Shoeing Hammer.
2. The Buffer.
3. The Drawing Knife.
4. The Searcher.
5. The Ragstone.
6. The Rasp. 7. The Apron.
8. The Farrier's Tool Bag.
9. The Pincers.

} Carried in the Tool Bag by the Farrier.

10. The Turning Hammer.
11. } Shoe Tongs.
12.
13.
14. Fire Tongs.
15. The Fuller. 16. The Stamp.
17. Pritchel, carried in the Tool Bag by the Farrier.
18. The Heel Cutter, half-round.
19. Anvil.
20. The Set.
21. Sledge Hammer.
22. Slice.
23. Poker.

The sledge, 9 lb. weight, is used by the striker to weld the hot metal, draw it to the required substance, and subsequently to hammer it through the " swedge " or " tool " ; to drive the stamp through the web and to cut the heels.

The " swedge," " crease," or *" concave tool,"* usually called the *" tool,"* is a mould through which the hot bar is pulled by the smith, whilst it is hammered by the striker, in order to give the concave shape required.

The fuller is a blunt chisel set hammer fashion in its handle and is hammered into the metal by the striker, as the smith draws it along. Fullers differ in pattern ; those made by farriers being usually blunter, and producing a shallower groove than the government pattern. Too sharp a fuller may easily cut a hot shoe in two if struck a lusty blow, and ruin the work, and deep narrow fullering is very liable to be accidentally closed during subsequent alterations.

The stamp is a punch, the point of which should be the same shape as the nail head. It is held in position by the smith, and struck first lightly and then heavily by the striker, till it penetrates the thickness of the web. At the toe the point of the stamp is held at an angle which will produce a coarser hole than is required at the heels, and the position varied in succeeding holes to give the necessary gradation. The terms " coarse " and " fine," applied to nail holes, denote their position on the foot surface of the shoe in relation to the width of the web. " Coarse " holes, *i.e.*, near the inner edge, so that the nails enter a good thickness of horn, are naturally placed at the toe, and as the wall gets thinner towards the heels the holes are made " finer," *i.e.*, they open nearer the outer edge of the web. The same terms are applied in the driving of nails to express their comparative nearness to the fleshy leaves.

The pritchel is a long steel punch, having the end shaped like the head of the nails used. The point of the pritchel should be an accurate reproduction of the neck of the nail, and as it soon loses its shape from the hot metal into which it is driven the smith frequently points and tempers it to regain the necessary shape.

The pritchel is used to finish off the nail holes begun by the stamp. In doing this, the punching of the unfinished hole is first completed and the shoe is then turned over and " back pritchelled," to get rid of the rough edges (" burr ") which might strip the nails in driving. Theoretically the nail hole should be so accurately stamped and pritchelled that it is an exact counterpart of the nail head, but in practice there are slight differences. In " back pritchelling " the smith makes the neck of the nail hole a little bigger than the neck of the nail, so that he may " pitch " the latter in or out, when driving it (p. 231).

This is a distinct practical advantage if carefully carried out, but if overdone the neck of the hole may be so enlarged that the nail becomes loose before the shoe is worn out. Another slight difference is that, although the exact shape of the nail head, the hole is made a little smaller, so that the nail, projecting slightly from the shoe, can be driven hard home, thus making sure it is secure.

Forging the shoe.—Hand-made shoes are turned either from new bar iron or " old stuff," *i.e.*, worn-out shoes. The latter method is adopted in the army, and as the necessary work entails a lot of hammering, the shoes so produced are of good, tough quality. It takes 1½ worn shoes to make a new one. The smith takes a worn shoe, bends it double at the toe, and between its doubled branches wedges half another one; so that the result is three thicknesses of metal. The doubled end is placed in the fire, and brought to a welding heat, then quickly laid on the anvil, where two or three rapid blows weld the three pieces into one, and at the same time produce a convenient shape for the tongs to grasp during subsequent operations. The lump of metal is now known as a " mould." The welded end of the mould is then grasped by tongs and the other end thrust into the fire and brought to welding heat. It may here be remarked that each fresh operation at the fire is termed " taking a heat," the intensity of which is judged by the smith, looking at the metal as it lies in the fire. At the right moment it is taken out, given a swing to get rid of cinders and loose flakes, and thoroughly welded into a rod of sufficient length to form one half the new shoe. When the smith has two strikers to help him, he simply beats time for them on the anvil, while he manipulates the metal, but if he has only one assistant he joins in the welding with his hand hammer. Having drawn it up to the proper length, he " turns " the shape of the half-shoe, and the striker, having placed the tool and cutter successively on the anvil, the concave shape is produced and the heels cut to a correct slope. The shoe is then turned over, the " fullering " pressed out and the nail holes stamped, beginning at the toe hole. Their position is first lightly marked, and then one or two heavy blows drive the stamp through, or nearly through. All these operations can be done by an expert workman at one heat; two may be required, but learners will often produce nothing but a burnt and useless piece of metal in half a dozen.

The process is now repeated on the other half, and lastly the clips are "drawn" and the holes finished by pritchelling.

Clips are " drawn " by holding the edge of the web over the edge of the anvil and striking with the side of the hammer on the desired spot.

Special tools are used for this purpose (*see* Plate British Army Pattern, set-up toe, p. 252).

The fitting of the shoe.—A well-fitted shoe should have a perfectly level, even bearing on the whole of the wall, the bars, the white line, and that outer rim of the sole which is naturally flat. It should follow the circumference of the hoof accurately throughout, and at each heel should be bevelled off so that the horn and iron are in line.

In riding horses it is usual to set the hind shoe back a little from the toe to avoid the risk of injury from over-reaching at fast work or when jumping.

The usual method is to shape the shoe as accurately as possible, by comparison with the old one, during the forging, and then to bring it hot to the foot. It is held in contact sufficiently long to sear the horn brown where it touches, and during this period the farrier makes a mental note of any further slight alterations of shape required, and the position of clips. Hot fitting is the general method adopted, because it is the best way to ensure a perfect fit, but on service a forge is not always possible, though shoeing is imperative, and *cold fitting* is at times a necessity in the army.

With hot fitting, the workmen can see at a glance from the brown appearance of the burnt horn where the web of the shoe touches the hoof; and by rasping these parts down till perfect contact of the whole is assured, as proved by a complete brown rim, he is certain to get an accurate fitting of the shoe to the foot.

With cold fitting, there is no such guide, and to get equal perfection requires a nicer appreciation by the eye of the surfaces to be joined. For this reason alone, cold fitting is not as a rule so accurate and solid as when carried out hot, and the result is a greater proportion of loose or lost shoes from the shoe rocking, and the clenches rising.

Another reason why heat is generally used in fitting is the ease with which the hot metal is altered. With light cavalry shoes this is not a point of such practical importance as with heavy and draught shoes, but, in any case, it adds to the labour. With very heavy shoes, any but the most trivial alterations to the width of the heels become impracticable in cold metal.

Although not so accurate and satisfactory, cold fitting can nevertheless be carried out with sufficient success to be of practical utility, and, being a necessity in war, must be practised in peace. To get satisfactory results, the workmanship must be of a good standard, and the shoer a thoroughly well-trained man.

An objection to hot fitting on the score of injuring the hoof is not a practical one, as it presupposes a bad workman. If the sole is over-lowered or too much burnt, no doubt a grave injury may result, and the shoe should be no hotter and not held on the foot longer than necessary; but with a skilful man no harm is done, and results justify its adoption.

Having obtained a level bearing, an accurate fit round the edge, and removed small pieces of horn where clips are fitted, the smith then cools the shoe, files it up, and it is ready for nailing on.

Faults in fitting.—(1) *Over-lowering of the sole* should not occur with an ordinarily careful workman, a possible exception being where a horse with unusually thin, flat soles is being shod for the first time.

(2) *Excessive burning of horn* is sometimes done from a mistaken idea that the procedure makes a more solid bed for the shoe. As a matter of fact, the reverse is the case, for the charred horn becomes so brittle that it crumbles away beneath the shoe, and is likely to be a cause of it getting loose. Occasionally this fault is practised to make rasping easier.

(3) *Dumping* may be a fault of fitting as well as of preparation. It is rigidly repressed in the army, but is constantly practised outside it. From a mistaken idea that the foot should be smaller and neater looking than nature has made it, the shoe is often made less in circumference than the hoof, and the latter is then rasped round the wall till the desired size is obtained. Its bad results have already been noted (p. 234).

(4) *Too wide.*—The shoe should accurately follow the outline of the foot and not project beyond it at any point, an error which may cause the horse to strike the opposite leg (brush). A little extra width is permissible at the heels, when frost nails are to be fitted.

(5) *Too long* a shoe, projecting beyond the heels, is distinctly faulty, as it increases the liability of the shoe to be torn off, if struck by the toe of the hind foot. The shoe should extend up to the end of the heel, and be bevelled off in line with the heel itself.

(6) *Too short* a shoe is equally faulty, as it fails to take a bearing on the bars, and so increases the liability to bruising of the heels (corns).

Nailing on and finishing.—When the shoe is ready for nailing on, the man takes the foot between his knees, holding it squarely and firmly; and laying the shoe accurately in position, drives one of the toe nails. He then readjusts the position if necessary, drives the opposite toe nail, which prevents any further chance movement, and drives the remaining nails in succession from toe to heel on each side.

Driving nails.—In driving, the smith begins with the toe nails first, because they serve to fix the shoe firmly in the position he intends it to occupy, and also, because the horn at this point is thicker than elsewhere, and he can therefore plant the first nail with confidence. As the heel is approached the horn becomes thinner, and greater care is required to avoid

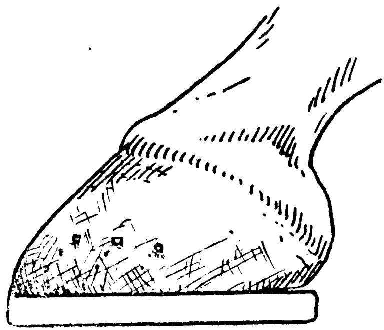


FIG. 51.—" Dumped " toe, sprung heel, heel of shoe too long and not bevelled off.

injury. The point of the nail is entered in the neighbourhood of the white line, and it is " pitched," or sloped at such an angle as is calculated to bring it out high enough up the wall to give a secure hold. At the same time, it must not be driven so close to the fleshy leaves as to " prick " or " press " (bruise) them. Nails are termed " coarse " when driven too close to the flesh, and " fine " when they start very near the edge of the wall. Those which make their exit far up the wall are " high," and those which come out very near the ground " shallow."

In judging whether the nail is being correctly driven, the man is guided by sound and feel. As the point is driven through the soft horn near the white line, towards the harder outside of the wall, the sound produced at each stroke alters, and practice enables him to detect any deviation from the normal. In addition he keeps touching the spot where he expects the point to issue, with a finger tip, and so gets a good idea as to its direction.

Nails should be driven a medium height, those at the toe a little higher than at the heel. If more are employed on one side than the other, the inside heel nail is the first to be left out, this being least necessary, and most difficult to drive safely.

As each nail is driven, the projecting point is seized by the claw of the hammer, and wrung off by a sharp twist, or is bent flat against the wall to avoid the chance of its wounding the man's leg.

Clenching up.—When all the points are wrung off the heads are well driven home by repeated blows of the hammer and at the same time the closed jaws of the pincers are pressed firmly upwards against the broken ends. This turns up a small portion of the shank, *the clench.* Immediately below the clench a tiny groove may, or may not, be made by the edge of the rasp for its reception, and it is then hammered firmly down on to the wall. A few strokes with the rasp smooth off any projection, and its edge may be run round between shoe and hoof, to bevel the rim of the latter with a view to prevent it splitting. The clips are hammered lightly into the same line as the slope of the wall, either at the conclusion or before clenching up.

Faults in nailing and finishing.—"*Pricks*" (p. 352), wounds from nails driven into the fleshy part, and "*presses,*" or "*binds,*" from their being so close that they bruise them, are bound to occur from time to time. Generally speaking, they are very infrequent accidents with careful workmen, and if they recur often, or in horses with good feet, may be regarded as evidence of inability or carelessness. It should be remembered, however, that animals with small feet and thin walls are always more liable to this accident than others.

"*High*" *and* "*Shallow*" *driving* may be regarded as faults if they are seen on well-shaped feet with thick, strong walls, but there are frequent occasions when both may be necessary. To obtain a hold on a brittle or broken foot, or to prevent injury to a weak one, they may be safeguards instead of faults.

Rasping the surface of the wall is the most usual fault seen, and is due, like some others, to a desire for a smart appearance, rather than usefulness and good work. There should be no rasping whatever above the clenches, and on or below them only sufficient for the purposes described above, and not as a means of dumping the foot to conceal a badly-fitted shoe. In fact, the fewer the rasp marks the better the work.

Points to be observed in "Passing Out" newly-shod horses :—

(*a*) When the foot is on the ground—

(1) Clenches are even, flat and broad, not too high or too low, and not driven into old nail holes.

(2) No rasping of the wall.
(3) No dumping of the wall.
(4) Clips are low and broad.
(5) Shoe fits the foot.

(*b*) When the foot is lifted off the ground—
(1) Nails are driven home.
(2) No unnecessary paring of sole and frog.
(3) Heels are level in height and not opened up.
(4) No daylight between foot and shoe or uneven bearing.
(5) Shoe is properly finished off.
(6) Shoe fits the foot; particularly, heels of the shoes are not too short.
(7) Shoe does not interfere with the functions of the frog.

(*c*) Trot up the horse for signs of lameness.

Winter Shoeing.

"*Roughing*" is to prevent slipping in frosty weather, and various means are adopted, that in use in the Army being the insertion of screw cogs.

Turning down the heels of the shoe is the common method of the country and is accomplished by taking off the shoes, drawing out, turning down and sharpening the heels, the outer one being turned across, and the inner one in the direction of the shoe. It is an effective means, but it necessitates removal of the shoes.

Screw cogs in the heels is the method adopted in the army. All mounted units are provided with tools for making the holes in the shoes and for the insertion and extraction of the cogs. During the winter months shoes are issued pierced for the reception of screw cogs, and units draw sufficient cogs to provide two sets for each horse. The cogs are inserted when the weather necessitates their use. The sharp edge of the outside cog should be across the shoe, and that of the inside cog in the same line as the shoe; this ensures a better foothold and also minimizes the chance of injury to the opposite leg.

Frost nails were used formerly in the army to prevent slipping. Frost nails are fitted into ordinary pattern nail holes at the heels of the shoes. The horses are shod a little wider at the heels, and the holes are punched so fine that the frost nails can be inserted without touching the horn, or involving the removal of the shoes. The holes can be cleared of dirt with a nail or pritchel at any period.

One nail should be inserted in each heel of each fore shoe, and one in the outer heel of each hind shoe, where there are no calkins or wedge heels; or, should it be considered expedient, in the case of draught or other heavy horses, one nail should be inserted in each heel.

The countersunk portion of the nail head should be completely embedded in the nail hole, only allowing the "chisel" head to remain above the shoe.

The shank of the nail is to be hammered tightly round the web of the shoe or pinched off about half an inch from the foot surface of the shoe; this can be done by making a nick in the nail with the edge of the rasp; a bend or two with the pincers will then break it. The part of the shank remaining should be firmly clenched by being hammered down.

It is not necessary to remove the nails when the horses return to stables, but it may be done at discretion. No special tools are needed for the use of these nails; the ordinary stamp and pritchel are suitable, and the nails are readily removed with pincers.

Wear of Shoes.

A month to five weeks is the period usually stated as the time a shoe should last, and this is correct as regards the time it is advisable to keep it on the foot, without attention. At the end of a month the horn has grown to an appreciable extent, and whether the shoe is worn out or not, it is generally advisable to take it off, and lower the foot. If the old shoe is still good enough to be replaced, the operation is called a "remove." The actual wear of shoes, however, depends, of course, on their original substance, the work done, and the nature of the ground travelled over. A shoe which might be rightly considered too light for use on the macadamized roads of England would be unnecessarily heavy, and wear for months in a roadless, sandy country, so that it is not possible to obtain one single type shoe which is perfectly suitable under all conditions. The actual weight of shoes generally used in England is about as follows:—

Hunters	4 to 5 lb. a set.
Light draught horses ..	8 to 14 lb. ,,
Heavy draught horses ..	up to 20 lb. ,,

The weight being so considerable, as light a shoe as possible should be adopted under all circumstances, but it must wear long enough to prevent too frequent shoeing, or the wall will break from constant nailing. Unfortunately the two requisites in an ideal shoe, lightness and long wear, are opposites which it is evidently impossible to combine in iron, and all that can be done in practice is to keep the weight as low as the average amount of work will admit.

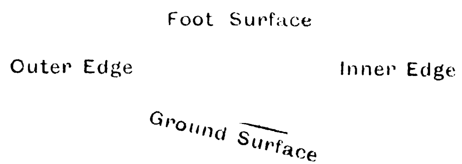
The rate of wear on macadamized roads is increased when the surface is wet, while road work under all circumstances wears out shoes very much quicker than cross-country journeys.

The wear of hind shoes is greater than of fore, and the outside of the shoe than the inside ; with rare exceptions the outside toe is the first place to be worn through.

Many horses wear their shoes much faster than others, the increase being sometimes more than twice as much. With ordinary shoes tested on roads, the individual difference in distance travelled will vary between 100 to 350 miles under precisely similar conditions.

Horses which wear their shoes abnormally quickly should be shod with the *convex shoe*.

The *convex shoe* is one in which the inner edge of the ground surface of the web of the shoe is thicker than the outer edge (it may be as much as ¼ in. thicker), so that the wear is taken up in the early stages of use by the inner edge, thus saving the outer edge and the nail heads for later wear. The increase of thickness from the outer edge to the inner should be gradual, thus—



VARIOUS PATTERNS OF SHOES.

Racehorses are generally shod during their training with the lightest class of concave, fullered shoe, weighing about six ounces, but for the actual race specially light " plates " from two to four ounces are put on.

Hunters and Hacks.—For both these classes the concave, fullered pattern, either flat or with small calkins and wedge heels, is the rule, the toes of the hind shoes being frequently " square " to lessen the chance of over-reaching.

Another class of shoe frequently found on saddle horses is the " tip." *Tips* are not more than half the length of full shoes, and their object is to bring the frog on the ground. It is an excellent method of doing so, but they require applying with considerable judgment or the extra concussion the animal experiences when the bare heel is suddenly brought to the ground may create further mischief.

Carriage horses are either fitted with " Rodway " pattern or ordinary plain shoes with calkins on the hind feet.

Draught horses of all descriptions are given plain shoes, which are, in the case of machine-made shoes, fullered to permit of the nail holes being punched through the thick web, with large calkins, and in some districts with " toe pieces." A toe piece is a strip of iron, welded edge on, across the ground surface of the toe of the shoe, to allow the horse to get extra purchase when starting a heavy load.

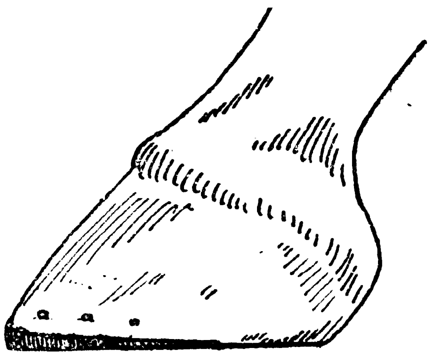


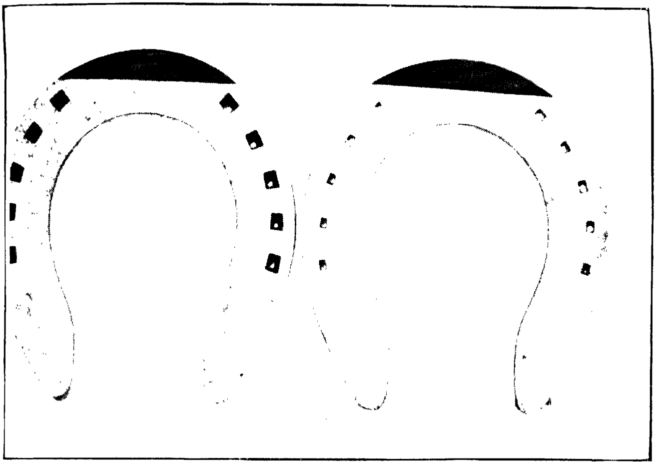
FIG. 52.—A tip.

Shoes to obviate stumbling are of two patterns, either the toe of the hoof is rasped short and the shoe " turned up " (" rolled," " dubbed ") at this part, or the metal of the shoe is thinned as much as possible, the object in each case being to shorten the toe and prevent its premature contact with the ground, at the moment when, the stride being completed, the toe is being turned up to bring the heel down. The two methods, *i.e.*, rasping the toe short and thinning the metal of the shoe, are frequently combined and make the best pattern for confirmed stumblers.

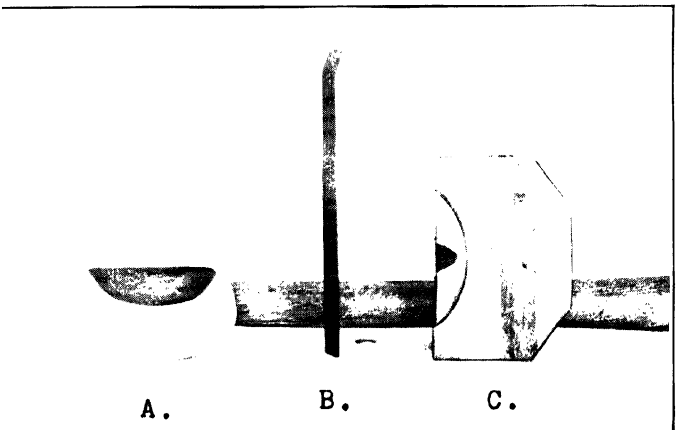
British Army pattern (*set-up toe*).—In this pattern the toes of the fore shoes are sharply set up at an angle of 22 degrees from the centre of the web in place of a clip.

It is considered that this pattern shoe is economical in wear and minimizes concussion, and can be opened and closed for the purpose of cold shoeing in the field.

"Set-Up Toe" Shoe.



Ground Surface. Foot Surface.



B. Side view of a "Set-up toe" Shoe. Note the angle at the toe.
A. Upper Tool } For setting the toe at the correct angle.
C. Lower Tool }

CHAPTER IX.

TRANSPORT BY SEA AND RAIL.

THE selection and fitting of ships for the transport of animals is carried out by the Board of Trade, and the duties of military officers in this matter, under ordinary circumstances, are confined to inspection after completion, to see that the fittings are in accordance with specifications, that the stores are of good quality, and the ship in every way fit for embarkation. For this purpose a board of naval and military officers inspects the ship prior to embarkations, and a veterinary officer accompanies them.

But during war, or at remote ports, any officer may find himself called upon to report regarding the fitness of a ship for the conveyance of animals, or take command during the transport of them. It is therefore necessary to have an accurate general idea of requirements and fittings, and a close acquaintance with the details of management during a voyage. The importance of this knowledge being possessed by all officers must be insisted on. For oversea expeditions the value of horses landed in good condition at the base of operations is not to be estimated in money; if in bad condition they are useless till they are fit; if landed well they are invaluable.

CLASS OF SHIPS REQUIRED.

The typical horse transport for troops should be of the shelter-deck type, good average speed, roomy for the number to be carried, fitted with bilge keels and a steady sea boat, broad of beam, with big hatchways, watertight doors in the bulkheads between the compartments in the 'tween decks, ample mechanical ventilation, good drainage, lighted throughout by electricity, and with specially good arrangements for exercising.

These requirements set a high standard, but the importance of the animals' condition when landed for a campaign is such as to more than justify all the expense incurred by their being insisted on.

Horses may be accommodated either in pens for 4 horses, stalls for 2 horses, or in single horse stalls.

Single stalls or stalls for 2 horses are recommended.

The great disadvantages attaching to the pen system are—

(a) that in rough weather the horses are thrown about so that one horse is injured by the repeated pressure of the weight of three others: this results in multiple injuries, exhaustion, and, frequently, trampling underfoot;
(b) that treads and injuries are much more frequent;
(c) that horses which are greedy feeders bully others, resulting in cases of debility;
(d) that horses which are carried in pens take much longer to recover from the effects of the sea voyage than those which are carried in stalls.

To ascertain roughly the number of horses which can be carried on a deck, ignore all portions of the deck where there is less than 12 ft. clear out from the ship's side; the remaining length in yards will give the approximate number of horses that can be taken on each side.

Speed should be good, so that the voyage may be shortened as far as possible; the longer the journey, the more condition is unavoidably lost.

Breadth of beam is essential, as it gives room and probably indicates steadiness, and a calculation of the actual size of boat required may be made on a basis of 8 to 12 tons according to length of voyage (gross tonnage) for each horse to be embarked, *e.g.*, a boat of 4,000 tons will, if otherwise suitable, carry from 320 to 500 horses.

Hatchways should be at least 18 ft. by 14 ft. to be of any use for horses, and the longer they are the better, to admit of sufficient head room for fitting "brows."

A *brow* or ramp is a gangway sloping from one deck to another to allow horses to pass up or down. Hardwood battens are screwed across the floor at intervals of 9 in. to give foothold, and the sides are boarded up high enough to prevent horses attempting to jump over.

Watertight doors are those doors which, when closed, divide the ship into watertight compartments. In some ships these doors are not fitted, the ship being built in compartments which do not communicate. In a horse ship this would entail much extra trouble, and only ships with communicating watertight doors should be considered suitable. Watertight doors are only fitted as low as the main deck. Lower decks and holds have no doors in bulkheads.

Ventilation.

Too much importance cannot be attached to the provision of ample means for ventilation. It is at all times difficult to ventilate lower decks and holds which are beneath the water line, and especial care should be taken to provide methods both for withdrawing the foul air, and for pumping in a fresh supply; this is especially necessary in the vicinities furthest removed from the neighbourhood of the hatchways.

In addition to hatchways and port holes, which should be kept constantly open whenever possible, the means for ventilating are: (1) permanent air trunks; (2) iron wind scoops; (3) canvas wind sails; (4) electric fans or blowing machines.

(1) *Permanent air trunks* with large movable cowls are fitted to each deck, and should be arranged in pairs, one being cut off close to the deck above, and the other within a foot of the deck, thus furnishing an up-take and down-draught (outlet and inlet). The cowl of the former should be kept turned from, and of the latter, to the wind, unless the ship is fitted with Boyle's or other patent outlet and inlet cowls which do not require this attention.

(2) *Iron wind scoops* are provided for fitting to port holes and scuttles, and as they stand out at right angles to the ship's side with the concave surface forwards, they deflect a constant current of air inwards.

(3) *Canvas wind sails* are long funnels with a wide bell mouth, and are arranged from the rigging in the same way as the permanent air inlets, *i.e.*, mouth to the wind. They can be employed as inlets for fresh air only; they should be fitted so that the opening of the funnel is about a foot from the surface of the deck, and their frequent inspection is a matter of necessity, as they are so liable to be accidentally blocked or collapsed, particularly when leading to the lower portions of the ship.

(4) *Electric fans*, blowing machines, or other mechanical means of ventilation should be fitted to all horse decks on ships employed for conveying animals for war purposes. By their means, if fully employed and judiciously distributed, currents of air can be set up, and a fresh atmosphere created in the dead ends of the decks, far from the hatchways, where ventilation on an adequate scale is otherwise impossible. Expense should not be the sole guide in fitting these, as the extra health and fitness of the animals on landing more than compensates, from a military point of view, for the extra outlay. Fans and the mouths of blowers should be adequately protected or placed in positions where they cannot be touched.

Whatever form of mechanical ventilation is adopted it should be ample for requirements when the hatches are battened down.

Drainage.

This is usually unsatisfactory on a horse ship. The whole drainage runs, as a rule, from the decks, down small pipes, leading from the scuppers to the bilge; the entrance to these pipes is guarded by a perforated cover to prevent them becoming choked with dung and other solids. Notwithstanding this precaution, the pipes constantly become choked and the urine has to be pumped up, and overboard, by hand. For this reason suitable hand pumps should be provided, unless a better system is adopted. There should be no difficulty in dealing with the drainage of decks above the water line; it should run straight overboard and not into the bilge. In decks, however, which are below water, it is more difficult to dispose of, and unless the ship is specially fitted for the purpose it must be got rid of as described above. The drainage of pens in the hold is allowed to run into the coal beneath the flooring. All dung must necessarily be brought up by hand from below and thrown overboard.

Arrangement of Pens.

Transports conveying mounted units can as a rule accommodate the horses on two decks only, owing to the amount of room required for troops; but in ships chartered for the carriage of horses only, all the decks may be utilized for the erection of standings, and the hold and alleyways can also be occupied if suitable.

Horses are not to be carried on topgallant forecastles or poops, nor are they to be stood against bulkheads or in the vicinity of steampipes. Five per cent. spare stalls are fitted.

All standings should be placed athwart the ship. Down each side of the deck a long row is erected, heads inward. When there is room enough for a row down the centre of the deck there must be sufficient space both in front and behind for free passage, and if width permits of double amidship rows, the animals occupying these should face outwards. Under no circumstances should a seagoing ship be fitted with fore and aft standings. This would place the horses sideways to the roll, in which position they are unable to balance themselves; and as the angle at which the ship rolls is always greater than the one at which she pitches, they are swung from side to side and frequently injured. The strain on the fittings, especially the side rails caused by this pendulum-like bumping, is also very great. They may give way, and heavy losses have been incurred in the past as the result. The plan is quite unfitted for a ship which may encounter any seaway. It may be used to advantage for river transport and economizes room.

Structure of Pens or Stalls.

The pens, etc., are constructed in accordance with the Board of Trade Fitting Specification as follows :—

Dimensions of Pens or Stalls.

		Ft.	in.
Maximum length in the clear between breast rail and back lining. (*Not less than maximum length to be given where possible*)	Horses	8	0
	Mules	7	0
Minimum length in the clear between breast rail and back lining for horses and mules	—	7	0
Passage between two rows of pens, clear between breast rails, not less than ..	Horses	6	0
	Mules	5	0
Breadth between parting boards in the clear	—	9	10
Pen for 4 animals	—	9	10
Stall for 2 horses	—	4	11
Height of the parting boards from platform to top edge	—	3	9
Height of breast rail from platform to top edge	Horses	3	9
	Mules	3	7

Note.—Each pen of 9 ft. 10 in. is for 4 horses or large mules, or 5 small mules.

Fittings on Exposed Decks.

1. *Cants.*—To be of White Pine 6 in. by 4 in. rounded on the top edge, to run fore and aft at front and rear of pens. To be fastened to the deck by ⅝-in. nut and screw or tapped bolts, spaced 5 ft. apart : if on wooden deck it is to be fastened by ⅝-in. coach screws spaced 2 ft. 6 in. apart.

Before fixing in position, watercourses 9 in. by 2 in. are to be scored out of underside of front cants for middle line pens, spaced 5 ft. apart and arranged so as to come between stanchions.

In the case of cants for side pens, watercourses are to be cut in all rear cants, but only in front cants when they are adjacent to the middle line stalls in order to give free drainage from the latter to the scuppers.

2. *Front Stanchions* to be of Pitch or Red Pine 6 in. by 4 in., spaced 5 ft. apart, centre to centre, the height of same to be 8 ft. from ship's deck. In way of horses' heads stanchions to be covered with zinc 9 B.W.G. from seat of breast rail bracket to a height of 2 ft. 2 in. Heels to be secured to the cant by ⅝-in. nut and screw bolt through heel of stanchion and cant.

The following are to be fitted on each front stanchion :—

(*a*) *Bracket for Breast Rail.*—An iron bracket $\frac{5}{8}$ in. thick by 4 in. wide, the seat of the bracket, which takes the lower part of the breast rail, to be 3 ft. $2\frac{1}{2}$ in. from heel of stanchion. The lower part of the bracket to be 8 in. long and bolted with two $\frac{5}{8}$-in. nut and screw bolts, the heads of the bolts to be let into the inside of the stanchions. The upper part of the bracket to be 7 in. deep, projecting $3\frac{1}{8}$ in. from stanchion for breast rail to drop into.

(*b*) *Halter Rings.*—Two $\frac{3}{8}$-in. iron rag pointed ring bolts (the ring being 2 in. in diameter) to be fitted on front of each front stanchion, one $23\frac{1}{2}$ in. above and one 15 in. below the seat of bracket for breast rail.

(*c*) *Swinging Stops of Hardwood of approved pattern* to be screwed on to the front of each stanchion in such a way as to keep the breast rail in place when they are turned down, and to allow it to be shipped or unshipped when the stops are turned up.

(*d*) *Staple for Hay Net.*—A stout 3-in. iron staple to be driven into front of stanchion 2 ft. 10 in. above the seat of the breast rail bracket.

In addition to the foregoing each alternate front stanchion is to have the following fittings :—

(*e*) *Battens or Fillets* of hardwood 2 in. by 2 in. to be screwed to the backs of stanchions to form a vertical groove 2 in. wide to receive the parting boards. A stop to be fitted in lower part of groove to keep parting board clear of platform.

(*f*) *Pins and Chains.*—An approved ball-headed pin to be fitted into a socket hole just above top parting board, and secured to stanchion by chain and staple.

3. *Rear Stanchions* to be of White Pine 6 in. by 4 in., spaced 2 ft. 6 in. apart, centre to centre, the height to be 7 ft. 2 in. from the deck.

These stanchions to be thoroughly secured in position by means of iron clamps fitted to bulwark rail or rails. Stop to be arranged on back of stanchions to prevent their rising. Heels and rear cants to be secured as in para. 2.

4. *Fore and Afters.*—A long upper end of front and back stanchions a 4-in. by 3-in. fore and after of Fir to be run. These fore and afters to be secured with $\frac{1}{2}$-in. nut and screw bolt through every rear and front stanchion.

5. *Roof Rafters* to be of Fir $4\frac{1}{2}$ in. by 3 in., spaced 2 ft. 6 in. apart and bolted to front and back stanchions and fore and afters alternately. All roof-rafters to be carried 2 ft. beyond front stanchions, and, as necessary, beyond back stanchions. (*See* " Sea Wall," para. 13.)

6. *Roof* to be of Fir 2 in. tongued and grooved, and carried 2 ft. beyond front stanchions, same as rafters. To be covered with new No. 2 canvas painted with three coats of oil-paint.

7. *Back Sheathing* to be of Fir tongued and grooved, 2 in. thick from deck to roof for side pens and to a height of 12 in. above top parting board for middle line pens. Sheathing to be nailed on to front of rear stanchions. Battens or fillets of hardwood 2 in. by 2 in. to be screwed on back sheathing to form a groove to receive parting boards. A wooden stop to be secured across the top of the groove to prevent the Parting Boards rising.

8. *Dung Ports* to be cut in back sheathing, where considered necessary, size about 24 in. by 24 in.

9. *Breast Rails* to extend from centre to centre of stanchions to be of Fir 10 in. by 3 in., with upper third covered with zinc not less than 9 B.W.G. Breast rails to be scored $1\frac{1}{2}$ in. deep 2 in. in at each end of the lower part over the iron cleat, so as to prevent them shifting fore and aft. Two 1-in. holes to be bored in each breast rail zigzagged 3 in. on each side of centre, and two $\frac{5}{8}$-in. rag pointed ring bolts with 2-in. diameter ring to be fitted in under edge of breast rail 1 ft. 3 in. from each end for use during feeding and watering. Two pairs of galvanized iron round-headed screws $2\frac{1}{2}$-in. by $\frac{3}{8}$-in. to be screwed into front of each breast rail for mangers. To be spaced 2 in. below top of breast rail and $9\frac{5}{8}$ in. and $20\frac{3}{8}$ in. from each end. A clearance of $\frac{1}{2}$ in. to be left between heads of screws and breast rail.

10. *Platforms* to be movable, and whenever possible reversible, end for end, both ends being cut round front stanchions for this purpose. To be of Fir 4 ft. 10 in. each (except in the case of single pens), with $1\frac{1}{2}$-in. deal boards the length of the pen, a 1-in. space being left between them, secured with foot battens the width of the platform. Foot battens to platform to be of Pitch or Red Pine 4 in number, 4 in. by 2 in., the front one to be placed 9 in. from the end of platform, and the middle two to be placed each 1 ft. from the centre of platform. The rear batten to be 12 in. from end when platform is 8 ft. long down to 9 in. from end when platform is 7 ft. long. These battens to be chamfered and secured

to platform by $\frac{5}{16}$*-in. snap-headed bolts and nuts, well recessed* below top of batten. All platforms are to have two battens underneath them ; one under front foot batten and one under rear one 4 in. wide by 1 in. thick, to be secured with six screws. They are to be cut through at the spaces between the boards for drainage. Care should be taken that platforms fit on deck and do not rock. Platforms should be fitted clear of the parting boards that they may be easily lifted.

11. *Parting Boards.*—Parting Boards of Fir 4 in number, to be 9 in. by 2 in., with 3-in. clearance between each. 1½-in. parting pieces spiked near each end of board to give this clearance. These parting boards to slide in grooves at outer and inner ends, one set to each alternative front stanchion.

12. *Securing.*—All fittings on exposed decks are to be secured as follows, and to the satisfaction of the inspecting officer :—

Iron bars 2½ in. by ½ in. fitted across roofs of stalls not more than 10 ft. apart. These to be secured to eye-bolts, bolted through deck by rods of 1-in. boltstave. Ends of ranges of pens cross-stayed from roof to deck diagonally by 2½-in. by ½-in. iron bars bolted to deck and through heads of stanchions. Rear stanchions to be thoroughly secured by means of iron clamps fitted to go over bulwark rail or rails with stops arranged on stanchions to prevent them rising.

In addition to above, stays of Pitch or Red Pine, 9 in. by 3 in., placed on edge, are to be secured between pens at sides and pens amidships or from side to side from roof-rafter to roof-rafter where no midship pens are fitted.

When stays extend from side to side a fore and after 6 in. by 4 in. to be run along middle line below them slotted on the top edge to house stays. Stanchions 6 in. by 4 in. to be erected in suitable positions on middle line to support this fore and after, securely fastened to same and to the deck.

Forward and after ends of rows of all pens on exposed decks to be close sheathed, full depth, with 2-in. tongued and grooved, upper portion of this to be hinged to let down, and the ends to be made portable where required. When necessary a breakwater is to be fitted as directed at the forward end of stalls on each side. Canvas screens to be fitted from outer edge of top of roofing to deck cants with lashings, etc., complete ; these lashings also to tie screens when rolled up. Screens are to be hung in front of all pens on the weather decks, as also at all ends of the centre pens adjoining hatches on next deck below.

13. *Sea Wall.*—In all ships crossing the N. Atlantic in winter and in other cases when directed, a "sea wall" of at least 2-in. tongued and grooved material is to be fitted from the bulwark rail to the top of upper deck stalls. In vessels with open rails it is to be fitted outside the rails (in addition to the sheathing inside the rear stanchions) and fastened to the roof-rafters, which are to be extended if necessary for the purpose.

Fittings under Erections and in 'Tween Decks.

14. *Stanchions, Breast Rails, etc.*—Material and scantlings of stanchions, breast rails, platforms, and parting boards as specified for fittings on exposed decks. Stanchions to be tightly wedged between decks, and to be secured at heads and heels as specified for exposed decks to prevent their shifting fore and aft, or athwartship, and to the approval of the inspecting officer.

15. *Back of Pens.*—Existing cargo battens in 'tween decks to be filled in close with intermediate Fir boards to a height of 12 in. above parting boards, and filled in on the upper part between frames. Where no cargo battens exist, the ship's side is to be lined up to a height of 12 in. above parting boards and top filled in as above.

16. *Ships fitted for Cattle.*—Cattle ships fitted with cement decks to have portable floor pieces not more than 4 ft. 10 in. long, laid close down on cement between outer two an inner two footlocks, and good drainage space to scuppers cut through footlocks and floor pieces under parting boards.

17. *Drainage.*—A passage 18 in. wide is to be left opposite every scupper, and where scuppers drain into the bilge, or are fitted with storm valves, they are to be covered with a dome-shaped rose, with $\frac{3}{8}$-in. holes. Sufficient number of scuppers to be cut in all 'tween decks and under all erections. As a general rule, a 4-in. scupper every 30 ft. of erections will be found sufficient. All scuppers to have the word "Scupper" painted on ship's side, immediately above them, in not less than 6-in. letters, and underneath them the words "This Scupper is for Urine and not for Dung." Watercourses 9 in. by 2 in. to be cut out under front cants where necessary for the purpose of allowing the urine from amidship pens to drain into the scuppers, and watercourses 9 in. by 2 in. under the front cants of all amidship pens.

18. *Water Service.*—A permanent water service pipe to be fitted to all horse decks carried fore and aft. A cock is also to be fitted at each side at the following stations :—At after end of forecastle, fore and after ends of bridge deck, and at poop front on upper decks, and at similar positions on shelter decks with an additional cock in alleyway on each side. In 'tween decks of ordinary length a cock is to be fitted at each side at forward and after end of each compartment. Special care to be taken that water service can be supplied from at least two independent pumps in the engine-room in case of a breakdown.

19. *Side Lights* in long deck erections to be spaced not more than 16 ft. apart, and in 'tween decks spaced about 12 ft. apart.

20. *Wind Scoops* of approved pattern to be fitted to all side lights.

21. *Electric Light* to be fitted in erections and in 'tween decks to give ample light. The candle lamps, for emergency lighting, to be of approved pattern and hung on proper hooks. All ships carrying remounts will be required to be electrically lighted and the dynamo will be required to be of force enough to carry out the entire service, of lighting the ship, and of working the fans at full power, simultaneously.

22. *Ventilation.*—All erections (not necessarily enclosed) and all 'tween decks are to have ventilators of sufficient size and number with their cowls carried clear above top fittings, besides which, all 'tween decks to have mechanical ventilation by means of fans, or other approved method, so as to draw all foul air from the after end and/or if necessary, from the fore end of each compartment, and exhaust same at the top exposed deck.

23. *Windsails.*—30 in. diameter with large mouth (square head preferred) to be supplied and fitted, at least two to each 'tween deck compartment and hold, and where required in erections.

CONVEYANCE IN HOLDS.

24. When it is found desirable to carry horses or mules in the holds, which should only be done where the ship is specially suitable and ample head room can be secured, the stanchions should be first fitted from the tank top to the deck above and coal * stowed through the hold around them, and a

* The coal or ballast will be supplied and shipped by either Owners or Government.

wooden flat $2\frac{1}{2}$ in. thick laid athwartships on fore and aft bearers on top of the coal throughout the holds, height to be not less than 10 ft. to the deck above and more, when possible, up to 15 ft. Foot battens to be secured to floor inside the pens as on ordinary platforms. The ship's side should be lined as in other decks, and a 12-in. bevelled board secured to the flat, to lean at an angle against the lining to allow for the settling of the coal.

The dimensions of pens and scantlings to be according to specifications.

Horses or mules should not be stowed more than 15 ft. before and abaft the hatch.

Two 18-in. ventilators with cowls should be fitted at each end of the hold.

Water service and lights to be as on other decks.

No pens to be erected amidships.

General.

25. *Pharmacy.*—Size about 6 ft. square for 300 animals, and 8 ft. square for over that number. To be built of 3-in. Fir stanchions and 1-in. boarding. Spaces to be left between the boarding of top half for light and air. A door to be fitted, provided with hanging lock.

Shelves with face battens to be fitted, as directed, around the bulkheads. Also bottle racks and a broad shelf 2 ft. 9 in. from deck, for dispensing.

26. *Spare Stalls.*—Five per cent. spare *stalls* are to be fitted in addition to the number of horses fitted for, and to be distributed among the different compartments and decks as equally as possible; half of them are to be fitted with slinging bars.

Stanchions to be of the same dimensions, etc., as for pens, and similarly secured, but spaced 2 ft. 6 in. apart centre to centre.

Parting boards, as for pens, to be fitted to each stanchion.

The slinging bars to be of Pitch or Red Pine 4 in. by $3\frac{1}{2}$ in. running fore and aft between the stanchions with dumb sheaves worked on them, four to each front and two to each rear bar for each stall. The centre of front bar to be 18 in. from front stanchion, the rear one to be 3 ft. from the front bar, centre to centre. These bars to be kept as high as possible, supported by and bolted to Fir rails, 8 ft. long by $4\frac{1}{2}$ in. by 3 in. secured to stanchions by $\frac{5}{8}$-in. bolts and nuts. Heads of bolts to be smoothly rounded, ends to be cut off flush with the nuts and covered with wooden caps carefully smoothed off.

Two belaying cleats of $\frac{3}{4}$-in. iron are to be screwed to front of each stanchion of the slinging stalls, 18 in. and 5 ft. 6 in. from the heel of stanchion respectively for belaying the falls of the hammocks.

27. *Finish.*—*All timber coming in contact in any way with the animals is to be well planed, smoothed, rounded and neatly chamfered off.*

28. *Numbering.—Every standing to be numbered and all detachable parts to bear the same number as the space to which they belong. Each set of parting boards to be also lettered A, B, C, D, beginning with A at the bottom.*

29. *Brows.*—Brows are to be constructed to allow of shipping horses or mules into compartments; these brows to be of easy descent from upper to main and all other decks, and are to be carried on board the vessel. Brows to have strong sparred sides 6 ft. high (not more than 3-in. spaces between spars): also in way of each fitting, etc., on deck, when more than 6-in. high, small permanent brows to be fitted where it is intended to walk horses. Every brow used for descent should have a sloping head guard at the lower exit when low 'tween decks render it necessary for protection of horses' heads. Guard to be framed of light ledges and boarded on the underside with 1-in. Fir well planed, the inclination from lowest fixed part to be greater than inclination of brow and to be not less than 4 ft. long. It should be slightly wider than brow and secured either to the stanchions of side of brow or to the coaming, by straps and clamps as may be found most suitable. Sides of brows to be tommed off at convenient positions for additional strength.

30. *Saddle and Harness Room* (*in Cavalry Transports only.*)—A space 20 ft. by 20 ft. for artillery, and 16 ft. by 16 ft. for cavalry, is required for each 100 mounted men. The room is to be built with Fir stanchions, 3 in. by 3 in. placed 4 ft. apart, and boarded with 1 in. boards close jointed for 4 ft. up, and open-spaced battens from there to underside of deck. Wooden rails, covered with canvas padded with straw, are to be fitted so that each saddle has a separate space. Stanchions of Fir 3 in. by 3 in. with spurs of 3-in. by 2-in. material 10 in. long, bolted through stanchion, are to be provided for all harness to hang separately, 2 or 3 pairs of spurs to be fitted on each stanchion as required.

31. *Small Gear Room* (*in Cavalry Transports only*).—Size about 300 cubic ft. for a battery of artillery or for half a cavalry regiment. To be built of Fir stanchions 3 in. by 3 in., boarded up with 1-in. boards 4 ft. 6 in. high, the upper part to be

battened. The door to be 2 ft. 8 in. wide, in the clear, made in two parts, each hung with strong cross garnet hinges, and fastened with a good stock or rim lock, and fitted with bar and hanging lock. Plenty of shelves and hooks are also to be fitted as ordered.

32. *Workmanship.*—All workmanship, material and general arrangement of the stalls to pass the inspecting officer appointed, who may make any reasonable alterations in this specification while the work is in progress. Workmanship to be carried out in first-class manner.

33. *Supply of Fittings.*—Contractors will generally have to supply all the fittings required by these Specifications, but in certain circumstances the Government will supply the following parts of pens :—

Front stanchions.
Rear stanchions.
Breast rails.
Platforms.
Parting boards.
Cants.

In this case the Contractor will be required to erect and fit up these and supply the balance of material necessary to complete the pens.

NOTE.—*Trade fittings.*—In the event of mules being conveyed from abroad they may be carried in Trade pen fittings, under special approval of Director of Transports, Mercantile Marine Department, Board of Trade, provided that they are in accordance with the Regulations of the port of shipment and are to the satisfaction of the Government inspector at the port. In this case the requirements of paragraph 26 of this Specification are to be complied with, and in addition a sufficient number of breast rails are to be made portable for access to passageways, and pens so arranged that, without removal of any of them, the mules may be walked around each deck for exercise.

Arrangements for exercise.—It is an advantage to exercise horses on board ship. This is not always practicable, but when it can be arranged a portion of one deck should have a track wide enough for two or three abreast, laid with suitable matting, and accessible, by means of brows, from both or all horse decks; should this plan not be feasible, all passages between pens should be wide enough and so arranged as to admit of exercise round the deck when feed boxes are removed.

EMBARKATION.

It is necessary to distinguish sharply between two classes of animals embarked for oversea service, the first comprising trained, well-conditioned, corn-fed troop horses which accompany their units, and the second consisting of remounts despatched subsequently accompanied by very small staffs, possibly untrained, and occasionally grass-fed till they embark. The conditioning of this latter class must be undertaken when they land. They cannot arrive fit for immediate work, but the troop horse may be required the moment he steps ashore, and therefore his condition should be maintained in every way possible. The first step towards this end is that he should embark thoroughly fit. It is inevitable that he will lose some condition en route ; this cannot be prevented under the most favourable circumstances, but the fitter he is for general purpose work when he steps on board, the fitter will he land if properly taken care of. Troop horses should not therefore be let down in condition before they embark ; they should be hard and fit ; but their bowels should not be constipated, and to ensure this their diet should be of a laxative nature for twenty-four hours previous to embarkation.

Just previous to embarkation they should be watered and fed with corn, and arrangement should be made that as soon as each is secured in the ship's pen, hay should be given, a procedure which helps materially to keep them quiet in their strange surroundings. If the embarkation is to be by slinging, the times of feeding should be so arranged as to prevent any animal being slung within two hours of watering.

Shoeing.—All troop horses should, before embarkation, have been recently shod. Unshod animals land footsore, from the wearing away of the horn which is softened by the constant moisture on board, and they are incapable of work or of being shod immediately on arrival. A careful inspection of the shoeing should be carried out immediately before embarkation and daily during the voyage.

Ship's Head Collars should be put on before embarking. These head collars have double head ropes, one from each cheek piece, which are fastened to the rings provided on the front stanchions. It is a good plan to tie one to a lower ring and the other to the upper ring on the opposite stanchion, allowing the animals just sufficient liberty to reach the hay net and feed box, but not to bite each other. When first placed in a pen some horses will try and jump out or rear up, but are prevented if tied as above.

Before Embarkation begins it should be ascertained that the way to the furthest pen is quite clear, that the side bars, or parting boards, are all taken down and handy for replacing, and that the brows and decks offer secure foothold. If possible, the hay nets ready filled should be on the pens.

Foothold may be secured by coir mats, ashes, or litter. Coir mats, when thick and heavy enough to retain their position without moving or wrinkling, are excellent. Thin coir matting does well if firmly secured, but is not safe if loose, as it slips under the feet.

Ashes, which are always obtainable from the engines, are excellent, and should be made use of throughout the voyage for this purpose. Litter is useful for scattering at the entrance of brows, as horses are used to its appearance and will step on to it with confidence : it may also be used with advantage to make a soft bed for them to land on when slung on board ; but it is rather slippery on decks, especially when new, and mats and ashes are to be preferred.

Walking on Board by a Gangway.—A steady and reliable horse should be selected to lead, and without any pause the others should follow, until the whole of the troop or section is aboard. If any horse gives trouble, he should be at once taken out of the line and kept till the others have embarked ; this will ensure a constant steady flow and prove quicker than checking the whole movement in order to deal with a few difficult animals. The entrance to the gangway is the spot where difficulty is usually encountered, but if the leader goes quietly and the others follow without pause only a few will be found troublesome. The leading horse is led to the farthest pen, the head ropes tied, and hay given. Horses which habitually stand or work together should be neighbours. Kickers should be given end pens and kicking boards put up. All men not detailed for other duties should stay with the horses till they are used to their new quarters.

Methods of dealing with troublesome horses.—If the gangway is neither long nor steep, they may be backed along it instead of led ; some will lead when blindfolded. If these methods fail a rope may be passed round the quarters when the horse is near the gangway and the animal forcibly pulled on to it by a couple of men at each end. A crupper may be made for the purpose by doubling a long rope and tying a loop in the centre, the free ends being brought forward and pulled on at each side when the loop is adjusted under the tail.

Slinging on board.—The slings for this purpose have a loop of rope attached to each spreader, one being eyed. The eyed loop is passed through the other when the sling is adjusted to the body and the eye placed over the crane hook. To the front and back of the slings are attached breast and quarter ropes, which should be fastened tightly, particularly the one round the quarter. To the head collar is attached a guy (long line) for the purpose of holding the head steady as the horse is being hoisted and lowered; it should be held by the man who is at the horse's head while the sling is adjusted, and at the moment the animal is swung inboard he should pass it to the ship, where it is held by the man who receives the horse on deck. A double guy is sometimes used, one line being held on shore and the other on the deck, but a single one is sufficient if the horse is properly trussed in the sling.

In slinging horses five men are required, one at the head, one at each side, one at the breast, and one behind. One end of the sling is passed under the horse's belly, and both ends are brought up to meet over his back: the eyed loop is passed through the other, and is received by the man on the other side, who hauls it through, hooking the tackle to it, both men holding up the ends of the sling until it is taut. The men at the breast and behind bring their ropes round and make them fast to the grummets, and the man who holds the horse's head makes fast the guy to the ship's head collar. When all is ready, the word "*Hoist away*" will be given, and the horse is to be rapidly run up from the ground to the necessary height, and then carefully lowered down to the hatchway. Two or three men should be stationed at the hatchway and between decks, to guide the horse when being lowered.

Timid or restive horses may be blindfolded.

Accidents in slinging.—The only probably accidents are: from the horse slipping out of the sling and falling on the quay, or from being injured as the result of struggling on first reaching the deck.

Slipping out of the sling may happen if the quarter rope is not securely and tightly fastened. Horses always slip out backwards, not forwards. The liability to slipping is increased if the head is not held steady, but if this is attended to and the animal well "trussed" in by the breast and quarter ropes, the operation is practically without risk.

On first reaching the deck, horses land all abroad, and as soon as they feel their feet make a bound forward and struggle unless they are firmly held by the head. A reliable man should therefore be selected for this post, and care should be taken to provide a good foothold and soft bed for the landing.

Embarking from lighters.—If the lighters can come alongside a pier, a gangway is used as for walking on board. On an open beach each lighter must have a ramp which lets down on the shore with suitable cross-battens to prevent slipping. Sand or shingle is used to bed the end of the ramp and to secure foothold. Horses pack best if placed athwart the boat, alternately heads and tails. A man is required for each horse. On reaching the ship's side, slinging is carried out as previously described, and however crowded, sufficient room must be reserved on each boat to permit of the first horse being slung without danger.

Embarking by swimming is rarely necessary, but if it has to be done the slings must be tightly secured on each animal before entering the water.

This is done by stitching them along the back with yarn so that they fit the body closely and will not sag downwards when in the water. If this precaution is not observed the horse is likely to get a hind leg caught in the slack whilst swimming, and drown. The breast and quarter ropes are securely fastened, and a long rope, about 8 yards, is passed round the top of neck and fastened rather tightly just behind the jaw, with an overhand knot to prevent it slipping. The ropes of the ship's head collar may be looped round the neck to prevent entanglement. The horse is then led into the water as far as he can walk towards the boat, and a man in the stern receives the rope and immediately reeves it through the stern ring of the boat to secure additional power in the event of the horse plunging. If the animal refuses to move towards the boat, splashing water on his back will induce him to. When once swimming, the rope should be drawn up towards the boat, which is slowly rowed to the ship. It is important that the boat should not go faster than the horse can swim or his head will be dragged under water; for this reason the rope should not be made fast but held and regulated by the hand (p. 149). On reaching the ship's side the hook and tackle should be lowered, passed through the sling's eye and the horse hoisted as previously described (p. 267).

DISEMBARKATION.

Disembarkation is carried out in a similar manner to embarkation, the details being reversed. The pens nearest the hatchways should be emptied first and the parting boards, as they are successively removed, placed where they will not interfere with the free passage of subsequent horses.

It is generally better to get everything belonging to men and horses out of the ship before horses are landed, as the men have not then to quit them after disembarkation, but in hot climates the atmosphere between decks when the ship is stationary may cause such sweating and distress that the landing of the horses becomes the first consideration. The ordinary head-stall and bridoon will be put on the horses before landing, and when slung the guy rope will be tied to the lower ring of the back strap and the bridoon knotted up to prevent entanglement. A straw or sand bed must be laid on the wharf for the reception of slung horses to prevent injuries from plunging. If exercise on board has not been feasible, attention to this point is the more necessary as animals are cramped and apt to injure their knees unless carefully handled.

Landing in boats or flats.—Great care is necessary in lowering from the vessel, especially if there is any swell: the tackle must be slacked and detached from the sling the moment the horse touches the boat in order that he may be able to get his footing. If there are no piers or landing stages, boats must be beached and the horses made to jump out.

Swimming ashore may be practised on emergency. The horse should be slung over the ship's side, without breast or quarter ropes being secured, and with a neck rope, as described previously ("Embarkation by Swimming"), and gently lowered into the water. The sling is detached and the neck rope handled from a boat. It is possible also to swim horses ashore without guiding them, but in such a case it is necessary for picquet boats to be stationed in order to prevent them swimming out to sea. When in the water a horse's range of vision is so limited that he cannot see a shelving beach till very close to it, and some horses should be kept at the landing point to attract the attention of the swimmers.

Management on Board.

As soon as the last horse is on board the ship should be got under way, and all previous arrangements with regard to embarkation should be made so as to admit of this being done. It is not of such great importance in a cold climate, but in warm countries the distress entailed by the heat in a stationary ship is very great and should be avoided. For the same reason, if on reaching the destination it is found that the horses cannot be landed immediately, the vessel should not anchor, but be kept on the move to secure better ventilation and cooler air.

Ventilation and exercise.—During the voyage the two points which demand the greatest attention from all concerned are ventilation and exercise. On the amount of ventilation and exercise together which it is possible to give depends the condition (not fatness) in which the horses land. The means by which they may be obtained have been previously described; it remains only to note that a constant inspection of every ventilator, outlet and inlet, is necessary. Sufficient and free exits for foul air are as important as entrances for a fresh supply. Canvas windsails must be constantly observed and kept free of all obstructions. Exercise and the mucking out of pens should if possible be carried out together, half the men being employed on each duty alternately; weather permitting, exercise for each horse of a unit should be continued as long as possible; it means additional work, and men should be thoroughly taught the reason for its necessity and that their future success and safety may depend upon the condition of the horses on landing.

Where a portion of the deck has been specially arranged for exercise and horses can walk two abreast, this work is greatly facilitated.

Sanitation.—This includes the mucking out of the pens and cleansing and disinfection of the decks. On transports carrying units it should be done thoroughly, daily; but on remount ships with a limited number of attendants this may not be feasible. It should, however, be done as often as possible. The method to be adopted is as follows: as many horses as possible are to be taken out of the pens for exercise (if exercise cannot be given they should be stood in spare pens or other available space), their pens are cleared of all droppings, which are placed in skips provided for the purpose; the platforms are raised, the deck cleaned, and the whole sprinkled with the dry disinfectants provided. On exposed decks the salt-water hose is an effectual aid to cleanliness, but the greatest care must be taken not to block the drainage pipes leading from the scuppers. Such a blocking is of common occurrence, and the result is that urine collects on the deck instead of draining away, has to be pumped up by hand, and the state of the atmosphere is rendered poisonous. The keeping free of the scuppers should therefore receive great attention and be the subject of a standing order to all concerned.

When it is only possible to move a few horses at a time they may be shifted in rotation into the cleaned pens and those originally moved placed in the pens last cleaned.

The following articles are provided:—

Wooden hoes.	
Triangular steel scrapers with 2-ft. handle.	
Iron hand shovels.	1 for every 5 animals.
Mops, 4-ft. handles.	1 for every 5 animals.
Baskets for dung.	
Bass brooms.	
Squeegees.	

Watering.—An ample water supply is essential, and horses should as a rule be watered three or, if the weather is hot, four times daily. A fresh-water force pump is fitted to each stable deck, and a 30-gallon tub is stood by it to dip buckets in, 3-gallon buckets being provided at the rate of one to six animals.

Feeding.—As regards feeding during a voyage, horses on board ship are under similar conditions to animals standing idle in narrow stalls on shore, and should be fed accordingly, that is, they should receive about half an average ration of corn and a full supply of fodder. This will be sufficient to prevent their falling off in condition without over-feeding them. The question as to exactly how much they receive daily is a matter for some discretion on the part of the commanding officer; at the beginning of a voyage and during very hot or very rough weather rather less than the average may be advisable; whilst with favourable conditions and facilities for plenty of exercise a rather more liberal scale would be justified.

The average daily rations, which are liable to modification from time to time, are:—

For Horses and Mules on Transports and on Freight Ships.

	Heavy draught horses.	Other horses or large mules.	Small mules.
Water	10 galls.	10 galls.	10 galls.
Oats	4 lb.	3 lb.	2 lb.
Bran	4 ,,	4 ,,	3 ,,
Hay	18 ,,	16 ,,	12 ,,

For each 100 horses or mules:—

Carrots (or other suitable roots)	75 lb. when procurable.
Oatmeal	1 ,,
Linseed	2 ,,
Rock salt	6 ,,

Carrots or other roots will not be put on board ships going through the tropics.

The full quantities of daily rations should not be issued unless they are actually required.

If exercise is not possible the amount should in no case be more than the average at any time. Oats should be crushed if possible. Feeds should be damped, and whenever chaff is procurable it should be mixed with them in liberal quantities. If oat hay is obtainable, this in itself constitutes a sufficient ration for remount horses. For the mixing of feeds a 30-gallon tub is provided on each deck.

To provide against cases of delay and breakdown 25 per cent. spare forage is carried, but is not to be issued except under the special circumstances for which it is provided.

Hay nets should be constantly attended to, and all hay fed from them. The hay net is usually suspended by a single rope at one side of the stall and swings to and fro every time the horse attempts to get a mouthful. It is better to sling it across the front of the stall with a rope to either stanchion so that it is in front of the animal and does not evade his efforts to secure the contents; feeding hay except from the net is very wasteful, unless horses are standing under hatchways during fine weather, when they may have it on the deck in front of them.

Routine of stable duties :—(i) Units :—

6 a.m.	Morning stables. Water, feed and hay.
8 ,,	Men's breakfast.
9 ,,	Muck out thoroughly, groom and exercise.
12 noon.	Water, feed and hay.
1 p.m.	Men's dinner. (After dinner get up forage.)
5 ,,	Evening stables. Water, feed and hay.
8 ,,	Water and hay.
	Hay nets and scuppers to be attended to by stable guards between stable hours.

(ii) Remount ship, with limited staff.

6 a.m.	Water and feed.
8 ,,	Men's breakfast.
9 ,,	till 11 a.m. Clean out and groom.
11.30 a.m.	Water and feed.
12 noon.	Men's dinner.
1 p.m. to 3 p.m.	Get up next day's forage and groom.
3.30 p.m.	Water and hay.
4 p.m.	Men's tea.
5 ,,	Feed and hay.
8 ,,	Water and hay.

The above routine may be varied to suit circumstances, and is given as a guide only. Where circumstances do not permit of sufficient exercise being given to all horses in the morning it should be continued during the afternoon till completed.

During calm weather as many horses as possible should be taken out of their pens and stood on exposed decks or under hatchways.

During rough weather men should remain with the horses, and especial attention given to the provision of foothold by the liberal sprinkling of ashes on the platforms.

The use of slings is unnecessary, except for veterinary cases. It has been stated that slings are useful if adjusted slackly, so that in the event of horses losing their feet they would be saved a fall, but this can only be the case in short stalls unsuited for horses. Given a stall athwart the ship, with good foothold and length enough to balance himself, a horse will not fall; he will, in fact, keep his equilibrium better than his master.

In the event of a horse being cast at any time, loosen the head, pull the fore feet out in front of him and place something against them to give purchase (a sack of chaff is excellent for this purpose when pressed firmly against the animal's feet), scatter a few ashes to prevent slipping, and he will rise with ease. If the horse struggles and cannot rise, slip parting boards between him and his companions to prevent injuring or scaring them. In the event of a horse being down on the deck during a storm and it being impossible for him to rise, he becomes a danger to others as he is shot from side to side by the roll; in such circumstances the feet may be hobbled together and the animal tied firmly to the nearest suitable support, until it is possible to let him get up.

Sickness amongst horses on board ship is due to or aggravated by excessive heat (fever and heat stroke), want of fresh air (staggers and pneumonia), or want of exercise (fever in the feet). By using the methods previously stated, these may usually be prevented, but in case of any sickness it may be taken for granted that fresh air is wanted, and the patient should be brought under a hatchway immediately. If a horse is suddenly violent (staggers), douching with water after bringing under the hatchway will be found effectual. As a measure of prevention, horses which are stood in badly ventilated pens (if any) should be moved every few days to better positions.

Fever may occur frequently, and horses be off feed as a consequence; but fresh air only will prove a curative, and medicine is not often necessary.

Constipation, which is frequent, should be overcome by sloppy mashes, and not by physic.

Fever in the feet will not occur if exercise is given, and the importance of this cannot be over-estimated. It will, however, occur in unshod remounts which stand still all the voyage, and it will be exhibited on landing.

Care on Landing.

Troop horses which have been well exercised during the voyage may be brought on to light work without any interval if necessary, but it is invariably better if time permits to allow as long as possible for graduated exercise on shore before any effort is called for. It is impossible to work remounts which are embarked soft and not exercised on board until they have been thoroughly conditioned; any attempt to do otherwise can only end in absolute disaster. As a rule such an animal, called on to work immediately, does one day only and is then broken down beyond recovery.

The amount of time required for this gradual conditioning, therefore, varies inversely to the fitness of the animal on embarkation, and the amount of fresh air and exercise it receives on the way.

Unshod, grass-fed remounts will land foot-sore, and cannot even walk far without risk of fever in the feet; such should be allowed some days' rest to stretch their limbs and gradually restore the healthy circulation of the feet, which, from long standing still, have become weak and easily overstrained. Added to this the horn of the feet is worn thin and soft, and requires a little time before a shoe can be safely fitted. Conditioning for such horses must be gradual.

Feeding will naturally be regulated according to work. As much food as possible should be landed with the horses. If the rations on shore are different to those they have been accustomed to, the two varieties can then be mixed, and the change of food made gradually, so as to avoid indigestion and colic.

Shipment of Other Animals.

Mules.—Mules are also carried in pens, four large or five small mules being accommodated in a pen. The pens are constructed in accordance with Fitting Specification shown on pp. 257 to 265, which also provides for trade pen fittings being used when special approval is given and various requirements are met.

Owing to the animals' propensity for gnawing everything, the woodwork within reach of their teeth should be smeared with soft-soap, and head collar chains substituted for ropes, or the latter soaked in creosote.

As regards amount of rations, *see* p. 272.

Cattle.—Special ships are used for the conveyance of cattle; they are provided with open cement floors, drainage behind stalls, and feed troughs on the deck. Owing to the fluidity of the excreta, flushing the deck for drainage is not so liable to choke scuppers, and can be more freely made use of.

Camels.—If camels have come a long railway journey to the port of embarkation they are sure to be stiff and cramped, and should be rested previous to slinging.

Slinging.—The camel should be made to squat, and a guy rope adjusted to control the head. If this is not done the nose rope is sure to be pulled on and perhaps torn out. The legs may be tied to prevent rising, or a man may stand on each, which is a simpler method. The sling is then slipped under the animal, adjusted, and rapidly hoisted.

On board they are made to squat, arranged closely along the deck with their heads inwards, athwart the ship, and a rope is passed round both forearms and over the neck to prevent rising. When the ship is under way they may be permitted to rise. They require a deck 8 ft. 6 in. high to stand comfortably. During rough weather they must be camped and secured as described. Sand is provided to give them foothold on deck.

Owing to the long periods camels are compelled to squat (camp) during rail or sea journeys any wound at the bend of the knee or hock is very likely to become much aggravated. If possible, such cases should not be embarked.

Railway Transport.

Trucks.—Animals are conveyed in trucks, or horse-boxes. Whenever it is possible they should be stood at the ends of the trucks parallel to the rails, facing each other, but unless the truck is specially fitted, as in India, or it is possible to fix temporary bars across each side of the door, this arrangement cannot be made and they are then placed across the truck with their head ropes tied to the sides. To prevent horses being frightened their heads should not face towards passing trains.

Closed trucks not specially fitted are very hot and should be avoided if possible. If there is no arrangement for tying up the horses their head ropes should be looped up before they are left. English cattle trucks hold six to nine horses, according to size; Cape trucks eight to ten; Indian vans eight to ten.

Entraining.—If from a platform, the sides of the door let down and form a bridge to the truck; if not from a platform, a ramp must be specially provided, and where it is known beforehand that this will be the case, temporary gangways with suitable cross-battens to give foothold should be provided. The only difficulty which occurs is from the nervousness of some horses to step across or up the ramp. This with untrained animals may give considerable trouble (*see* "Method of Dealing with Troublesome Animals during Embarkation"), but with troop horses practice in entraining should be part of their normal training and regularly carried out. Where if dummy wagons exist for this practice, the space between the platform and the carriage should be accurately represented, as the negotiation of this space is the cause of hesitation in horses trained on a dummy with a solid ramp to the truck's edge. Horses should be led quietly into the trucks, a reliable one chosen to lead, and the man stepping in without looking back at the horse; if one goes in, the rest follow easily, though some will always jump in. The great thing is to take it all quietly and without upsetting animals by noise and violence. Keep troublesome ones till last. With adequate training they will generally walk in and out like sheep. Sand should be used on the floor of the truck to prevent slipping.

Harness on journeys.—It may be necessary to keep harness on during railway journeys; but if it is not essential for operations, it should be removed, and loaded in separate trucks, as the animals travel better stripped, and the gear is less liable to damage. In any case, care must be taken to remove bits and slacken all girths and surcingles, neglect of which latter precaution has been known to cause severe injuries from long-continued pressure.

Horse-boxes are constructed to hold three animals in separate padded compartments, parallel to the line of rails. When loaded, the horses should be tied short by the head to prevent accidents from their trying to turn in the stall or getting their forelegs up in the manger. Owing to the shortness of these stalls, knees and tails are liable to get bruised, and kneecaps and a tail guard are advisable. When a tail is bandaged to prevent its being rubbed, it must not be wrapped too tightly, or the pressure may cause the hair to fall out; a better method is to encase the tail in a leather sheath which buckles or laces like a legging and is kept in position by a strap leading from the top to the roller pad.

Mules.—The habit these animals possess of gnawing woodwork should not be forgotten when they are tied to truck sides; a smearing of soft-soap will prevent it.

Camels.—The height of the camel necessitates his being carried in a sitting position. They may be made to squat on the platform, the fore and hind legs tied, and then be hoisted on to a truck, or they may, if space permit, step on to the truck previous to squatting. They should, of course, be unloaded and allowed exercise as often as possible, and as they are invariably very cramped at the end of a railway journey, should be given time to recover the use of their limbs thoroughly before marching or embarking for oversea transport.

Watering.—Adequate arrangements for water are necessary, and must be thought out beforehand. In properly fitted trucks and horse-boxes it offers no difficulty, but with large numbers in cattle trucks it is often difficult to water satisfactorily. Water may be given from buckets or the animals taken out of the trucks, the latter being by far the best if the horses are trained, troughs handy, and time permits. Horses known to be troublesome should not be detrained, but watered by hand. If watering by buckets has to be adopted, the best method is to put one man in the truck and pass buckets to him. In hot climates, watering becomes a matter of the greatest importance, and advance information should always be wired to halting places, so that trains may be shunted at once to their proper sidings and near the water supply.

Feeding en route.—Here again the fitting of the truck is all-important, and in cattle trucks where horses are loose or tied to the sides it is waste to attempt to feed with hay, any thrown on the floor of the truck being rapidly trampled up with the droppings of the animals. Corn and chaff may be given in nosebags, one or two men being left in the truck during feeding.

If for military reasons long journeys have to be made in unfitted trucks, a special halt of sufficient duration to detrain, water and feed with corn and hay twice every 24 hours (say a total of three hours) should be arranged for, if the journey is to last more than a day, and horses are to keep in condition. If the circumstances do not admit of so much time being devoted to feeding and watering they will lose in condition, and it becomes a question for the commanding officer as to which is the most desirable course to pursue.

With fitted trucks, as described below, the necessity for long halts is not so urgent, though advisable if time permits, and horses can be fed with hay en route.

The danger of fire when hay is used in trucks, owing to red-hot cinders from the engine, should be explained to all attendants, and, on the same account, all smoking should be prohibited.

In India, all trucks for conveyance of horses are provided with a breast bar across on each side of the door. When the truck is in ordinary use for goods this bar is sunk level with the floor or fixed near the roof, and raised or lowered when required. The floor arrangement is most convenient. Four large or five small horses or mules are packed in each end, and the breast bar having been adjusted their head ropes are tied to it. The doors at both sides can then be left open and the space in the centre is occupied by forage and attendants. Corn is fed from nosebags, and hay from a blanket stretched between the breast bars. It is a simple, inexpensive arrangement, which admits of troop horses, performing long railway journeys, being properly fed en route.

CHAPTER X.

THE MULE, DONKEY, CAMEL, OX AND WATER BUFFALO.

The Mule.

Of all pack animals the mule is the favourite, and although frequently employed as a draught or riding animal, it is as a pack carrier that he is known best. He is capable of great endurance, tolerates thirst well, can put up with changes of climate and food, and is not fastidious regarding the latter. The shape of his back makes it easy to fit him with a saddle, while the toughness of his hide helps to preserve it from galls. Mules are usually cheerful, intelligent animals, appreciate proper handling, and resent violence. They are particularly free kickers, often shy with strangers, and touchy about the head and ears; but with attendants that understand them, they are by no means troublesome, and easy to look after and keep in condition.

Their one drawback from a military standpoint is their liability to stampede under fire. This, however, may be largely overcome by training.

Mules vary in height from 12 to 17 hands. Big American and Spanish mules are utilized in draught or for riding, but 14·2 is about the largest employed for packwork. North and South American, Spanish, Italian, Maltese, Cyprian, Egyptian, Syrian, Abyssinian, Persian, Chinese, Indian, and Cape mules have all been employed at various times, and with the exception of large Spanish mules, evidently unsuited for packwork, all have been satisfactory.

The mule is the product of a jack donkey and pony mare as opposed to the jennet, which is by a stallion pony out of a she ass. It is distinguished from the latter in that it possesses more of the characteristics of the donkey at the head and the horse at the tail, whilst the jennet is just the reverse.

Being a near relation of the horse, and with a digestive system of the same pattern, all the general rules for the care of horses may be applied to mules, and if equal attention is paid to their stable management and feeding, they are much easier to keep in condition when at hard work.

Selection. Conformation.—*The shape of the back* is the first consideration, particularly in pack mules. It should be straight from wither to croup, or inclined to be roach backed, rather than hollow. It should be well covered with muscle, broad and level on the top, and short, but sufficiently long to carry the pack saddle without injury to the point of the hip. A long back is a weak back, and if also hollow and narrow is the worst shape for a mule.

The chest should be deep, and have a good breadth across the shoulders.

The quarters should be well developed and muscular. In the pack mule the strength of the quarters is of more importance than the shape of the forehand. In moving up or down hill with a load on the back, this necessity for powerful quarters becomes very apparent.

The forehand is, when compared with its importance in the horse, a secondary consideration. The withers are naturally broad and low, and the shoulder looks upright, but the low wither is a positive advantage in saddle fitting, and the animal is a proverbially sure stepper.

The neck should be strong and muscular, and is naturally short and straight.

The legs are, compared with the horse, slender looking, but so long as they are short, clean, and straight in front, large measurements need not be looked for. Behind, they are frequently cow-hocked, and this is not a drawback if the hocks are free from disease. Spavin, the result of the severe hill work mules are frequently called upon to undertake, is a common cause of unfitness.

The feet are narrow and boxy, as compared with the horse, but very strong and hard wearing.

Age.—The teeth resemble those of the horse in every particular. The first pair of permanent incisors appear between two and three years, and are in wear at three; at four years four permanent teeth are in wear, and at five the whole six are present. The corner tooth may not be fully in wear over its whole surface till six years, and subsequent to this age the changes are similar to those seen in the horse's mouth.

The age at which mules are fit for transport work is four years for light work, five years for hard work. They are better at six, and work satisfactorily till eighteen or twenty, sometimes even longer. In the hurried buying that often precedes a campaign, the age required for those selected will, sometimes, depend upon the number which must be obtained in a given time, but those of full age should be bought first, and the immature ones under pressure of necessity only. For campaign purposes a comparatively old animal in working condition is more serviceable than a fresh, fat, young one.

Two classes of mules are in common use in the Army.

Light draught and artillery pack mules, often called "Ordnance mules."

The British Army specification of a light draught is:—Height, 15 to 15·2 hands; age, 4 to 6 years; weight, not less than 1,100 lb.; girth, not less than 69 in. Artillery Pack Mules:—Height, 13·3 to 14·2 hands; girth, for 13·3 hands not less than 63 in.; for 14 hands and over not less than 64 in.; must have suitable pack action and straight back.

The Indian specification for a pack artillery mule, with comparative table of standard girths in inches for various heights at ages, is as under: minimum height, 13·2; maximum, 14·2.

Height.	4 years.	5 years.	6 years.
	in.	in.	in.
13·2	60	60½	61
13·3	60½	61	61½
14·0	61	61½	62
14·1 and over	62	62	63

The foregoing girth measurements should obtain when the animals are in working order; if they are fresh mules in big dealers' condition a slight increase must be looked for.

The weight of loads carried by artillery pack mules, including the saddle (which are necessarily heavy), varies from about 300 to 380 lb. It necessarily follows that mules of high quality are necessary for this purpose.

Types of other mules used in India and the Colonies, such as army transport draught mules, army transport pack mules, first and second class (India), pack (Sudan), vary greatly as regards size and loads carried, *e.g.*, in India an army transport pack mule, first class, carries 2 maunds = 160 lb., excluding the saddle.

Feeding.—The rules for feeding horses are applicable in every particular to mules, and the quantities required are, size for size, about the same, but mules are generally able to keep condition on a somewhat less generous diet, and are not, as a rule, at all fastidious as to the quality of the forage offered to them. This does not mean that mules should not receive their full ration.

The scale of mule rations adopted in India and at home is as follows:—

SCALE OF MULE RATIONS IN INDIA.

—	Gram crushed.	Barley crushed (*a*).	Bran.	Salt.	Fodder hay, other than oat hay or lucerne dry (*b*).
	lb.	lb.	lb.	oz.	lb.
Light draught mules, *viz.*, draught mules in artillery, engineer, signal units and cavalry brigade transport companies other than those working in army transport carts.	$2\frac{1}{2}$	$3\frac{1}{2}$	2	1	18 (*c*).
Pack artillery mules	$2\frac{1}{2}$	3	—	$\frac{2}{3}$	20
Sapper and miner and Class I equipment mules of signal service.	—	$5\frac{1}{2}$ (*d*)	—	$\frac{2}{3}$	20
Class II equipment, machine guns and Lewis gun mules of pioneer and infantry battalions.	—	$5\frac{1}{2}$ (*d*)	—	$\frac{1}{2}$	15
Army transport draught and 1st class pack mules	—	$5\frac{1}{2}$ (*d*)	—	$\frac{1}{2}$	14
Army transport, 2nd class pack mules	—	$4\frac{1}{2}$ (*d*)	—	$\frac{1}{2}$	12

(*a*) In Burma paddy will be issued in lieu of barley.

(*b*) In stations where hay is not available, bhoosa will be supplied in lieu. The ration for mules in all stations will be hay or bhoosa, whichever is cheaper.

(*c*) Also 3 lb. bedding.

(*d*) Or gram, whichever is the cheaper. (Not applicable in the Chitral Garrison.)

SCALE OF MULE RATIONS AT HOME.

—	Rations in permanent or temporary stables.			Rations in camp.	
	Oats.	Hay.	Straw.	Oats.	Hay.
	lb.	lb.	lb.	lb.	lb.
Heavy draught mules	12	16	8	13	16
Light draught mules	10	10	8	10	10
Ordnance mules	7	10	8	8	9
Pack mules	6	10	8	7	9

In the "pack trains" employed by the American army to accompany their cavalry, the mules, which may range from $13\frac{1}{2}$ to 16 hands, but are preferred at about 14, are allowed 9 lb. of oats, corn (maize), bran or barley, and 14 lb. of hay. They are fed twice daily, the grain being placed on sacks or canvas covers. The morning feed is light, and the balance of grain and all the hay is given at the evening feed. These mules are required to keep touch with cavalry as regards marching powers.

In the Abyssinian campaign, where the mules are said to have averaged 14 hands, the ration was at first 5 lb. grain and 12 lb. hay; but this was subsequently increased to 8 lb. of beans and 15 lb. of hay.

In the Zulu war, North American mules, averaging 15·2, and used for draught, were given 8 lb. maize, 12 lb. oat hay, 1 oz. salt, and as much grazing as possible. Cape and South American mules, 13·2, received 5 lb. maize, 5 lb. oat hay, and $\frac{1}{2}$ oz. salt.

The Chinese, who are very careful in feeding their ponies and mules, give 10 lb. to 12 lb. grain (Kaoliang, a millet) daily to a big mule of 15 hands or over.

Watering.—In the matter of water, mules are somewhat dainty, and if the supply is not to their taste will, unless extremely thirsty, decline to drink. Like horses, they are somewhat creatures of habit in this respect, and although refusing to drink from a stream may take the same water freely from the bucket or other vessel they are used to. When very thirsty, they may drink as much as a horse or pony of similar size, but under ordinary circumstances they are not greedy drinkers, and generally endure thirst well.

Marching with mules.—On the march mules can be led or driven. The latter is a very usual method, and when so trained they may be trusted to carry bulky loads on narrow roads and steep hills with perfect safety. The "pack train" mules of the American army are accustomed to follow a "bell" mare, and they move quite independently once they are loaded.

The pace of mule transport is from 3 to 4 miles an hour, the mule being a quick walker. A short stepping, active pace is preferred to long striding action as being less likely to shift the load, and so incur risk of galling. They should not be kept under load longer than necessary.

The ordinary distance of which mule transport is capable is 20 to 25 miles a day, and this only when in good condition and suitably loaded, if the rate is to be maintained for a considerable period.

To maintain the working efficiency of pack transport constant supervision of the saddle and loads is essential, otherwise serious galls are bound to result with consequent wastage and inefficiency. This applies especially when marching through hilly country, the loads being very liable to become displaced and requiring frequent adjustment.

After a march, the loads having been removed, the girths should be gradually slackened, unless it is quite certain that the animal's condition is so hard that girth swellings will not result from suddenly releasing the pressure on the skin.

Halts.—When unsaddled, mules should be allowed to roll, a proceeding they thoroughly enjoy and one which rapidly dries the heated back. They are usually shackled by foot shackles with short chains, or fastened with head chains, as they invariably chew ropes.

They should be grazed wherever this is practicable, and the practice of herding them and teaching them to follow a bell mare is very useful for this purpose.

The herding of mules, that is, teaching them to graze quietly when turned loose, is paid particular attention to in America, and certainly is a great advantage if it can be done.

Crossing rivers.—Mules are good swimmers, and can ford fairly deep streams, but great care must be exercised in fording with loads on, as the animal is top heavy, and *if taken out of its depth will probably turn on its side and drown.* As a rule loads should be removed unless it is certain that the ford is practicable. In swimming, the same rules as for horses are applicable.

Shoeing.—Wherever the work and roads cause excessive wear of the feet, mules are shod in exactly the same way as horses. Their feet generally are strong, the horn tough, thick and quick growing, so that on unmetalled roads they are frequently worked unshod. In such cases all the attention necessary is to round off the edges of the wall occasionally to prevent it splitting, and to lower the heels or shorten the toes if required, in order to keep the hoof to its proper proportions. As a rule the feet are inclined to grow high at the heels, and this is the point which wants most frequent attention.

THE DONKEY.

The donkey is for his size an excellent pack animal, and is so employed in many countries, including India, Egypt, Sudan, Somaliland, Persia and China. The type and size varies greatly. The white Egyptian riding donkey is an excellent ride and commands a high price. The type of donkey usually available for military purposes is the small pack animal, and can usually be purchased for a few pounds. The Spanish and American " Jack " donkeys are used for mule breeding.

Large numbers of Egyptian donkeys were used in the Judean Hills in Palestine during the Great War with great success. They withstood the rain, cold and exposure very well, with little inefficiency and wastage.

Shoes of similar type to horse-shoes had to be used owing to the stony nature of the ground. His pace is slow, compared with the mule, and his load varies from 50 to 150 lb. according to the size and breed, about 80 lb. only being most suitable for military work, but he demands comparatively little attention and small rations ; will do well on poor classes of forage and is a valuable transport animal on lines of communication. The points to be considered when purchasing pack donkeys are, generally speaking, the same as those recommended in the previous pages dealing with mules, except as regards size. Immature animals should not be employed. Males are preferable, and usually easier to obtain. As far as possible males and females should be kept separate owing to their highly developed sexual instincts and trouble caused thereby in camp. Castration may be advisable.

Height.	Rations.
10·1	Grain { Peace 3½ lb. / War 4 ,, } If inferior 5 lb.
10·1	Fodder { Green 25 ,, or
10	Dry, 13 ,, or Bhoosa 13 ,, }
9·3	Small donkeys get 3 to 4 lb. grain.
9·2	Fodder, 20 lb. green.
	10 lb. dry or 10 lb. bhoosa.

They usually travel in droves and are particularly hardy, useful pack animals, if they are not overloaded or overdriven. Their pace is two miles and a half an hour, and they can cover fifteen miles a day, though if allowed to go their own pace they are capable of doing over twenty miles a day for a short period.

The saddle of pack donkeys is generally a pattern known in India as the "sunka." A "sunka" is a bolster stuffed with straw and supple sticks or canes, which is doubled in the centre, and its sides tied close together. The bend of the bolster is placed well in front of the animal's withers, so that these and the spines of the backbone lie in the space between the doubled portions, and on this the load is supported.

Both beneath and above the "sunka" a thick layer of blankets is arranged to form a protective pad, and when in skilled hands it gives fairly good results. As, however, everything depends on the skill of the attendants in arranging this simple form of saddle, it is quite unsuited for transport which is not very thoroughly acquainted with it, and is in any case inferior to a good pack saddle of the right size.

The Camel.

Camels may be divided into two classes: double-humped and single-humped. The double-humped camel, also called the "Bactrian," is found in Turkestan, and throughout Central Asia. This is a long-haired, sturdy, powerful animal, bred in and accustomed to rigorous climates, and capable of marching in snow-covered mountains. This variety has been utilized by the Russians in their central Asian expeditions, but is not found in any of the regions where we have made use of camel transport.

The single-humped camel, which is alluded to in the following chapter, is found in Arabia, Northern Africa, Egypt, Sudan, Abyssinia, Somaliland and India. Generally speaking, it is longer legged, lighter built, and shorter coated than the Bactrian, and bred in hotter climates. The two varieties inter-breed, but the cross is said to be useful and hardy only when the sire is Bactrian. Breeding has been specialized to such an extent that the riding camel (Sowari, India; Hagheen, Egypt) forms a distinct class as compared with the baggage animal, and may be aptly compared to our thoroughbred horse. For the formation of special camel corps, such as were employed by Napoleon, by Napier in India, and by ourselves in Egypt and Palestine during the Great War, riding camels alone are suitable, but as a rule the camel on service is a baggage animal, and it is with reference to this animal in particular that these notes are framed.

As a baggage animal the camel can, under suitable conditions, carry 250 to 450 lb. twenty miles daily, and this must be looked upon as the limit of his normal powers when properly cared for. It is well to keep this in mind, for the animal's virtues are such that it is easy to unwittingly overtax him. Patient to a degree, enduring hunger, thirst and pain with a stoical courage beyond all others, the first sign a camel may give that he is being asked to do the impossible is to drop down dead, on which account he has been classed as "delicate." The one point on which a camel may be fairly regarded as delicate is, that he is peculiarly susceptible to changes of climate and surroundings. For this reason the camel should be selected with a view to the country in which it is to be employed, when if properly cared for they make excellent transport, are not more difficult to deal with than other animals, and on occasion are capable of a sustained effort which cannot be accomplished by any others. Selection, however, is not always possible as in India where the plain camel is of necessity employed in the hilly country of the frontier, a fact which renders a sound knowledge in care and management of the camel all the more essential. They are somewhat lacking in intelligence, but are willing machines, and must be driven with care and judgment.

Selection.—The camels selected for any particular service should, as previously stated, be suitable to the local conditions under which they are expected to work, and must be of sufficient age and good conformation. The opportunity for watering in the Somaliland desert may occur only every three or four days, and perhaps not for a week ; the camel from the delta of Egypt, accustomed for generations to green food and plenty of water, will not endure such conditions, while any desert-bred camel would do so. On the Kirghiz steppes the camels are under-sized, shaggy animals with lion-like manes, accustomed to work in deep snow, but are incapable of standing the climate of the desert, as indeed are any bred in cool climates. It is then imperative that the animals chosen for any expedition must be suited to the local conditions as far as practicable.

Animals which are used to working on sand or soft ground soon become foot-sore if worked on stony or hilly roads.

Indian camels generally stand heat and thirst well, except such as come from Baluchistan and the extreme north.

Egyptian camels, if desert, or crossed desert-delta breed, are suited to hot, dry regions, but the animal bred in the delta is a big, soft creature, unable to withstand the privations of desert life, especially on service, though an excellent means of transport in his own locality. *In the Sudan* at least seven breeds are found among the tribes. The Bisharin and Kababish are, perhaps, the most noted. The former are of light, well-bred appearance, capable of great endurance, but unsuited to heavy loads. The Kababish, from the Bayuda desert are large, strong and accustomed to find their own living in the desert ; they are, therefore, considered valuable when grain feeding is not to be procured, but require plenty of grazing.

Arabian camels are comparatively small and light, but are good workers in hot regions, and are accustomed to grain feeding, without which they rapidly fall off in condition.

Abyssinian camels are strong, short-legged and compact, and good workers, suitable for hot climates.

Somali camels are small and light, but capable of keeping condition when water is scarce, as they are accustomed to go several days without watering. It does not appear, from experience, that they are so generally hardy and useful as the Indian, Arab or Abyssinian varieties. All varieties just mentioned are only suitable for work in hot climates; if camels are ever required to winter in a rigorous climate they must be selected from breeds accustomed to such severe weather, or enormous mortality will inevitably result.

Age.—A judicious selection with respect to age is important, as the permanent incisor teeth are not sufficiently numerous until the animal is at least six years old to enable it to get a living under active service conditions. The mouth is a wreck between four and six years, and the teeth cannot cut and tear the tough thorn or hard fibrous plant which form a large portion of the camel's grazing. If worked under campaign conditions at this period the beast practically starves.

The milk or temporary teeth commence to appear in the lower jaw either at or shortly after birth, and *at two months* the six temporary incisors are cut, being very small and overlapping at their edges. *At twelve months* they are well up and in wear, and as the jaw grows bigger and wider they no longer overlap but become separated from each other. *At two years* there are still only temporary teeth, well worn and quite separated; *at three* they are more worn, and *at four* they are mere stumps, wide apart, peg like, discoloured, and, for hard grazing, of little use. *At four and a half to five years* the central pair of permanent teeth are cut, and the other pairs in succession yearly, so that *at six years* the animal has four (central and lateral), and *at seven years* six (central, lateral, and corner) permanent incisor teeth in the lower jaw. In addition there are also, on each side of the lower jaw, two tushes, which are somewhat irregular in the time of their appearance, but are usually in evidence at six and fully up at eight years.

In the upper jaw there are three tush-like teeth on each side which are cut between five and six, and are also fully up at eight. There are no front teeth in the upper jaw, their place being occupied by a hard gum similar to that seen in the ox.

When the permanent incisor teeth first appear they are broad, white, sharp-edged cutting teeth which slightly overlap each other at the edges; but as they get worn they lose their sharp outline, become first of all grooved on their edges from tearing at hard and tough plants, and subsequently worn down into discoloured, brown, rounded stumps, quite separate from each other. When they first appear their cutting edges project almost horizontally out of the jaw, but with increasing age they get more and more upright, and become not unlike the stumps of aged horses. These changes take place gradually between the ages of ten and fifteen, after which the teeth are not in themselves as reliable a guide as when considered with other signs of age. From the very tough nature of much of the camel's natural fodder the teeth are liable to get broken, and though this is usually a sign of years it is not necessarily so. At about fifteen the hair on the tail becomes white, the eye sometimes loses its translucency, and the hollows over the eyes become markedly deeper.

The animal attains its prime at nine. For military purposes seven to twelve are suitable ages for purchase, and under no consideration should camels be bought for immediate service under six, though they may be taken up to fifteen or more if their teeth are quite good and they are otherwise suitable.

The most usual error that is made by the inexperienced in ageing camels is to mistake well grown three- or four-year-olds with worn milk teeth for full grown animals, but a comparison of the milk and permanent teeth should enable a careful observer to avoid this difficulty. The size and strength of the permanent tooth is of itself sufficient guide ; when worn to a stump it is a thick, strong, round, brown stump, something like a very old horse tooth ; the milk tooth is half, or less than half, the size, and when worn to a stump is a blackened, shapeless little scrap, without any firmness of attachment to the gum. The gum itself is, in the young mouth, plump, tender, and rosy, while in that of the veteran it is lean, tough, and rather yellow than pink.

Conformation.—A well-nourished, healthy camel has the head erect, the eyes clear, the ears pricked, and the hump rounded, plump and vertical, or only with a very slight inclination to one side. The chest should be deep, and the fore legs move freely on each side of it without touching and without splaying. The body should be comparatively short, and well ribbed up, the belly well rounded, and the hind-quarters plump, muscular, and not too bent at the hocks. The paces should be easy, with an undulating movement, free from lameness, and without crossing of the hind or splaying of the fore limbs, both of which probably denote injury from slipping up, and inability to carry a load. The callosity beneath the chest upon which the weight of the animal is supported when kneeling, should be deep, large, and free from fissures. The pads of the feet should be large, elastic, and also free from cracks. The stride at the walk is six to seven feet, and the ordinary pace two and a half miles an hour for "baggagers," and up to twelve miles for riding camels.

Examination for purchase.—In examining camels it is well not to be foolhardy, for although they are very easy to handle, they are, nevertheless, sometimes apt to resent approach by the white man, and they can kick with considerable violence. They can cow kick up to the point of the shoulder and sweep the foot outwards and backwards to a considerable range. With the forefoot they can strike forwards and also kick sharply upwards towards the elbow. They have been known to kneel on a man after knocking him down. It is only when standing, however, that they are troublesome; when sitting they are no trouble, and although they make strange gurgling noises in the mouth they are very rarely known to bite. When ageing, stand to one side, as saliva and food is sometimes shot out of the mouth when it is opened, especially if they are ruminating. When beginning to handle the animal the nose rope should be held by the attendant (*serwan*) and a careful examination in the sitting position can then be carried out with perfect safety.

(1) *Walk round the animal*, noting the general suitability for the purpose required and, carefully, the condition of the skin for mange. A baggager should be of a stouter build and more muscular appearance generally than the riding camel. The latter is longer of leg, lighter of bone, and run up in the flank like a greyhound. *The hump* is a general index to health and condition. It should be firm and plump, inclined backwards rather than forwards, and upright, or very nearly so. In riding camels it is generally smaller than in baggagers.

Camels in poor condition are often affected with some incipient or latent disease, possibly a disease which is spread by biting flies and known as *Surra* in India, *Nagana* in Egypt and Sudan, or they may have internal abscesses or some other disease. It is, therefore, not advisable to purchase them unless it is very evident that their poor condition is due to bad management or starvation.

For whatever purpose the animal is required, the deep-chested specimen is what is wanted, those with shallow girth and narrow chest having no stamina. During this stage of the examination, note the condition of the chest pad, the strength and straightness of the limbs, that the tendons are not enlarged from sprains, that the sides of the chest are not scored by galls at the level of the elbow, and if a female that she is not pregnant. If possible it is better to avoid purchasing females at all. They are seldom offered for sale.

(2) *Have the camel walked to and fro and subsequently*

trotted.—Stand first at each side and then end on to the animal. Note freedom from lameness, straightness of action and freedom from elbow galling. There should be no rolling or crossing of the limbs in movement. The camel is liable to serious sprains from " slipping up " or " splitting," and as a result is unable to carry weight, an inability which is sometimes to be detected by the action. If the animal has slipped up badly the hind legs may be crossed, and the forelegs " splayed," when he is going, and any suspicious ones should be thoroughly tested under a load, or otherwise rejected. Elbow brushing is also a serious fault, resulting from the friction of the leg against the side and chest pad in animals which have the elbow tied in. It is a constant trouble, and with animals in hard work, impossible to prevent. Animals which have it should not be bought for a campaign. The marks of rubbing are easily seen, and there is often a lump on the side of the chest pad where the friction takes place.

(3) *Make the camel sit down,* age him, examine the nostrils, head, eyes, hump, back and loins ; pluck at the hair or brush off mud wherever there may be a suspicion of a sore. Look carefully at the foot-pads, and specially examine the skin for signs of mange, at any places which were noted during (1).

As the animal sits down, it should be noted whether this is done easily and without effort or trembling ; the condition of the chest pad should also be observed, and whether the weight rested on it troubles the animal. This pad, if not very thick, is liable to get wounded, or rubbed sore, and may be a constant source of trouble. The examination of the hump and back should be careful, as dealers, with intent to deceive, plug old wounds, gum hair over sores, or smear mud on the back, as if the animal had been rolling. Any suspicious place should therefore receive great attention. The sides of the hump and ribs, and the spines of the loins are the most likely situations to be injured. The nostrils should be looked at to see that they have not been lacerated by the nose peg being pulled out, a condition which often means a troublesome animal, but may be due to accident or brutality. Animals with a discharge from the nose should not be purchased, as such is often indicative of a chronic disease of the sinuses of the head, called in India " Kapauli." The eyesight should be perfect or the animal cannot graze to advantage ; in old camels, partial or total blindness is common, and a practical test, by holding food within sight, should be adopted in doubtful cases. The foot pads should be large, hard, and well-developed, and the toe-nails sound and free from splits. Small pads are indicative of want of endurance.

(4) *Put on a full load,* 250 to 450 lb., according to the size and variety, and make the animal rise. A ready method is to make two sufficiently heavy men join hands over the back. The uprising should be accomplished easily, without hesitation or trembling of the hind-quarters. Inability to do this or sit down readily denotes a loss of power of the hind-quarters, called in India "Kumri."

The stringency of examination must depend on the numbers required, and the time within which they must be got. It must not be expected that very large numbers of working animals will be found free from every possible defect, and if certain numbers *must* be bought in a certain time, the main point to remember is that the animals wanted are those that are in full work at the moment, and able to continue doing it. Mange, sore backs, youth, and pregnancy, are the chief things to avoid. It is frequently very difficult to buy camels in large numbers free from mange, a disease most common in native-owned camels. If such have to be purchased, they should be cured before being issued for work, as mange is the commonest cause of inefficiency, debility and wastage. Dealers and tribes show their worst animals first as a rule, hoping to obtain the maximum price for them; they are experts at hiding sores, as stated above, and they fill the animals with water just previous to exhibition, to give the belly a plump appearance.

Structural and Other Peculiarities of the Camel.

The lips are extremely mobile and the upper one is bifid. The lower lip, especially in old camels, tends to be pendulous. *The eyes* are very prominent, and liable to injury, but are protected from exposure to sand and sun by a long, heavy fringe of eyelashes, and beetling brows. *The mouth,* like that of other ruminants, is furnished with incisor teeth in the bottom jaw only, the top having a hard pad of gum, at each side of which are three tusk-like teeth. The mouth is constantly opened, and gurgling, bellowing sounds emitted, which arouse some distrust in those unaccustomed to handling the animal. During these sounds, the "palu," a bladder-like membrane from the back of the mouth, is brought into view, and occasionally protrudes beyond the lips. It appears to be a special provision for moistening the back of the throat, and if this is correct is a very useful help in combating thirst. It is also very much in evidence during the rutting season, known as *Musth* in India, and *Hiyg* in Egypt and the Sudan. During this period he will often attack other camels without reason, and cause severe injuries to the withers and testicles, and other parts of the body by biting. He will also attack human beings. On the top of the head is found a gland, the surface of which becomes quite moist during exertion whilst the rest of the skin is quite dry.

The skin should be free from scurf, and thickening in the bends of the joints, but on the knees, elbows, stifles and hocks, it shows thickened, roughened patches, hard enough to prevent damage to the parts when the animal is kneeling or sitting, which is its normal position for rest. Under the chest is a large boss, with a hard surface, on which the weight is rested, and this should be particularly well developed, thick, and free from wounds or soreness.

The hump is a fatty, fibrous lump developed on the summit of the back. Its actual size varies considerably according to breed; it is, generally speaking, smaller in riding and desert camels than other varieties. It has been regarded as a sort of reserve stock of food on which the animal subsists during privation. It is true that the hump wastes in starving or sick camels, and wastes rapidly, but as it is very small in some desert camels, which are amongst the hardiest varieties, it can hardly be regarded as a reserve larder, but rather as a peculiarity of breed and locality. Its condition, whether naturally large or small, is, however, a correct index of health and fitness. In health it is firm, plump and upright. In disease, under privation, and in extreme age, it shrinks and gets flabby, often leaning much to one side.

The feet are formed for travelling over soft sand in particular, but are equally suitable for any ground which gives a firm foothold. The toes are not distinct, but are embedded in a large elastic pad, the under surface being of horny consistence and carrying short, strong nails at the front. When the foot comes to the ground, the whole pad flattens out and gives an ideal foothold on loose sand. It is, however, ill adapted for muddy, slippery ground, and over such the animal is unable to travel with ease or safety. This peculiarity leads to the accident known as "splitting" or "slipping up." Both hind and forelegs are liable to slip out sideways and severe sprains or broken shoulders or hips result. The accident is most common and severe in the hind limbs, and if a fracture does not occur, the strain of the muscles inside the thighs is often so severe as to incapacitate the animal from carrying a load in future.

The digestive system calls for special notice as regards the stomachs, for on account of their peculiar structure the idea has become prevalent that the animal is possessed of a water storage system which only needs replenishing at infrequent intervals. Like other ruminants, the stomach is divided into four compartments.

The paunch is very small in the young, but develops into the largest compartment in the adult animal. On its sides are a number of small cells or sacs which on post-mortem examination always contain a quantity of grumous fluid, a mixture of food and water. The capacity of the cells on the right side is about a quart, on the left side about a gallon. Their contents are usually not nearly so much, and the fluid is not pure water, but a mixture of food, water and mucus. They may be a means of storing fluid, but the idea that a camel keeps the supply of days in these sacs does not bear investigation.

The honeycomb, or second stomach, is aptly described by this popular name, and consists of a deep and intricate network of compartments exactly like a honeycomb. It also usually contains a fluid mixture of water and food.

The third stomach is not so well developed as in the ox, and the fourth compartment is where the digestion of food really commences. The camel, like other ruminants, can go for long periods without water, but has no special water storage except as above described ; and his treatment in this respect when on service calls for the exercise of common sense (p. 298).

The temper of the Camel is peculiar. Though as a rule docile under attendants who understand them, they are liable to sudden fits of rage which are most pronounced in the male during the rutting season, and on this account it is advisable to keep males and females apart when at work. At other times they are quiet and obedient, though when loaded or handled they make curious gurgling sounds in the throat. *Geldings* are of course easier to manage than entire animals, and though it is said that they are deficient in stamina, they were proved to be very good workers in the Somaliland, Egyptian, and Palestine Campaigns.

Under fire they are less liable to panic than other animals, and if made to kneel will remain so, perfectly quiet and contented. Breeds not accustomed to Europeans are, however, timid on their approach, and it has been observed that the Somali camel is specially nervous and liable to panic at night.

Pain, if one may judge by other animals, is borne by them with unusual stoicism. They will struggle on without marked symptoms until quite exhausted by disease and privation, and on this account it is necessary to keep careful watch for the first signs of their being unwell, or they will continue quietly at work till beyond recovery, and it is this characteristic, coupled with an ability to withstand thirst, that constitutes the sole difference between the camel and other transport animals. He will continue to work after having reached a point of exhaustion which stops other animals, and having overstepped that point he either dies or takes a very long time to recuperate.

Want of ability to stand climatic change is the weak point of the camel, and on this account their selection must be careful and their diet strictly supervised till they are accustomed to it. In this connexion, too, it should be noted that when taken to strange pasture they will sometimes refuse to eat at first, or, on the other hand, will consume poisonous plants as readily as any. Fresh grazing should therefore be well examined before animals are allowed to roam at will.

Feeding Camels.

Before stating the actual rations which camels should receive it will be well to consider the question of feeding generally, with special reference to service conditions. The camel is a herbivorous animal that gets its living by grazing and browsing on trees, shrubs, and rough grass found in its native locality, and thrives on such fare so well that in many places he performs the work normally required by his owner without any supplementary rations. But it has to be remembered that camels which live and work under these conditions do so under the eyes of their owners, who appear, even when on the march, to put the welfare of their camels before any other consideration, in cold weather marching slowly and allowing them to pick up what they can on the wayside, in hot weather marching almost entirely at night, camping by day, and under all circumstances allowing their animals ample time to graze and chew the cud. They recognize, too, that camels will not graze in the heat of the day in extreme hot weather. Whereas an army usually camps by wells around which the grazing has been cleared or badly fouled, the camel owner will camp at those places on the road where the best grazing is to be found.

In regions where grazing is sparse and work is demanded, we find the owner supplements what the animal gets himself with a ration of grain. Leaving thirst out of the question, camels so fed prove better able to withstand hardship, and keep their condition better on service than those at graze only.

But in feeding grain of any sort, we must remember that it can easily be overdone, that the digestion cannot cope with large quantities, and that under no conditions can it take the place of bulky food to any great extent. It must be given *in addition* to the ordinary amount of fodder, to compensate for the extra wear and tear demanded by extra work. These conditions are often hard to comply with on service, when especially in hostile country it is often impossible to graze at all, and the problem of providing bulky food without which camels cannot thrive becomes an extremely difficult one, but they must be borne constantly in mind and put in force as far as possible. The camel can do several days' work without food, and except for his usual grumblings, do it uncomplainingly, but it taxes his constitution just as severely as it does that of other animals and renders him unfit for further exertion. It is noteworthy that the animals of the Camel Transport Corps serving in the Palestine Campaign of 1918, which received a regular issue of bulky forage in lieu of grazing, kept their condition far better than camels used in any other campaign where grazing was regarded as the source of provision of this form of forage. It is not always possible to adopt this procedure, but where possible it should be done. It ensures that all camels get a sufficient ration, it prevents losses from straying, poisonous herbs, etc., bites and injuries while loose at graze, and wandering into bush country where "fly" may be prevalent.

It must be remembered that the camel must be treated under any circumstances like other herbivorous, cud-chewing animals as regards the general rules which should guide his feeding. These are: (1) A sufficient supply of fodder or as much grazing and browsing as possible should be given him. (2) A sufficient period of quiet must be allowed daily for him to chew the cud. We may to a certain extent educate his inside to adapt its needs to our special requirements, but these two rules must be observed on service, or the animal's health suffers. Camels unused to grain should be brought on to it gradually; they may require hand feeding to begin with, but they soon become accustomed to it.

Various camel rations.—India.

—	Peace.	War.
Ground barley or gram if barley is not obtainable.	5 lb.	6 lb. { If inferior quality, 7½ lb.
Fodder or { green	40 ,,	40 ,,
Fodder or { or dry	25 ,,	25 ,,
Bhūsa	16 ,,	16 ,,
Salt	1 oz.	1½ oz.

Cumin seed (Zira), 1 lb. a month, may be issued to camels on field service at the discretion of officer commanding corps. An extra ration of 1 lb. goor (coarse sugar) may be issued on service.

Egypt :—

Grain	... ...	10 lb.
Fodder (dry)	... ...	12 lb.

In Egypt "doura" is the grain usually given; gram, beans, or barley are used as equivalents.

In the Somaliland Expedition, Indian and riding camels received their usual rations and hay, in lieu of other fodder, 20 lb. Somali and Arabian camels received 4 lb. of grain only (gram, barley or jowari), and fodder as above.

The foregoing are good rations and the outcome of experience. Grain, especially barley, should be crushed if possible; with jowari and other millets, however, it is not so necessary, and cannot always be carried out.

Gram, oats, rice or other forage grains may be utilized if necessary, and if judiciously fed they are all useful.

Grazing.—Whilst every one agrees that camels require at least six hours' grazing daily, it appears to be equally certain that this is the hardest possible thing to get for them on service, even when it is plentiful. Under military conditions, camels seldom get enough grazing, and they will not graze in the heat of the day in warm weather. This necessity for long hours of grazing does not of course apply where fodder can be supplied, but this of course is not possible on the march. Camels should have their forelegs hobbled if there is any danger of their straying.

While, however, the military situation may not admit of six hours daily, this is the standard to be aimed at if condition is to be maintained. The plants that a camel eats are very numerous and vary in every district, many being of the most unlikely appearance and thorny to a degree, but if accustomed to them they are excellent feed.

An officer should invariably visit the grazing ground; he should look for poisonous plants, and if finding any, warn the grazing guard of their presence and location. He should see that all animals are properly distributed, so that each gets a good opportunity to graze; he should also look out for any animals that are off feed. If not inspected, attendants have a habit of tying their charges to trees to prevent them straying, and not troubling about them any further. Every use should be made of local knowledge to get information as to the best grazing available, and the presence of poisonous plants.

Green food of any description is welcome to the camel. All green grain crops, the pea and bean tribe, and clovers, are eaten with avidity; and if the animals have been on dry food only, or are hungry, they should not be allowed to gorge themselves on first entering a field of succulent fodder. They generally overeat under these circumstances, and may suffer from flatulent colic, which may prove fatal; their grazing on such food should be limited to begin with.

"*Bhūsa*," *i.e.*, broken straw, is fed to camels when grazing or other fodder is not to be procured, and may, with advantage, be mixed with their grain rations to ensure thorough mastication. "Missa Bhoosa" is the most suitable variety, but it is not so digestible as the previously described plants or hay.

Method of feeding.—On the completion of the march, or morning portion of it, the animals should be grazed till afternoon, and fed with grain in the evening after being brought back to camp. In addition, whatever fodder has been collected for them is given after the grain food, and they are left in peace for the night. In very hot weather they do not graze during the hottest part of the day, but should be left undisturbed on the grazing ground, where they will seek what shelter is to be had, and chew the cud.

Watering Camels.

In this matter we are confronted with the traditional idea that camels require watering at very infrequent intervals, and that it is indeed a good thing to accustom them to go without water for long periods. This belief rests on some foundation of fact, in that the camel can, and in some regions has to, go without water for several days on end. Some can subsist and work for as long as ten days in this manner, and Somali camels, which are most tolerant in this particular, are said to have gone even longer. This ability to go without water is a feature which the camel has in common with some other ruminants, but it cannot be argued from this that, under the conditions of war which we impose on the animal, infrequent watering should be made a rule. As a matter of fact, the more work you ask the camel to do the more water he requires. The conditions of service are totally different to, and much harder than, the normal work of the animal. The loads are, generally speaking, heavy, the marches long and often hurried, the opportunities for rest and grazing limited, and the general wear and tear increased. Under the circumstances, the baggage camel requires more water and more frequent watering on service than at any time.

Different breeds of camels vary widely as to their requirements, and in their capability of enduring thirst. The big Delta camel of Egypt requires a copious drink every day, whereas the Somali camel does very well if he finds water every fourth day, and the question of selecting animals for the work in hand is again a consideration.

It has been said that if a desert camel is frequently watered he loses his power of abstinence for long periods. This power has now been acquired by generations of training, and might be lost in the same way, but the conditions under which we use the camel are those which demand harder work than he has ever previously performed with probably less food, and certainly less rest than he is accustomed to. Under these conditions, even the native owner waters him frequently, and on service that is the rule to follow. Camels, like other animals, require more water in hot than in cold weather.

Camels should be watered every day on service, if water is to be had.

Egyptian Delta and river camels must be watered daily.

Indian camels will do well enough if watered every other day.

Arab and desert camels will go two or three days.

Somali camels will not die if watered once every four days; but it is better to make the rule to water daily, if water can be got. With green grazing much less water is required than when dry food is given.

After long abstinence it is not wise to let camels fill themselves hurriedly; it is better to give a very moderate quantity at first, and subsequently allow them to drink as much as they will. After four or five days' abstinence in hot weather they may drink as much as twenty gallons.

Camels prefer still to running water, and should be watered while the sun is up and the water warm. It is usual to water them in the afternoon on their way back from grazing, and before they receive their grain food. On the march camels are not usually allowed to drink at wayside streams, and though this is contrary to the rules for other animals, it appears to be the outcome of experience. If, however, it is known that no water is procurable at the halting place, the rule should, of course, be broken.

Marching with Camels.

The considerations to be borne in mind are:—The animals should not work more than eight hours a day.

They should be allowed to graze from 8 or 9 a.m. till 4 or 5 p.m.

The personnel must get sufficient rest at night.

With marches of not more than 15 miles, the whole may be done at once; but if 20 miles is demanded, morning and evening marches should be carried out.

When the ground is suitable, *i.e.*, free from ditches (nullahs), and there is a moon, camels march well at night, and night marching has the advantage of being cool and allowing them plenty of daylight for grazing. On the other hand, if the road is difficult and the night dark, night marching is not advisable, and a start should be made at dawn.

The pace of baggage camels under favourable conditions is $2\frac{1}{2}$ miles an hour; it may perhaps occasionally exceed this a trifle, but, under any circumstances, it is bad policy to hurry, as it quickly wears them out. A start should be made at 2 or 3 a.m.; the morning march concluded before 9 a.m., and the balance, if any, done after 4 p.m. More than 20 miles a day cannot be expected as a rule either from men or animals.

Riding camels will carry 250 lb. 30 miles daily for long periods, their best pace being an amble or jog of 5 to 6 miles an hour.

The loads should not be adjusted till just before starting, six hours being, generally speaking, a sufficient time for the animals to bear their burden at a stretch.

A *halt* of from 5 to 10 minutes should be made every hour during a march to allow camels to urinate. This act in the male camel is accomplished very slowly, the urine being ejected backwards, in a very thin stream, for several minutes at a time.

Camels are generally tied by their nose ropes to their fellows in front, in strings of three. They should be untied at steep or difficult places, to prevent the chance of these ropes pulling on and perhaps lacerating the nose.

It is satisfactory to know that it is becoming the custom with army camels, at any rate, to abolish the use of nose pegs and nose ropes. They are quite unnecessary and cause much mutilation of the nose and great suffering; camels can be quite easily accustomed to being led by their head-collar ropes.

If there is no hurry and the country permits, it is better to march them loose, on a broad front, and allow them to graze as they go; but the plan is seldom feasible on military expeditions.

Crossing ditches.—Unless able to stride across, a ditch presents a serious obstacle to the camel, and where steep-sided, narrow nullahs are frequent, portable bridges have been carried to facilitate crossing. These consist of two or three stout planks, with battens, forming a platform about 3 ft. wide and 8 to 10 ft. long. The weight they have to bear, *i.e.*, the loaded camel, is 1,500 to 1,600 lb. They were found necessary in Afghanistan.

Crossing rivers.—If the stream is not very swift, the camel can ford to a depth of four feet, and is secure on a shifting sandy bottom, which his passage renders firmer and more fitted for other animals.

If obliged, he is a good, strong swimmer, but will not enter the water unless compelled. When out of his depth, only the head is above water, and if not interfered with he can swim a considerable distance, and has been seen to cross the Nile at Wady Halfa, where the stream is very broad, and the current powerful.

Management during halts and in camp.—On arrival in camp loads should be removed, girths loosened, and saddles removed one by one. As each saddle is removed the back should be rough-groomed, dried, and examined for injuries. Camels should then be sent out to graze.

The best form of grooming implement is a piece of 1-in. rope made into a circle of about 5 in. in diameter.

Camels suffer from cold at night, and rugs must be provided.

In hot weather, clipping is advisable if it can be carried out; it materially assists in maintaining condition and preventing exhaustion.

On returning from graze, or on completion of the evening march, the whole of the grain feed should be given. Each camel should be fed separately, the food being placed on a piece of sacking, or some such material, and not from a heap, common to several animals: this method leading to gluttonous feeding. Timid and slow feeders do not get their share, and the bullies gorge themselves and sometimes get fatal colic or stomach staggers as a consequence.

The halting place should be chosen where the ground is level and clean. Sand is suitable. Any stones likely to interfere with the animals resting comfortably, or damage their breast pads, must be removed.

The formation may be in lines, with sufficient space between them for inspection purposes; or if the space permits, in ovals with heads inwards. This latter is the usual native method, and where fodder is given at night it is good from an economical point of view.

Equipment of Camels.

The equipment of baggage camels is a saddle with girth crupper and breastpiece, a head stall and rope and loading ropes. In addition, a blanket and loading nets are sometimes provided.

Saddle.—Camel saddles are of various local patterns, but the Egyptian pattern, large and small, as used during the Great War in Egypt and Palestine, proved to be the best, and was adopted as the standard one for army use in that country.

The large pattern saddle weighs about 80 lb., the small pattern 56 lb.

It consists of two wooden arches, two cross-poles, two or four side bars, two front pads, one back pad.

Each arch is made of two parts, held together by means of two stout wedges in the case of the large pattern saddles, and one in the small.

The cross-poles are lashed together on either side of the arches and just below the wedges with strong, thin cordage.

The arches, cross-poles, and side bars, are of the toughest and straightest grained wood available.

In the small pattern saddle for use with light burden camels there is only one side bar on each side, and the rear arch and pad are much shorter than the front.

The pads.—The pads are made of stoutly woven cotton material with the outer sides strengthened by a lining of jute. They are provided with pockets, in the front ones at the top and the back ones on the inside, through which the stuffing of rice straw is inserted.

They are fixed into position by means of cord lacings which go right through the arches and pads and back again, care being taken to draw them thoroughly tight and in such a manner that the cordage becomes recessed in the pads, otherwise friction injuries will result.

The front pads should be so fitted as to keep the arch at least 6 in. clear of the withers, and this can be done by adjusting the straw stuffing.

The back pads should be so fixed as to prevent any weight being carried on the hump. This is done by pushing the pad forward 2 in. or more out of the vertical, according to the fall of the back from the hump. This pushing forward of the back pad also keeps it clear of the hips and short ribs, which would otherwise be galled.

In no case must the pad be so long as to bear on the loins, or a bad gall of this part is inevitable.

It is essential that each camel should have its own saddle and that the stuffing of this be altered from time to time, in order to conform to alterations in the shape of the back, or relieve pressure from parts which show signs of undue wear. Nothing but constant attention to this matter will avoid undue loss from sore backs.

The girths of the standard pattern saddle are double with iron rings at the four ends and lateral straps joining back and front. They are made of strong cotton webbing, and strong hemp ropes are fixed to the side bars and passed through the rings when girthing up.

The breastpiece and *crupper* should be just tight enough to keep the saddle from shifting, but not so tight as to gall. There must, owing to the animal's action, be some front-to-rear movement of the saddle.

Loading nets have been tried and discarded in favour of ropes, with which the load can be more satisfactorily secured and which are themselves of much less weight.

The Riding Camel.

The *riding camel* proper is as distinct from the baggage animal as a thoroughbred is from a cart-horse. In the Middle East, the best riding camels are bred in the hilly portions of the North Eastern Sudan ; riding camels are found, too, in various parts of India, where they stand higher on the leg than the Sudanese riding camel.

A riding camel with good smooth action is not an uncomfortable animal to ride even over long distances when once the rider is accustomed to the peculiar motion, and when the pace does not exceed 6 miles an hour.

The Sudanese riding saddle (Makhloufa), used practically only in Egypt and the Sudan, differs entirely from the Indian one, which is in general use throughout almost all other countries, inasmuch as the seat part is really a cupped-shaped piece of wood on which, suitably padded with a pillow and rugs, the rider sits with his legs hanging over the front of the saddle, no stirrup-leathers nor irons being provided. The Indian saddle, on the other hand, has a seat rather resembling that of a horse's saddle with leathers and irons complete. Usually the saddle is a double one, capable of taking two riders sitting one behind the other. In the case of the Indian saddle, the rider can rise in his stirrups at the trot, whereas in the Sudanese one the rider merely bumps. The Indian saddle is therefore the better if the pace is faster than a quiet amble.

The riding camel is controlled by the head-collar rope, which pulls on the nose band ; this rope is also used to guide the camel by pressing it on the side of his neck. In addition, there used to be the nose peg with its rope, but this method of control is unnecessary except in the case of unbroken camels, and so is rarely seen out of camel owners' hands.

The Ox.

Oxen are employed as pack or draught transport animals in many parts of the world ; as pack animals we have employed them in Abyssinia, and many Indian expeditions, and in draught they are largely used in South Africa and India. They are generally more suited for line of communication transport than for employment at the front, and are by no means such good pack animals as mules, but that they may be successfully used for packwork in difficult country is shown by the tea caravans which come over the Shan hills in Burma. The oxen employed are small, the loads are not heavy, and perfectly balanced. The saddles are kept in place by a crupper and breastpiece only, no girth being used, and, so equipped, the steepest and roughest of mountain paths are successfully surmounted.

The Ox in South Africa.

In *South Africa*, the " trek " ox is used in draught, though the natives also employ them as pack animals. They are yoked in pairs, and sixteen constitute an ordinary " span " for a wagon.

In the Zulu War it was found that if allowed ample time to graze and judiciously worked, they could cover from 15 to 20 miles a day, day after day, without knocking up. The manner in which they drew heavy loads over rough ground, across rivers and drifts, up steep and long hills, on roads impracticable for English draught horses, was marvellous.

Selection of oxen.—In selecting oxen for transport work it should be borne in mind that they live and thrive best if worked in or near the localities in which they aré bred. If possible, up-country oxen should not be worked on the coast line, as it is found that the change of climate and grass produces loss of condition and disease. None but trained oxen should be employed, and they should not be put to work before they are four or five years old.

Age up to which they are serviceable.—The age up to which they are serviceable depends on the care and attention they receive and the quality of the grass on which they are grazed. In localities where the grass is good they will work until they are sixteen or seventeen years old ; if the grass is of indifferent quality, until they are eleven or twelve years old.

Pace and hours of work.—They can travel at the rate of 2 to 2½ miles an hour, and can work for 7 or 8 hours a day. In the winter months, owing to the grass being scanty and deficient in nutriment, oxen are not able to perform so much work as in summer. Generally speaking, winter grass is only sufficient to keep the oxen alive, not to work on. It becomes poor about the latter end of June, and often in the first half of that month ; and such was found to be the case along the line of march in Zululand. Cattle fall off in condition from the beginning of July until the spring grass is growing in September. This remark applies generally to cattle fed on grass, and not to transport oxen only.

Coating.—Oxen cast their coats about September, when the spring grass is coming in, and get their winter coats in March. As the tone and vitality of the system is somewhat lowered during the process of coating, and they are thereby rendered more susceptible to external influences, it is incumbent when this process is taking place that the work should be reduced, and measures taken to prevent exposure to wind and rain.

Intolerance of wet with cold weather.—Bovine tolerance of wet with cold weather is small, and if oxen are exposed to it when in low condition they die off rapidly, and in great numbers. When wet weather prevails it is advisable to knock off work altogether, and turn the oxen into bush or sheltered ground.

Sore necks.—Another cogent reason why oxen should not be worked in wet weather is that the yoke causes " sore necks " from the increased friction of the wet yoke on the skin. The part of the neck on which the yoke bears becomes excoriated, and the skin tender and tumefied.

In the way of prevention, that part of the yoke, and the skin on which it bears, should in rainy weather be well oiled or greased, so long as the oxen are working.

Watering.—Oxen should be watered at least three times a day in summer and twice a day in winter.

System of trekking practised by transport riders.—Transport riders when engaged on private business generally travel at night. As a rule they inspan at sundown, work four hours, then outspan for four hours, and then inspan until sunrise. By this system of trekking the work is done during the night, when it is cool, and the oxen have the whole of the day to rest and graze. This sensible method could not, however, be carried out in time of war ; nevertheless, a modified form of it could be practised on the lines of communication, and in those parts of the country where there was no danger of being attacked by an enemy. Oxen should not be inspanned for more than four hours consecutively.

Selection of camping grounds in cold weather.—When camping for the night advantage should be taken of rises in the ground to shelter the animals from cold winds, hail and rain. In Zululand, there is often excessive cold and rain on high mountains, while it is comparatively warm and fine somewhat lower down.

The fact that oxen are slow in recovering from low condition, that when in this state their draught power is reduced by one-half, and that cold, wet weather kills them off like flies, should be ever present in the minds of the officers in charge.

Outspanning in winter.—When "trekking" in winter, oxen should be "outspanned" near rivers, brooks, spruits, low-lying ground, or bush country, as in these places grass is more abundant, and of a more nutritious character.

Spare oxen.—It is advisable to have two spare oxen with each span, to replace the sick or lame. A sick or lame ox should be removed from the span at once, as he does not represent any draught power, is, in fact, "a passenger," and has to be dragged along by the others.

Time required for grazing.—Oxen should be allowed to graze at least six hours a day; this, unless the grass is good and plentiful, is insufficient. When practicable, oxen should be grazed an hour before starting in the morning; this would enable them to ruminate (chew the cud) en route. In South Africa it is not the custom to give grain.

The Ox in India.

In India the draught ox is worked in pairs, yoked to small carts. They are rarely harnessed in teams of more than four, and that is exceptional, and as the roads are hard and good, they have to be shod. They were employed in Government service for drawing siege guns, and are used as draught and pack transport. Siege train bullocks were specially large, powerful specimens bred for the purpose, and for this work they were eminently suited, as they stood fire well.

Selection and age.—In India bullocks purchased by Government are required to attain a certain standard of measurement, as follows:—

—	Draught or pack.
	in.
Height (from behind the hump)	48 to 50
Forearm, immediately below the elbow:	
Under 5 years	15 to 20
Between 5 and 6 years	16 to 20
Cannon bone	6½ to 9
Length of back from behind the hump to root of tail	38 to 44

The hump should be firm and plump, the back level, and the whole body muscular.

Malformation of the hoofs and the turning out of the toes excessively are causes of rejection.

With working oxen, lameness from sprains and bony enlargements of the hock are to be looked for.

The neck must be examined for yoke galls or swellings, which are often so severe as to incapacitate the animal altogether.

Age.—Bullocks are purchased between 4 and 6 years of age. The age is told by the incisor teeth and by the rings on the horns. The upper jaw presents no incisor teeth, but a firm, smooth gum, whilst in the lower jaw there are eight incisors, which are naturally somewhat loosely fixed in the gum.

The whole of the milk teeth may be seen in the mouth of the calf at or shortly after birth, and no change, except such as is due to growth, wear and tear, takes place till the animal is 18 or 20 months old.

Between this period the central pair of milk teeth drop out and are replaced by the corresponding pair of permanent teeth which are well up at 2 years old.

The second pair or middles appear at 2 years 3 months and are well up at 2 years 6 months; whilst the third pair or laterals appear at 2 years 9 months, and are well up at 3 years old.

The corners usually appear at 3 years 3 months and are well up at 3 years 6 months.

The above periods are liable to variations of either 2 or 3 months earlier or later.

At first the teeth present broad sharp white edges, and are close together, but as they get worn they show a flat yellow top and get gradually rounder and more separated from each other.

A 5-year-old ox will have all his teeth in wear, but while the centre pair show a well-marked flattened table, the corners have only got their edges slightly worn away.

The age may also be told by counting the rings at the base of the horn and adding two.

This is a simple method with young cattle, but it need hardly be pointed out that cattle dealers all the world over take care that the horns do not show a large number of rings when they offer cattle for sale.

Feeding.—The digestive apparatus of the ox is in the main like that of the camel previously described. There are no "water sacs" attached to the paunch, the second stomach is of simpler pattern, and the third more distinctly divided from the fourth.

The paunch occupies the largest portion of the belly, and, leaving out all unnecessary details, the question of feeding the ox on service resolves itself into giving him sufficient bulky fodder to fill the paunch and allowing him time to chew the cud subsequently. Inability to comply with these requirements means rapid wastage of ox transport, and nothing will stop it.

Grain feeding is the rule in India, in addition to bulky fodder, but although it adds to the working power and stamina, it cannot compensate for loss of bulk in the ration. On service, of course, it must often be a choice in the mind of the commander, whether he will push on at the risk of sacrifice or not, and, although the military situation may require it, it should be quite understood that ruminants cannot stand being hurried on in the same manner that horses and mules can. Their digestive arrangements will not permit it, and certain loss must follow.

For this reason, as previously stated, oxen are better kept on lines of communication, where it may be possible to carry out the work under conditions suitable to them.

In India, rations for working bullocks are as follows :—

	Peace.		War.	
	Draught.	Pack.	Draught.	Pack.
	lb.	lb.	lb.	lb.
Barley or grain	5	5	6	4
,, ,, if inferior ...	—	—	7½	5
Fodder { green	30	30	30	30
or				
dry	20	14	20	14
or				
,, bhūsa	14	14	14	14
Salt	⅛ oz.	⅛ oz.	⅔ oz.	⅔ oz.

In Burma, unhusked rice (*dhan*), and in Madras, kūlthi, is issued instead of gram or barley, and cotton seed, oil cake or millets may be used also. Grain, except kūlthi, should be crushed or soaked before being given. Kūlthi should be boiled.

The grain ration is fed in the evening, after work is finished, and is usually spread on a cloth or tray before each animal. Mangers should be used when possible.

Fodder.—Oxen will eat and relish a coarser class of grass and fodder than horses, and all grasses, straws and stems of standing crops may be given.

If animals are suddenly brought from a dry to a green ration, they should not be allowed to gorge themselves at first or they get flatulent colic (blown : hoven), but if possible some dry food should at first be mixed with the green.

Bhūsa is excellent feed, and if sufficient is procurable little else is required.

Watering.—Oxen should be watered two or three times daily, according to the temperature of the day. They should be allowed to drink on the march whenever opportunity occurs

Marching with oxen.—The pace of ox transport is, as previously stated, 2 to 2½ miles an hour, and if not over-driven they will travel 15 to 20 or even 24 miles daily under favourable conditions. The pace and distance covered with oxen depends not only on the weather, but to a considerable extent on the drivers, as the animals can only be induced to work well by those who thoroughly understand their peculiarities and to whom they are accustomed. As a rule, they are very timid of strangers, and become dangerous or stampede if approached by white men when they are only accustomed to natives.

They should not be worked when the sun is hot, and for this reason marching in the late evening and early morning is to be advocated. In India, however, where they are used to heat, they can very often be worked all day, or during great part of it. Up hills they are generally good pullers if not over-taxed, but if they lose heart they become obstinate, and lie down. As yoked animals have little or no control over carts going down hill, an efficient brake is always necessary.

During halts, if not grazing, and at night, the animals may be tied to the yoke bar, as they give no trouble and will remain quietly chewing the cud till required.

Pack bullocks are driven in droves ; they are apt to straggle in search of fodder, but under skilful management move at about two miles an hour, carrying 160 lb. They may be secured to a picket rope, by a neck rope being fastened alternately on each side.

Crossing rivers.—The ox is a good swimmer, takes the water readily, and can ford comparatively deep streams against strong currents.

Shoeing.—In India, where working oxen have to travel on made roads, they are shod. The shoes are flat pieces of iron shaped to each claw, and have a stay turned up at the toe so that it rests against the inside of the claw and prevents the shoe moving, and small, rose-headed nails are used to secure it. The animal is cast for the operation as follows :—A rope is put round the horns, passed back to the wither, where a turn is taken round the girth, then passed to the loins where another turn is passed round the belly. The rope is gradually pulled tight, and the bullock sinks quietly down. The feet are then tied together and propped at a convenient height for the smith.

The Water Buffalo.

The water buffalo, a powerful animal, is also largely employed in India, chiefly for draught work. Though slow movers, they prove very useful when employed either singly or in pairs, and can draw very heavy loads for considerable distances provided they are not hurried beyond their normal pace.

Their management is similar in principle to that of the ox, except that they should be allowed a daily wallow in the nearest stream or pond during the heat of the day; otherwise they suffer extreme discomfort, which affects both their health and condition.

CHAPTER XI.

THE PREVENTION AND FIRST AID TREATMENT OF DISEASE.

On service the majority of casualties among animals come under the following headings :—

contagious diseases ; loss or want of condition and exhaustion ; colic, and wounds and injuries.

Loss or want of condition, combined with injuries, usually account for the bulk of the losses, and these may be regarded as preventable. Contagious diseases are also to an extent preventable, and their spread may in any case be greatly checked by simple precautions. The best means of prevention, generally speaking, is a thorough knowledge of the management of animals in health. Whilst the animal is fit and in condition, hardship and exertion can be borne without injury, but once the troop horse is sick, injured or exhausted, he is only an encumbrance to a fighting unit and has to be left behind, his place being filled by a fresh animal, possibly not in hard condition. It is on this account that so much stress is laid on the necessity for thorough knowledge of stable management, feeding and work under all circumstances, and to the importance of directing attention to the prevention of injuries rather than to the treatment of those that have occurred. Sufficient knowledge to deal with injuries and emergent cases in a common-sense manner, until professional assistance is obtainable, is an excellent addition to the mounted soldier's education ; but these occurrences will be comparatively few and far between if horses and other animals are got and kept thoroughly fit. For use, in such cases as can be treated in the lines, units are provided on service with a small field veterinary chest, the contents of which and directions for their use are as follows :—

CHEST, VETERINARY—UNIT PATTERN

Weight, 23 lb.; six in skeleton case, $1\frac{1}{2}$ cwt.

List of Contents

<table>
<tr><td rowspan="3">Space A.

Bandages, compressed, 3-in. 48

Chloral Hydrate Balls,
3 tubes of 6.</td><td>Space C.
5 oz. Sulphate of Zinc. 18 grain tabloids.*
6 oz. Acetate of Lead. 18 grain tabloids.*
4 × 1 oz. pkts. Medicated Lint.
4 boxes, each containing six 2-drachm ampoules of spts. æther nit. conc.</td><td rowspan="3">Space B.

Bandages, compressed, 3-in. 20

Wool, Absorbent,
1-oz. pkts. 32

1 tin containing 20 tubes Iodine Powder,
each tube containing sufficient powder to make 1 oz. of tincture.</td></tr>
<tr><td>Space D.
Carbolic Soap in tin.
6 Physic Balls (4 drachms) in tin.
Hemp in tin.
5 oz. Boric Powder in tin.
7 oz. Boric Vaseline in tin.
2 Thermometers in cardboard holder.</td></tr>
<tr><td>Space E.
4 oz. Perchloride of Mercury tabloids.
Spts. Methylatus, 20 oz.
Lysol, 8 oz.
Tow Carbolized, 12 oz.
1 bottle for Iodine in tin case.</td></tr>
</table>

On top of D is a tray to hold solutions for dressing wounds. This tray, when full, holds one quart.

Instructions for Use

* Crush a tabloid and dissolve in 2 oz. of water.

To make White Lotion, dissolve one tabloid of zinc and one of lead, each in 2 oz. of water, and mix to form 4 oz. of lotion. The strength of this lotion is $1\frac{1}{2}$ drachms of each drug to the pint.

Perchloride of Mercury.—Dissolve one tabloid in one pint of water to make lotion of 1 in 1,000.

Lysol.—$\frac{1}{2}$ oz. to one pint of water makes a solution of 1 in 40 for wounds.

Chloral Hydrate.—Dose, 1 ball to be given for colic, and not to be repeated within an hour. Pierce one end of the ball before giving it to make sure of its dissolving rapidly, or dissolve in one pint of cold water.

In some units a Veterinary Wallet is also provided, which is carried by the farrier on his saddle. The contents of this wallet are as follows :—

WALLET, VETERINARY, MARK III.

Weight, 5¾ lb.

	On Flap.
1 Bottle spirit, Meth.	1 Searching knife.
1 Ligature case.	1 Scissors, dressing, 6 in.
1 Tube containing 6 chloral hyd. balls.	1 Forceps, dissecting, 6 in.
1 ,, ,, 1 oz. hyd. perchlor. tabs.	1 Thermometer.
1 Tin containing 10 tubes iodine powder.	
10 Bandages, compressed, 3 in.	
6 oz. wool.	

THE APPEARANCES OF HEALTH.

The horse.—The forefeet are always square and firm on the ground, but one of the hind feet may be rested on the toe. It is noteworthy that the horse never rests a foreleg unless there is something the matter with it. The head is always on the alert, eyes wide open and ears pricking to and fro. The coat shines, and the skin may be rolled about on the muscles beneath, being loose and supple. The pulse is about 40 ; the breathing about 15 to the minute ; the temperature 100 ; the colour of the lining of the eye and nostril is salmon pink. The bowels are moved frequently on an average eight times in 24 hours, and the "droppings" are usually just soft enough to split as they fall on the ground. They should not be coated with slime, and their colour varies from golden yellow to dark green, according to the nature of food. The urine is passed several times daily, in quantities of a quart or more, and is rather thick in appearance and light yellow in colour. Both horse and mare, when urinating, straddle, grunt and assume a very awkward position, with the skin on the quarters wrinkled, which should not be mistaken for pain. In the mule the droppings are smaller, harder, and darker in colour, and the breathing will in all cases be faster in the smaller sized animals.

The camel.—The head is erect, ears pricked and eyes wide open, except when chewing the cud, when they may be temporarily closed, or nearly so ; the skin free from scurf or thickening about the bends of joints ; the flank full and showing no hollow, and the hump plump and not leaning much to one side. The pulse and breathing are difficult to take and the results not very trustworthy. The temperature varies from 97 to 98 in the morning and 100 to 101 in the evening. The droppings are in small hard balls, and are passed without effort; the urine is clear and voided backwards by both sexes, the act in the male occupying a considerable time.

The ox.—Constant leisurely chewing of cud when at rest, muzzle moist, skin loose and supple and the hair licked up in places. The animal consorts with its fellows in the herd; if sick, the ox frequently separates itself from others. The pulse about 50; temperature 101 to 102; breathing 15 to 20. The bowels are frequently moved, and the droppings are naturally soft. The urine is clear and can be voided by the male without stopping for the purpose.

Temperature.—The temperature is most conveniently taken at the anus. It varies slightly during the 24 hours, being higher at midday and evening than it is during night and early morning. Immediately after work, and especially in a hot sun, the temperature of healthy animals may rise, but as a rule it is unaffected by climatic conditions, and it is thus a most valuable guide. The thermometer should be observed before introduction into the bowel to make sure that it is below the normal temperature of the animal, wetted or oiled to make its passage easy, kept in a sufficient time to register accurately (three minutes is ample for the slowest thermometers) and cleaned in cold water. Before putting it away shake the mercury down again below the normal temperature. A rise of temperature often precedes any visible symptoms in contagious diseases, and so is important in weeding out "suspected" animals.

Breathing.—The breathing may be most conveniently noted by the rise and fall of the flank, the movement of the nostrils, or on a cold morning by the steamy expiration of the breath. It should be counted when the animal is first approached, as excitement, fright or movement cause an increase in the number of the respirations. Breathing is usually noiseless, and any sounds made whilst breathing deserve attention as they indicate that the lungs or throat are affected. The rise and fall of the flank is steady and gradual, but in broken-winded animals there is a double effort to expire the air from the chest.

Pulse.—The pulse may be easiest felt beneath the lower jaw of the horse and mule; inside the arm or at the back of the fetlock of the ox; by the heart beats of the camel. The animal should be at perfect rest when it is taken, as exercise and excitement quicken it. In illness the pulse is usually faster than normal, and its character varies considerably, the two most important differences which it is necessary to note being whether it is stronger or weaker than it should be.

The colour of the lining of the eye, nose and mouth indicate the state of the blood, as in these situations the covering over the blood-vessels is so thin that the condition of the circulation may be judged by observing them. Normally, they are of a salmon pink colour, and free from spots or discharges, but during illness they may become a darker red (congested), paler (from loss of blood), yellowish (bilious), or spotted (petechiæ).

The skin should be supple in all animals, free from scurf and rolling easily on the structures beneath, and the hair of the coat should lie evenly, feel smooth, and carry a gloss. In disease it may be "hide-bound," or feel as if it were stuck firmly on the muscles below; "scurfy," from want of attention or sometimes from mange; and the coat may be "dull" in appearance, "harsh" to the feel, or "staring," that is, having the hair on end instead of lying flat.

The eye should be bright, alert, and wide open. In the camel a watery discharge from the eye is often an indication of illness.

Nursing is attention to every detail which conduces to the comfort or benefit of the patient. The chief points to be noted are:—

(1) Ventilation (in buildings). There should be plenty of fresh air and no draughts. Horses and other animals do not require to be kept in a warm atmosphere, but they do better if extremes of temperature can be avoided during the 24 hours. Standing in the open as animals do on service, they should be sheltered as far as possible from high winds, but as a rule cases of illness make good progress in the open air, unless the weather is bad.

(2) Clothing should be sufficient for warmth, but not so heavy as to be a burden to weak animals or make them sweat. Body rollers should not be drawn tight enough to impede the movements of the chest in breathing.

Bandages should be applied to the legs from below the knee to the coronet to keep up the warmth of the limbs. They should not be too tight or they will impede the circulation, and they should be woollen, if procurable. Hay or straw bands or strips of blanket or sacking may be utilized on emergency, or if linen bandages are to be had, tow, cotton wool, hay or straw may be loosely bound round the legs.

Bandaging.—No one portion of the bandage should be drawn tighter than another; the strings should not be tied tighter than the bandage is put on; the strings should be fastened at the outside of the leg. In bandaging uneven surfaces (such as the hock and knee) or swollen surfaces, be careful to put plenty of wool, tow or any soft padding under the bandage, and do not draw it tight. In bandaging wounds which have a hanging lip of skin, be careful to commence from below, so that the lip is brought into its natural position. Do not bandage wounds of joints at all tightly. For hot bandages use flannel or blanket; for cold bandages use thin doosuti or linen.

(3) Bedding, when obtainable, should always be used for the sick unless they are camped on loose sand, when it can be dispensed with. Horses will take rest, especially when sick, if their bed is level and soft, but will not lie long or often unless this is attended to. In all cases it should be kept dry, clean, and free from smell.

(4) Food.—Animals which are likely to be at work again within a short time should be kept on a plentiful ration, so that they return strong and fit, care being always taken not to allow their bowels to become constipated. Cases likely to remain in hospital for a considerable period must have their grain ration reduced, but should receive compensation in an extra allowance of bran, green forage, or hay.

Sick horses and others which do not feed freely require coaxing to eat. They should be fed in small quantities and often, as many changes of food as can be secured should be offered to them, especially varieties of green food, which are not only tempting to the animal but serve to keep the bowels in order. With weak animals care should be taken that the feeds are placed within easy reach so that feeding entails no exertion, and several varieties of food may be left with the animal during the night, as they will often feed when everything is quiet. Water should be kept constantly within reach and changed frequently, as the sick will continually play with and slobber in the water while it is fresh. The amount of food taken by animals which are seriously ill often tells very heavily for or against recovery, and every endeavour should be made to induce them to take nourishment. Feeding by hand sometimes tempts a sick horse to eat.

Instead of the ordinary dry feeds issued, cooking may sometimes be employed with advantage. Oats, barley and maize may be boiled till pulpy, and given cool. Linseed should be cooked very slowly, or soaked until the result is a glutinous mass; it is most indigestible unless thoroughly cooked or soaked.

Green food of any description should be taken full advantage of, and, as a rule, any reasonable quantity may be given with safety.

Animals which are weak from illness will occasionally lie down for days at a time and require considerable attention to prevent the occurrence of *bed sores*. These are pressure galls on those points where the weight of the animal is greatest when lying, and occur on the outside of the shoulder and elbow and point of the hip and stifle; at first the skin is bruised and subsequently falls off, disclosing a round sore. The actual treatment of the sore should be carried out as explained under "Wounds," but for prevention the case should be turned over from time to time and the parts massaged; salt and water or methylated spirits applied to harden the skin and the bedding levelled and kept thick and soft. Such cases, too, may sometimes suffer from cramp, when they will struggle until their position is altered; or the bowels or bladder may require relief, when an enema should be given or the catheter passed.

Fomenting.—Let the water be hot and near the patient, soak the blanket or cloth, wring it out nearly dry, apply it to the part, and put a thick dry wrapping over it to keep the heat in. Change it every twenty minutes or half an hour.

Massage is often of service in helping to disperse swellings around joints and tendons. It is best carried out as dry massage applied in a circular manner to the affected part.

Poulticing.—The object of poulticing is to soften the part to which the poultice is applied; warm poultices also relieve pain. Bran or linseed meal are the best, and should be kept wet and not allowed to dry on the place to which they are applied. Poulticing has, however, been largely replaced by the use of the fomentation bucket. This is usually a tall wooden bucket filled to the required level with water to which an antiseptic may be added. It has the advantage that the heat of the fluid may be regulated, and it has not the objection frequently made to the poultice, which, unless constantly renewed, becomes sour and a breeding ground for organisms.

Drenching.—Use a drenching tin or bottle with a leather-covered neck. Raise the head just high enough to retain the medicine in the mouth by placing the loop of a twitch in the mouth as a support (not on the lip), and do not pour down more than the horse can swallow at a time. If the animal coughs, lower the head immediately.

Stomach tube.—In veterinary hospitals liquid medicines are now usually given by means of the stomach tube, which is a piece of rubber tubing passed up one of the nostrils and down into the stomach. Liquid food, such as gruel, may also be given this way to sick animals which will not take nourishment voluntarily.

Balling.—Take the tongue in the left hand, but do not pull on it violently, turn it upwards so that it opens the mouth, and push the ball as far as possible over the root of the tongue. Stand at the side and not straight in front of the horse, and do the whole thing as quietly and quickly as possible. After delivering the ball, watch the left side of the neck to see it swallowed, and if the animal does not swallow quickly, give a mouthful of water or green stuff to induce it to do so.

Enemas, clysters should be copious to be effectual. For colic cases they may be given cold, but for all other cases they should be about blood heat. This may be easily judged by placing the arm in the water, which should feel very slightly warm. Oil or grease the enema nozzle so that it will enter the bowel easily.

General Measures for Dealing with Contagious Diseases.

All suspected contagious diseases should be immediately reported to the nearest veterinary officer.

(1) *Segregation.*—The animals should be divided into three groups, *i.e.*, affected, suspected, and healthy. The suspected should include all those which have been in contact with the diseased, although they may not present any suspicious symptoms at the time. Attendants, watering, and feeding arrangements, and all gear should be included in this separation and should be kept separate until the outbreak is over. The distance between the different groups should, if possible, be sufficiently far to prevent any chance communication between them, or when military considerations restrict the space at disposal, fencing of some sort should enclose each group, and if there is a prevailing wind the healthy should be placed to windward and the suspected and affected to leeward in the order named. Once an animal is placed in the affected group it should remain there till all danger is over, and on no account be replaced among the healthy, although it may perhaps have been moved in error in the first instance.

(2) *Disinfection.*—Strict cleanliness of lines, gear, water troughs, feeding boxes and bags, and personal

cleanliness of attendants are in themselves good safeguards against the spread of disease.

To disinfect open lines.—Scrape off the top layer of earth, strew the lines with litter, mix the scrapings with it and burn over the whole surface. Quicklime or chloride of lime may be mixed with loose earth to disinfect it.

In all cases where it can be used fire is the surest agent to employ if the work is done thoroughly, and by means of the painters' lamp it can be employed almost universally.

Walls, woodwork and fittings.—Other methods employed: these may be scraped and sprayed with a disinfectant, painted with boiling tar or scalded with steam.

As it is difficult to maintain water at boiling point, one can only look upon this method as a means of removing grease and dirt.

Whitewash should not be considered a disinfectant.

Floors should be flushed with a disinfectant.

After disinfecting a stable, the doors and windows should be left open to flush the building with sunshine and air.

Ironwork of saddlery, etc., can be passed through a flame, and all grooming kit and blankets should be soaked in a reliable disinfectant. Anything not worth the trouble or expense of retaining, such as old lining or stuffing of saddles, brushes, etc., should be burnt. The personal disinfection of attendants and their clothes should not escape attention, as they are liable to carry the disease in some cases, particularly when dealing with mange, epizootic lymphangitis and rinderpest.

Saddlery and harness.—(*a*) *Petrol* is the best agent for disinfecting saddlery.

(*b*) Apply petrol or wash in warm water with hard soap to remove grease, soak for a few hours in a 3 per cent. solution of Cresol, rinse in clean water and dry.

Blankets and horse rugs.—(1) By steam in a Thresh, Foden or "Sack Steam Disinfector." Twenty minutes' super-heated steam followed by twenty minutes' dry heat.

(2) Soaking for several hours in a disinfectant solution, such as 3 per cent. solution of Cresol.

Numnah pannels must not be disinfected by steam as this method would perish the leather; they should be soaked in a disinfectant solution.

(3) *Inspections* of all healthy and suspected animals should be carried out daily, and in cases where it may be a guide the temperature of suspected animals should be recorded.

(4) *Destruction and disposal of dead.*—To shoot a horse use a Greener's Humane Killer if procurable, otherwise a pistol for choice. If obliged to use the small bore rifle, be very careful that no one is standing within sight anywhere behind the animal, as the bullets are apt to come out and traverse considerable distances. Stand close with the pistol, almost touching the forehead, and held at a right angle to the head. The head can be brought into a convenient position by offering a handful of corn. Aim at the centre of the forehead, well above the level of the eyes, just below the place where the lowest hairs of the forelock grow. The animal will not fall forward, but collapse exactly where it stands.

Disposal of the dead.—The problem of disposal of dead animals may assume serious proportions in time of war. Carcases can be disposed of by burning, burial, or by removing them to a selected spot where they are disemboweled and the viscera buried deeply, or the stomach and intestines opened up and the contents spread out in a thin layer to dry quickly and so prevent flies breeding, the empty carcase being left to be disposed of by Nature.

The latter method should only be used in tropical countries where the air is dry and the sun temperature very high.

It will lessen the evils consequent on gradual disintegration if the dried remains are collected together and burned.

Burial places should be clearly marked as " foul ground."

In many cases improvised crematories can be built on which the bodies of animals can be burned and every endeavour to build them should be made in all camps. When no incinerator is available two methods of burning carcases can be used:

(1) Bostock's Pit. (2) Cross Trench.

(1) *Bostock's Pit* is the better method, being easier, requires less fuel, and burns the carcase more completely. It is carried out as follows :—

Dig an oval pit large enough to take the carcase, about 7 ft. long and 3½ ft. deep, with a cross trench at the bottom 9 in. wide and 9 in. deep. On the windward side, one foot away from the pit, dig a trench, 4 ft. long, 18 in. wide and a little deeper than the pit. The trench should have its long axis at right angles to the pit. Connect the pit and trench with a tunnel. The tunnel is for draught.

Place straw and wood and a little coal in bottom of large pit and sprinkle with paraffin. Place the carcase in and arrange fuel (wood, coal or dried litter) round and over it.

Light the fire at the draught tunnel. The carcase will be completely burned without further trouble.

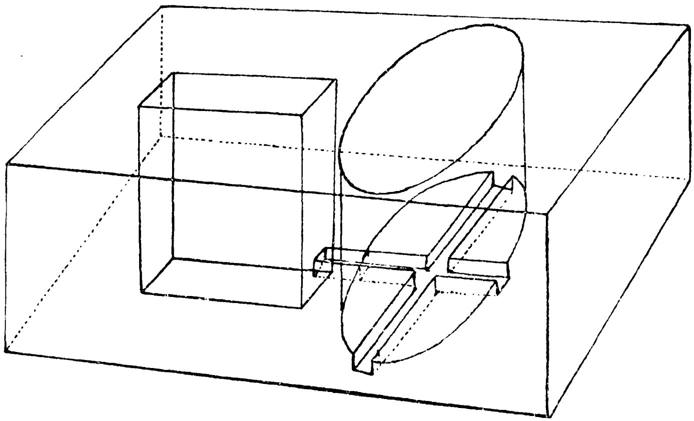


FIG. 53.—Diagram of Bostock's Pit.

(2) *Cross Trench.*—Dig a trench in the ground the shape of a cross, each trench to be 7 ft. long, about 15 in. wide, and 18 in. deep at the centre where the two meet, and becoming shallower as they rise to the surface of the ground. Throw the earth into the angles formed by the trench, and on this place two stout pieces of iron—the trench provides the draught. Use a layer of stout wood to make a base, and on this place the carcase followed by more wood, the pile is lighted by straw. Dried horse manure makes excellent fuel for this purpose.

The carcases of animals which die or are destroyed for such diseases as Anthrax, Epizootic Lymphangitis, Surra, and Rinderpest, should be burned or buried with special precautions and under veterinary supervision, and the ground marked with a notice board, "INFECTED GROUND."

In France, horse carcase economizers were installed on the lines of communication ; they were hygienic and economic.

Disposal at sea.—To prevent carcases floating they should be opened up before throwing them overboard.

CONTAGIOUS DISEASES.

Fever.—The symptoms of fever in all animals are similar; a high temperature, rapidity of the pulse and breathing, generally constipation of the bowels and a scanty and high-coloured urine. In addition, shivering fits may sometimes be seen, and the coat stares, but usually these symptoms have passed before the case is noticed. Fever cannot, as a rule, be looked upon as a disease in itself; it is generally only one of the symptoms of a contagious disease which is causing it; for instance, it accompanies cattle plague, anthrax, and many others.

Simple fever, that is, a fever in which no definite cause can be found, may perhaps occur in the horse, and in such cases is generally an easy matter to deal with; work, especially in hot climates, will cause the animal's temperature to rise temporarily, though it generally subsides quickly; and this is more particularly the case where the atmosphere is full of moisture and the sun's rays are severely felt.

The treatment of fever should include a strict attention to the animal's comfort and the state of the bowels, this latter being, as it always is, extremely important, but physic balls should not be given. Warm enemas, about blood heat, may be administered two or three times daily when there is constipation.

The food, if there is any appetite, should not contain more than half the usual quantity of grain which the animal receives, and may be given sloppy or cooked with advantage. Green food of any description may be given freely. Water should be always kept by the animal and frequently changed.

Anthrax is usually a rapidly fatal disease, produced by the growth of a germ in the blood. It attacks all animals and may be conveyed from one to another, but is most generally caused by the germ being consumed in the food or water; it is communicable to man.

The general symptoms are the same in all animals; high fever, want of appetite, rapidly increased swellings in various parts of the body, spotting and purple colouring of the lining of the eye and nose, bloody discharges from the nose and sometimes from the bowels, and rapid death.

In the horse the patient may be found in many cases with swelling of the throat, which rapidly increases. This swelling, which is common in all cases of the disease, is rather soft and doughy to the feel; the finger pressed into it will leave a dent ; it may occur in the chest or belly, when chest symptoms or colicky pains will be shown. Later a rusty or bloody discharge may be seen to run from the nostrils, and death occurs in about 24 to 48 hours. Among cattle it is quite usual to find the animals dead, the disease being very sudden in its course, but in other cases the characteristic swellings appear and the case lasts for a day or two, presenting the same symptoms as already described. When cattle are found dead there is often a bloody discharge from the bowel.

After death the general appearances are a tarry-liquid condition of the blood, great enlargement of the spleen, and yellow jelly-like swellings in the chest, belly or throat, and in cattle under the skin.

Prevention.—In all cases of sudden death anthrax should be suspected. The blood from the ear veins or fluid from the swellings (if present) should be examined under the microscope. If the germs of anthrax are found the carcase must not be cut but should be burned or buried deeply. Before moving the carcase the head should be enclosed in a sack and the anus plugged with tow soaked in disinfectant, to prevent escape of discharges. The stable or standings and any contaminated ground should be well disinfected. (*See* Disinfection.) As the disease is usually introduced by food this should be changed. Cases may occur after grazing, in which case the area should be inspected and changed, and grazing stopped if necessary. In-contacts and animals which have had the same food may be given serum (Anthrax).

Anthrax carcases should be buried in a fenced-off area, away from camps and cultivation. The grave should be deep enough to allow 6 ft. clear above carcase. The area should be clearly marked "FOUL GROUND—ANTHRAX." Anthrax graves should be dug as far as possible from running water.

Coughs and colds are of frequent occurrence among all animals, horses, mules and camels being the most frequent sufferers. Sudden changes of temperature, and exposure to draughts when heated or in stables, are liable to cause them, and they are also prominent symptoms in outbreaks of influenza. A cold (catarrh) is inflammation of the lining of the nostrils, and a cough is produced by inflammation of the lining of the throat (sore throat) : the two very frequently accompanying each other. The symptoms are discharge from the nostrils and the presence of a cough. The discharge is at first watery, but in the course of a few days it becomes greyish and thicker, and then alters to a yellow colour ; it runs freely from both nostrils and does not smell. The cough varies somewhat according to the state of the throat ; if the lining is dry and hot it will be a short, painful one, whilst when there is much phlegm it is hoarse and longer. Handling the throat and the effort of swallowing food frequently produce it, and when the swelling inside is great or the throat is very painful, the animal may be unable to swallow and the food returns through the nose. In severe colds fever may accompany them, and in such cases additional care should be taken to prevent the chance of the lungs becoming inflamed. What appear to be colds and sore throats may be the beginning of strangles or pneumonia.

Treatment.—General attention to comfort ; steam the head to promote free discharge ; rub the throat with liniment. If the cough is very painful, only such food as is easily swallowed should be given and the state of the bowels carefully attended to.

Epizootic Lymphangitis.—This is a highly contagious disease affecting horses, mules, and donkeys, but is not communicable to man. It is due to a specific organism and may lie dormant in the system for a considerable time.

The symptoms are the development of a chain of small abscesses along the course of the lymphatic vessels ; these may occur on any part of the body, though most frequently seen on the limbs, which become swollen, the general appearance being very similar to the condition described under Glanders-Farcy.

There are certain distinctions, however, which differentiate this disease from glanders, viz. :—the readiness with which the sores heal, the fact that the enlarged condition of the lymphatics and resulting abscesses always have their original starting point from a wound, the absence generally of pain and febrile symptoms, the character of the pus in the abscesses, which is thick and white or creamy, no reaction to the mallein test, and usually the absence of any signs of unthriftiness in the affected animal.

The method of infection is by direct inoculation, *i.e.*, the conveyance of material from an infected wound to a healthy wound, either by means of flies or by a careless dresser using the same dressing material for healthy and infected wounds.

As both glanders and epizootic lymphangitis are serious diseases, great care should be taken to isolate all suspected cases in the most rigid manner, and if either disease is confirmed the affected animals should be destroyed immediately.

This disease has been stamped out of the United Kingdom, but exists in many other countries.

Foot-and-mouth disease.—A fever which affects cattle particularly, but also sheep, goats and camels. Its special characteristic are small blister-like eruptions in the mouth and around the junction of hair and hoof. It is extremely catching and must be dealt with strictly whenever discovered, as it may spread very rapidly and incapacitate cattle from work.

Symptoms.—The first thing noticed is usually that the animal is off feed and slavering at the mouth, and when watched it may be noticed that the lips are "smacked" repeatedly. When the feet are attacked the animal is lame, and examination of both feet and mouth will show the characteristic bladders, which when broken leave a shallow sore. Under good treatment these usually heal rapidly.

Treatment.—Pay attention to the state of the bowels and give the cases soft food which they can eat without causing pain, washing out the mouth occasionally with weak boric or alum lotion. Treat the sores around the feet antiseptically. As a rule, the disease runs a mild course, but if the feet are allowed to get dirty the hoofs sometimes slough off. As this disease is very rapidly spread, the strictest isolation of any animal or unit in which it occurs should be observed. If no case occurs for a fortnight after the last case recovered, the outbreak may be considered over.

Glanders-Farcy is a contagious disease peculiar to the horse and mule and occasionally communicated to man. It is very slow in development in many cases, and may lie dormant in the system for a long time. It is communicated from one animal to another by the discharges from the diseased, and consequently calls for very strict measures of precaution when dealing with an outbreak.

The visible symptoms are a slight, sticky discharge from the nose, usually from one nostril, a hard lump under the jaw on the same side as the discharge, the lump feeling as if it was stuck on to the jaw and not freely movable. Small sores may appear in the nostril or in certain situations on the skin (farcy buds), and these have the same sticky discharge as seen from the nose and show no inclination to heal. When these sores are found on the legs the disease is popularly known as "farcy," but it is the same disease as glanders, only the ulcers are on the skin instead of the nose. The glanders-farcy ulcer is a small ragged-edged, angry looking sore, covered, after it bursts, with a glutinous, not very copious, discharge; these ulcers occur in lines one below the other, and the common situations for them are in the nose, down the inner sides of the limbs, and occasionally on the neck and face. In their neighbourhood the lymphatic vessels may be seen standing out under the skin like knotted cords, and it is in the course of the cords that the sores occur. Cases of this disease may linger on for a considerable period after these symptoms are observed, and should be destroyed, when the disease has been confirmed.

Measures for dealing with an outbreak.—The obviously diseased are slaughtered and those that have been in contact with them segregated. Carry out strict disinfection of standings and gear. The temperatures of the in-contact animals are taken daily, as the first indication of the disease is often an irregular slight fever. A daily inspection of all animals is made, especially of the nose, beneath the jaw, and at the insides of the limbs. This disease almost invariably declares itself on service, and all cases with nasal discharges, especially if only from one side, should be regarded with suspicion and placed under observation, even if there is nothing else obviously the matter with them.

Remedial measures are not of any use, and once a case has been diagnosed as glanders it is destroyed and the carcase, etc., burnt or buried. The use of the diagnostic agent " mallein " now enables the veterinary service to deal with glanders in a much more satisfactory manner than previously, and as a precaution all remounts are tested with it on joining the service to ascertain their freedom from the disease.

Mallein is a diagnostic agent which, when injected under the skin of a horse or mule affected with glanders, causes a reaction resulting in a rise of temperature and swelling at the seat of injection. On the other hand, healthy animals do not give this reaction. By using mallein for periodic testing of army horses it is possible to detect the disease in the early stages before symptoms of the disease are shown. In this way the spread of the disease is prevented.

Inflammation of the lungs.—Pneumonia may occur from the extension of a cold into the lungs, or may, especially among horses, arise without any visible cause, when it should be treated as a contagious disease and the case segregated. In outbreaks of influenza among horses it is a somewhat common form for the disease to take. From whatever cause it arises the general symptoms are :—the animal will probably be noticed dull and off feed ; there may be a history of a cold or cough for a day or two previously ; the animal stands still, the fore-legs probably a little wide apart, the breathing hurried, the pulse fast, and the temperature high. The lining of the eye will be generally found a brighter red than normal, and the bowels are usually constipated. From day to day the changes to be observed are slight, the pulse remains fast but gets gradually weaker, the breathing remains hurried but may become more shallow, the temperature keeps high and the appetite is gone or capricious. After a few days the animal begins to get visibly thinner, and the wasting is so rapid that at the end of a fortnight many cases are skin and bone. A slight rusty coloured discharge may be sometimes observed from the nostrils, and a painful cough is often a constant accompaniment. When the ribs over the lungs are struck with the tips of the fingers, the sound produced is duller than normal.

Treatment.—In this disease, above all others, good ventilation and nursing are necessary. The great thing is to get the case to eat sufficient food to keep up the strength. Every variety of food may be tried to tempt the animal, and small quantities of different sorts should be left in the stable at night. Water should be kept within easy reach and changed whenever fouled. Warm enemas and green food should be frequently administered if the bowels are constipated, but physic balls are not to be given. If the case is weak, a stimulant is beneficial (carbonate of ammonia ball). After recovery a long rest is essential to allow the lungs to get back their elasticity.

Influenza is a contagious fever which attacks horses and mules. It is chiefly to be feared when large bodies of animals are suddenly collected together, and specially if the sanitary surroundings are not good.

Symptoms.—Fever and great lassitude, with generally a highly coloured lining to the eye (pink eye), which may also be considerably swollen. When the disease attacks the chest and air passages, there will be discharge from the eyes and nose, resembling that described under catarrh, and in severe cases inflammation of the lungs may follow. In another form there may be rapid swellings of the limbs, and occasionally the bowels are affected and there is diarrhœa. It is easily communicated from one animal to another, and the usual precautions for dealing with contagious diseases should be observed.

Treatment.—In this disease the weakness of the patient is great and the wasting rapid, whilst appetite is often wanting, or, at any rate, capricious. Nursing is of the greatest importance, and every endeavour should be made to get the patient to eat in order to keep up the strength. The body should be clothed and the legs bandaged warmly, whilst, if stabled, draughts should be avoided. After recovery ample rest should be given to recover the strength before being put to work.

Jhooling is a contagious skin disease of camels characterized by the appearance of ulcer-like sores which discharge pus. The disease usually makes its appearance in the cold weather in India.

The first sign of the disease is the formation of a hard swelling from 1 to 5 in. in diameter usually about the neck, hind-quarters, or abdomen.

The swelling is very irritating, and the camel gnaws, or rubs it, leaving a raw patch which quickly suppurates. When healed a white patch of skin is left.

If the sores occur near the girth they take a long time to heal.

Treatment consists in curetting the sore and dressing with powdered permanganate of potash.

Rabies is a disease, the virus of which affects the brain, causing madness.

It occurs most frequently amongst the canine species (dogs, foxes and jackals), and it is conveyed, by biting, to man, horses and cattle. The virus of the disease is contained in the saliva. The disease has been stamped out of the British Isles, but it is of frequent occurrence in other countries, particularly India. It manifests itself in two forms, which are called Dumb Rabies and Furious Rabies. The first signs of the disease are, a marked change of disposition or habits of the dog with restlessness and nervousness, a vacant look, mental delusions, snapping at imaginary objects, hiding in corners, a morbid appetite, eating stones or wood, and the bark may be altered in tone. In the course of the next 24 to 48 hours definite symptoms of the furious or dumb stage will arise. The furious stage will be accompanied by more marked mental delusions, a peculiar drawling howl and paroxysms of fury, biting itself and any objects within reach. A stringy saliva will hang from its lips. The dumb stage is evidenced by paralysis of the lower jaw or limbs, with no tendency to bite. Salivation is copious.

The disease in the horse causes it to become vicious and aggressive, mutilating its own body, tearing its clothing by biting.

Cattle stamp their feet, shake their heads and gore with their horns.

Death is invariable in all animals affected with rabies.

A dog suspected of rabies should not be destroyed but kept tied up securely with two chains, for 10 days. If rabies ensues definite symptoms will appear in a few days. Any person bitten or licked by a rabid animal should report forthwith to the medical authorities in order to undergo anti-rabic treatment.

An animal bitten by a suspected rabid dog should have its wounds cauterized with pure carbolic acid.

Rinderpest (*cattle plague*) affects all ruminants, and is most common and fatal in India among oxen. It is a highly contagious disease, and the strictest precaution should be taken to try and prevent its spread.

Symptoms.—The disease is so general and widespread in

India that many of the cattle are naturally more or less inoculated against it and have a mild form. The prominent symptoms are want of appetite, cessation of rumination and purging. On closer examination it will be found that there is fever, a bran-like eruption on the inside of the lips and on the gums; the lining of the eye and mouth become purple or spotted; there is often a profuse discharge from the eyes and sometimes the nose, and in many cases the motions are bloody. The animal separates itself from the herd, the back is arched, and there may be considerable straining to pass the fæces. The case rapidly loses flesh and, as a rule, death ensues in four to eight days. Mild cases recover slowly, but this is naturally a rarer occurrence on service than elsewhere.

Prevention.—During an outbreak of cattle plague the animals should be separated into three groups:—(1) diseased, (2) in-contacts, and (3) healthy. All animals should receive a dose of anti-rinderpest serum, which protects them from the disease for about two to three weeks.

In some cases the animals are not segregated, but all are given serum and the diseased left with the healthy. In this way all get the disease in a mild form, and often the outbreak is over more quickly by this method.

Disinfection of standings, walls, mangers, etc., should be carried out and carcases of dead should be burned or buried. If no case occurs for fourteen days the outbreak is considered over.

Cattle can be rendered immune for life against this disease by inoculating them with anti-rinderpest serum and blood from an infected animal.

Strangles is a fever and catarrh of young horses, the prominent feature of which is an abscess which develops between the branches of the lower jaw; there is also fever, and in many cases the animals may be off their feed and get thin. It is contagious, but large outbreaks are chiefly confined to remount depots. The disease is a serious one and occasions severe animal losses; it is closely associated with one form of pneumonia.

Symptoms.—Fever, catarrhal discharge from the nostrils, and swelling beneath the jaw. This swelling is at first hard and diffused, but within a few days it becomes prominent in the centre between the jaws and gets soft at the point. It then bursts and generally heals rapidly.

Treatment.—Feed the animal well and pay attention to the state of the bowels, keeping them soft. When the abscess has burst or been opened, the discharges must be destroyed as the disease is contagious and its prevention is the main point to be attended to. The general rules for dealing with contagious diseases and wounds apply.

Surra.—A fever produced by a parasite in the blood, in most animals, but chiefly affecting horses, mules, and camels. It appears in tropical countries, and is most prevalent during the rainy season. The parasite is conveyed from one animal to another by means of biting flies or ticks.

The symptoms are fever, which appears and disappears or gets less every few days; dark red spots on the lining of the eye and nose, which are often yellowish; the appearance of nettle-rash over the body, and, later on, swelling of the legs and lower surfaces of the body. The animal gets thin and weak, and usually dies in about six weeks from the time it was noticed to be ill.

Diagnosis.—Surra is diagnosed by a microscopical examination of the blood under a low power, when the parasite (trypanosome) can usually be detected.

Treatment.—This disease has been responsible for very heavy losses in camels in the past, but recent investigations and experiments have resulted in the discovery of a drug (Naganol), one intra-venous injection of which is usually sufficient to cure a camel. The great advantage of this treatment is that, on the disease being diagnosed, the animal can be given an injection and immediately returned to work.

The same drug has also proved highly successful in the treatment of surra in equines, though in their case five injections, two intra-venous and three intra-thecal, are usually necessary to ensure a complete cure.

Tick Fever (*Piroplasmosis*).—This is a fever produced by a parasite in the red blood cells of horses, cattle, sheep and dogs, each class of animal having its own specific parasite.

The disease is transmitted by ticks, and perhaps mosquitoes.

The disease is widespread, particularly in tropical countries. The disease affecting cattle in Great Britain is called "Red Water" or "Moor-ill."

Symptoms.—Fever appearing and disappearing, in some forms red urine is passed. If the disease goes on for some time the animal falls away in condition, becomes very weak and dies.

Prevention.—Careful observation. Segregation of suspected cases. Avoid infected pastures and the use of fodder and bedding from them. Destruction of ticks on animals by dipping or spraying. Destruction of ticks in stables and on pastures.

Treatment.—In the horse intra-venous injections of Quinine, Tartar Emetic or Trypan Blue have been used with success.

Ulcerative Lymphangitis.—This is a chronic contagious disease of the horse in which there is a progressive inflammation of the lymph vessels with a tendency to form an ulcer. The disease usually develops in the lower limbs and infection apparently takes place from wounds in contact with soil.

Symptoms.—Leg swollen, isolated firm sensitive abscess appears which breaks, leaving an ulcer.

Treatment.—Preventive. Careful antiseptic dressing. Keep horses out of mud as much as possible. Wounds on the legs should be bandaged. Case to be isolated.

Horse Sickness.—This is a South African disease fatal to horses and mules. The visible onset of the disease is usually very sudden, the animal falls shortly after it is noticed to be ill, quantities of froth are voided from the nose, and death is rapid. Attempts at cure are of no avail. The exact cause of the disease is not yet known, but observation points to the great probability of its being transmitted by mosquitoes which bite during the night only. Preventive measures based on this view have given good results, and the following precautions are at present observed in South Africa :—

(1) During the horse sickness season, *i.e.*, from November till June, or until the first frost, no horse or mule is taken out of stables between sunset and sunrise.
(2) Water is not allowed to stand in or near stables, and all vegetation, except trees, is removed from them.
(3) Some dung is allowed to remain behind the horses, as mosquitoes will not approach it, and smoke fires are lighted at the entrances of stables.
(4) As the blood of the affected is very virulent, carcases are cremated and standings thoroughly disinfected.

The preventive inoculation of mules has also given satisfactory results and is being carried out.

Mange is produced by small insects which live in or on the skin ; it is found in all animals ; and each class of animal has its own particular variety of itch insects. On service this disease is a constant source of trouble and loss, and deserves particular attention, as it is very easily spread and often cured with difficulty. In the horse and mule there are two troublesome forms—

(1) The dry, produced by insects which live beneath the skin.
(2) The moist, in which they are found on the surface of the skin.

Symptoms.—In both cases the common situations for the disease to be first noticed are on the head, withers and back, and sometimes, but less frequently, the quarters. In the dry form small pimples may be felt about as big as a pin's head, and from these the hair falls, leaving a small pea-sized bald spot. In the wet form a moist, rapidly-increasing patch will be seen from which the hair falls, and in both cases there is severe itching. If the place be gently scratched the animal will smack or nibble with his lips and lean or rub against the hand; when being groomed he will lean heavily against the brush, and when loose he will scrub against anything rough with such violence as to make the skin bleed.

In the camel.—The parts first attacked are those where the hair is thin or which are in contact with the ground when the animal sits down; the insides of the legs, lower part of the body, neck and sides. The animal rubs its legs together or scrapes itself against trees; the appearance of the diseased patches is much the same as described above, and later the skin becomes thickened and scurfy.

In the bullock the disease may be usually first noticed round the root of the tail, but may also be found on the body, the symptoms being identical with those previously described, but not usually so acute.

The disease is of great importance on service owing to the loss of working power or even mortality which it causes. When well fed, groomed, and clothed it may not be so marked in its effects, but when work is hard and food scanty, animals rapidly waste and die from the constant irritation.

Treatment.—Segregation and strict disinfection, clip, singe, and wash with hard soap and warm water; then dress all over with sulphur 1 part, sperm oil 4 parts, mixed together thoroughly.

On no account should linseed oil be used.

Rub in the dressing thoroughly with an old body brush, work it in with the hands for two days, then wash thoroughly with hard soap and warm water, taking great care to remove the whole of the dressing from the coat, otherwise blistering will result.

Sweat and well groom daily after washing off the first dressing, and in ten days repeat the dressing, washing and grooming.

In cases where any itchiness or other signs of the disease remains, a third dressing should be applied and a final washing, etc., carried out.

Another method of treatment which has given excellent results is by dressing the affected animals with calcium bisulphide solution, applied warm at a little over body temperature. The proportions of the ingredients are as follows:—

Lime	12 lb.
Sulphur	30 ,,
Water...	100 galls.

For the treatment of Mange on a large scale, this is by far the best method for either horses or camels, as dipping baths can be constructed and large numbers of animals passed through them daily, with a consequent considerable saving in time, labour, and dressing solution.

Daily exercise and a liberal diet throughout the treatment are essential.

If weather permits, clothing should be withdrawn from any unit in which the disease exists till the outbreak is over, as it is one of the main sources of contagion.

All gear, blankets, etc., should be thoroughly disinfected before being used again.

Daily inspections of all animals are imperative until the unit is declared free from the disease.

Ringworm, round bald patches covered with greyish scales about the size of a florin, common in all animals and caused by a fungus growing at the root of the hairs, is contagious but not always serious. Clip off the hair round the patch, and dress with iodine (tincture or ointment) both over and around the spot.

Contagious Stomatitis.—A contagious disease of horses characterized by occurrence of blisters in the mouth, inside the lips, on the gums and tongue. Sometimes they appear on the skin of the lips and nostrils.

Treatment.—Isolate affected animals, using separate watering arrangements and separate utensils. Treat affected animals with solution of potassium permanganate (1 per cent.).

Disinfect stables, utensils, etc.

Lockjaw (Tetanus) is caused by a germ which gains entrance to the body by wounds and which is found in the ground. It most usually, therefore, follows such wounds as pricks of the feet and broken knees which come in contact with the soil. The symptoms are stiffness and constant spasm of the muscles of the jaws (lockjaw), neck and back; the other muscles of the body may be affected, but it is most noticeable in those mentioned. The jaws are fixed, the tail is drawn to one side and quivers; if the head is lifted up the haw or third eyelid appears and the animal is very easily startled. The mouth is often seen covered with food from the patient's efforts to eat, and this may be the first thing to draw attention to the case.

Treatment.—Keep the animal as quiet as possible, separated from others and away from all noise, give a noiseless bed which is easy to walk about on, such as sand or old short litter; feed on plenty of boiled sloppy food, which the animal can suck down; give at the outset a dose of physic, and having put plenty of food and water within easy reach, do not allow any one near the animal for twelve hours at a time. Absolute quiet is the best treatment. In all cases look for wounds, and thoroughly cleanse and treat them with antiseptics. Cases which live over ten days generally recover if carefully nursed.

Non-Contagious Conditions.

Broken wind is due to an affection of the lungs, and animals affected have a difficulty in expiration, so that a special effort to do so may be noticed on looking at the flank (*see* p. 314).

Barsati is the Indian name for ulcers of the skin, which appear generally round the lips, eyes, coronets and fetlocks, and sometimes on the sheath and penis of the horse; they are liable to recur annually, heal with difficulty, and chalky lumps (kunkar) are found in them. They disappear during the cold season or when the animal goes to the hills.

Choking is the stoppage of something in the gullet which the animal has swallowed and which is unable to pass down to the stomach. It is most frequent in cattle, but may also occur in other animals. In the horse, hastily swallowed bran or gram or carrot, and in cattle pieces of sugar-cane or roots are the most frequent causes. The symptoms produced are great uneasiness and spasmodic attempts at vomiting, the head being drawn towards the chest and then suddenly shot out. If the obstruction is in the neck it may be readily seen. In cattle, hoven rapidly comes on if relief is not afforded.

Treatment.—Give small doses of oil repeatedly (about two ounces); in cattle pass the probang; in horses, do not attempt this but walk the animal about. Do not allow water to drink, as it will cause the obstruction to swell, and if the stoppage is complete it will only return through the nostrils; after relief is obtained starve the animal for twelve hours.

Colic is the name given to the train of symptoms which animals show when they have got pain in the belly: the pain may be due to a variety of causes, but the symptoms exhibited are often similar. The majority of the causes of colic are connected with the food and feeding, and if cases are at all frequent, a strict inquiry should be made into feeding arrangements. Crib-biting, wind-sucking, bolting food, unsuitable or unsuitably prepared food, sudden changes of food, a surfeit of green fodder, watering or working severely immediately after feeding, are all causes of indigestion and colicky pains. In the horse we may distinguish two distinct forms of colic—spasmodic and flatulent.

Symptoms—Spasmodic colic.—The pain is not continuous, there are intervals of ease between the spasms during which the animal appears quite well until another spasm suddenly occurs. The case is generally violent, paws, stamps, kicks at its belly, lies or throws itself down, rolls, crouches in the loins when walking, stretches itself out as if trying to stale, looks round at the sides, sweats in patches or, in very severe cases, all over; the pulse is fast, the breathing hurried and distressed, the lining of the eye a bright red, the mouth dry, but the temperature remains normal. Many, or all of the symptoms, may be observed inside five minutes, and then there will be a cessation of pain and the animal will appear well till another sudden spasm occurs. As the attack progresses the pains get more frequent and longer and the rests shorter. When relief is obtained the symptoms disappear very quickly.

Flatulent or windy colic is due to fermentation of the food in the bowels, which become distended by the resulting gases. The belly is inflated, giving the animal an unnaturally rotund appearance, and the pain is continuous, though not so violent as in the spasmodic variety. The animal does not throw itself about so much, but appears somewhat sleepy, though uneasy and fidgety, scraping, wandering slowly round attempting to lie down but afraid to do so, while the pulse remains fast and the temperature is not altered.

In both varieties there is usually severe constipation during the whole of the attack. Treatment should be directed to two points, viz., the relief of the pain and stimulation of bowels. For the first, any of the following remedies may be given :—The animal should be walked about and hot fomentations applied to the belly and a chloral hydrate ball given for the immediate relief of the pain. To stimulate the action of the bowels copious enemas should be given every half-hour, and if the case is not relieved in two hours, a physic ball should be given. Other remedies for the relief of pain which may be administered and are likely to be procurable are: ginger, two teaspoonfuls; brandy, or other spirit, 4 ounces; turpentine, 1 or 2 ounces. The turpentine must be mixed with oil, 1 pint, or beaten up with eggs and milk. For cattle and camels the doses may be doubled.

In cattle the most common condition which produces colicky pains is "hoven," or a flatulent condition of the rumen, caused by fermentation of the food in it. The distension is most noticeable in the left flank, which is swollen and gives out a drum-like sound when tapped; the animal is uneasy, kicks at its belly and grunts from the pain.

In slight cases two carbonate of ammonia balls will give relief, and it is advisable to give a laxative—Epsom salts, 1 lb., or linseed oil, $1\frac{1}{2}$ pints.

Camels also suffer from this condition, and when in pain champ the jaws, kick and roll or simply press the belly firmly on the ground when lying. The same treatment as for cattle may be carried out.

Constipation is due to want of sufficient activity of the bowels and is to be avoided as being a contributory factor to indigestion and colic. Change of food, cooked or wet feeds, green fodder and enemas will overcome it, and if these prove insufficient small doses of physic may be given.

Crib-biting and wind-sucking.—Both these vices consist in the swallowing of air by the animal. The cribber lays hold of the manger or anything else within reach, arches and sets the muscles of his neck, and gives a grunt at the moment he swallows ; whilst the wind-sucker does the same thing without laying hold of anything with his teeth. These vicious habits are important from the fact that they give rise to loss of condition, indigestion, and colic, and various measures are adopted to prevent them. The wind-sucker, or flute bit, is probably the best device : it is simply a hollow iron bit with holes bored in it like a flute and prevents the animal sucking ; it should be worn constantly. A broad strap lined with soft felt passed fairly tightly round the top of the neck in front of the ears and buckled in front of the forehead will also prevent the habit for a time and can be worn even at work. When the horse's head is depressed to eat, it will be found that the strap becomes quite loose. He cannot, however, crib-bite or suck wind with the head in this position.

Debility cannot be considered a disease, but it is a condition which so frequently demands treatment on service that it must be given attention. The causes of weakness and loss of condition on service in all animals are want of food or want of time to consume it, overwork and exposure. To these must be added such diseases as cause subsequent weakness, particularly mange. As a rule, such cases only require a rest and judicious management as regards their food, and on this head it should be remembered that an exhausted, debilitated animal is unable to digest large amounts of food at a time ; the stomach and bowels are not equal to it ; and as a rule better results can be obtained by giving them moderate quantities of easily digested material and feeding them often. They should also be protected from all unnecessary exposure and kept clothed if the weather requires it. Medicinal treatment is of secondary importance to nursing in such cases.

Diarrhœa is met with on service as the result of overwork, exposure or unsuitable foods, and in the horse particularly is sometimes very troublesome. Dry foods will sometimes stop it, and a dose of oil or aloes is advisable to clear any irritating matter out of the bowels. In cases which are obstinate, both in constipation and diarrhœa, a strict attention to the feeding is the most effectual treatment as a rule. When it is persistent a carbonate of ammonia ball will frequently stop it.

Exhaustion from fatigue may be met with after heavy work. The symptoms are usually that the animal on reaching the journey's end lies down and shows no inclination to feed, though it may be unusually thirsty. Sometimes there is considerable sweating, but the body will be found cold and the pulse feeble. Clothe warmly, give a carbonate of ammonia ball. If possible, give a warm mash instead of the usual feed.

Lampas is inflammation of the gum behind the incisor teeth of the upper jaw of the horse. It is seen only in young animals when changing their teeth, and does not occur among adults. It may be noted that the horse's palate immediately behind the upper incisor teeth is often below the level of them, and this is frequently mistaken for lampas. When it does occur it is from food working up between the teeth, and the removal of this and soft feeding is all that is necessary.

Leeches are numerous in some pools and streams, and occasionally fasten on to the lips, and crawl up the nostrils and mouths of animals when drinking. Their presence may be suspected from the animal snuffling or bleeding occasionally from one nostril. Keep the patient without water for 24 hours, and then when it is offered the leech will probably appear and may be seized. When they are found on the skin the application of salt and water causes them to drop off. Any pool known to be infested with them should be avoided as a watering-place, or the water previously filtered through a cloth, or passed through wire mosquito netting, 18 meshes to the linear inch.

When pumps are used for infected pools or wells the intake orifice should be protected with this wire netting.

Lice may frequently be found on camels, and occasionally on horses, on which they cause considerable irritation. They may be readily detected on looking carefully into the coat, and the affected animals should be clipped, if possible, the hair burnt where it falls, the coat singed to destroy the lice and nits and then paraffin emulsion applied.

Lymphangitis (weed, Monday morning disease, big leg) of the hind legs may be found chiefly amongst hard-worked animals after a day's rest. The leg suddenly swells, and there may be knotted cords down the inside of the thighs; in severe cases the skin may ooze a little sticky fluid. This disease may be confounded with the swollen hind legs seen in some cases of glanders-farcy, from which it is distinguished by the suddenness of its appearance, generally after a rest, and the absence of ulcers (farcy buds). There is great pain and lameness.

Treatment.—Give a physic ball, exercise two or three times in the day for short periods. Horses known to get this disease should be given regular exercise and light feeding when not at work.

Nettle-rash may frequently be seen on the skin of the horse, the most usual situation being the side of the neck, but occasionally all over the body. It appears as flat swellings varying from a small bean to a patch as large as a plate in size, coming suddenly and generally disappearing in a few hours. It is usually of little importance, and a change of food and care not to water when the animal is heated is all that is necessary to ensure it not recurring. In febrile diseases, and especially surra, nettle-rash is a frequent symptom.

Rheumatism is not a frequent disease among animals, but may be observed on service when there is a great daily variation of temperature or after an outbreak of influenza. Horses and camels are liable to it, more particularly camels. Where the days are very hot and the nights equally cold, these animals are often observed to be "cold struck," stiff all over—a form of muscular rheumatism. Brisk rubbing with the hand or brush, and moderate exercise when the sun is warm, is generally sufficient treatment. When the affection attacks the joints these are swollen and painful and should be kept warm, and may be rubbed with liniment. In all cases the bowels should be kept soft and freely moved.

"Roaring" is the noise made during hard breathing by horses which have one side of their larynx paralysed. This makes the opening of the windpipe smaller than it should be, and so a "whistle" or "roar" is produced when breathing is quick and deep, as in galloping.

Staggers is a general term, which includes any condition which causes the horse suddenly to fall and be incapable of getting up again. The usual causes are pressure of the collar or breast harness on the large vessels of the neck, which causes a congestion of the brain, or the effect of the sun combined with work. This is the usual cause in a hot country, and the attacks are most frequent during damp, muggy weather, horses which pant and feel the heat being most likely to be affected. The ox and buffalo also feel the sun greatly when working, and will often lie down and decline to rise if they are exhausted; in such cases it is better not to attempt to make the animal continue work until recovered from the exhaustion. In horses the symptoms are a sudden reeling gait and generally falling, the hind-quarters being frequently quite paralysed ; some cases are quiet when down, others are very violent and require holding down.

Treatment.—Shade from the sun, cold water to head and spine, and keep as quiet as possible. When recovered give a purgative and soft feeding for some days. Cases of staggers not due to the above causes are usually from brain affections, and have to be cast.

Ticks are numerous in some localities, and may be killed by touching them with paraffin. If they are pulled off, the head sometimes remains in the skin and festers.

Worms in the bowels are very common in all animals, and when in excessive numbers may cause loss of condition. Green food aids in their expulsion, and turpentine, one ounce together with a dose of oil, may be given ; for the small round worms found in the rectum of horses an injection of salt (four ounces) in a bucket of warm water will be found useful.

Wounds and Injuries.

Under this heading the majority of cases which can be successfully dealt with in the lines on service occur, as many of them are, at the outset, slight, and if properly attended to the animals can be often kept at work.

Wounds may, for the purposes of description, be divided into (1) clean cut, (2) torn, (3) bruised, and (4) punctured :—

(1) Clean cut wounds, inflicted by a sharp-edged instrument, are simply a division of the skin and muscle without any loss of substance. They are characterized by the freedom with which they bleed and subsequent readiness with which they will heal ; the reason being that the blood-vessels, which are sharply divided without tearing or stretching, remain wide open, and when the bleeding has stopped the two cut surfaces, not being bruised or torn, come together readily and join with comparative quickness, there being no loss of substance to make good in the healing process.

(2) Torn wounds, made by blunt instruments, such as hooks, do not bleed quite so freely nor heal so readily as clean cut ones. This is owing to the fact that the parts are stretched considerably by the blunt edge of whatever causes the wound, which, being unable to cut clean, tears its way through, and consequently the blood-vessels, which are elastic, fly back like indiarubber and twist themselves into knots which stop the

bleeding. Again, as the flesh is torn, portions of it are so badly injured that they subsequently die, and as these dead pieces must come away before healing can be completed, this class of wounds takes a longer time to repair.

(3) Bruised wounds comprise many of the worst injuries met with, and are most difficult to treat successfully; for being caused by falls and blows from blunt objects, not only has the wound itself to be considered, but also the bruise which has been sustained, and this is often the most serious part of the injury. Under this heading are included such cases as broken knees, many saddle galls from pressure, treads, some over-reaches, and in fact all wounds which have been accompanied by a severe contusion. Bruised wounds bleed but little, but there is often considerable loss of skin, and the surrounding portions which have not been actually killed are so severely hurt that they subsequently die, and the wound which at first appeared a trifle will be larger and deeper after the lapse of a few days, the healing being thereby considerably retarded.

(4) Punctured wounds, so frequent in the feet of animals from treading on nails, sharp stones, etc., or from thorns entering the skin, are dangerous from the fact that the small opening in the horn or skin made by them closes immediately, and should any dirt or poison have been carried into the wound, it will create inflammation and matter will form; for this reason it is often necessary to enlarge the opening in order to cleanse thoroughly the wound beneath. On the other hand, if the penetrating object be perfectly clean, they may heal without any trouble at all, and they bleed but very slightly.

Wounds made by firearms vary according to the missile which inflicts them. A piece of shell makes a jagged hole, which is both bruised and torn, whilst a small-bore bullet will either puncture a little hole in the muscles and soft bones, or may make a large smashing injury if it encounters the resistance of a hard, solid bone.

The healing of wounds takes place in slightly different ways according to the class to which they belong, but in the main the process is similar in all. With clean-cut wounds there may, provided they are absolutely clean, be a direct joining of the severed surfaces, and the wound will then heal in a very few days, but, generally speaking, this is a result seldom obtainable in animals, because of the conditions under which their wounds are usually received. When, as in torn and bruised wounds, there is a certain amount of dead and dying skin or flesh around the wound, this comes away with the discharge from the surface before healing takes place, and in bruised wounds especially the amount which does so is sometimes considerable. From the sides and bottom of the wound there then grows a bright pink mass of granulations, which on reaching the level of the skin, hardens on the surface and forms a scar.

A scar is not skin but a good substitute for it; it is, however, more likely to be chafed or rubbed than skin, as it is neither so elastic nor strong.

Wounds of the surface of the skin only—grazes, for instance —generally heal under a scab, which is formed by the clotting of the slight quantity of bloody fluid which oozes from them, and under this dry cap the granulations grow till, when they are level, they push the scab off.

A perfectly healthy healing wound should be a bright pink, the surrounding edge whitish and without any matter discharging from it.

Discharges from wounds are caused either by dead or dying material which is in the wound, or by the growth of germs, and it must be distinctly understood that no such thing as what is popularly called a "healthy" discharge exists. All are harmful and should be got rid of by treatment as soon as possible.

Treatment of wounds.—The great principle in the successfu treatment of wounds may be summed up in the word "cleanliness." Cleanliness of the wound itself, of the dressings and the dresser are of the greatest importance, and although wounds will often heal in spite of dirt and bad treatment, they do so much quicker, better and more certainly when these points are strictly observed. Let it be understood a wound is not "healed" by any treatment; the treatment should keep it thoroughly clean and Nature repairs it. The danger of much so-called treatment must here be called attention to: the application of dirty dressings by dirty hands to wounds is frequently the means of spreading disease instead of stopping it, and the thorough and skilful use of soap and water is frequently of more benefit than such misapplied remedies.

Bleeding.—Stoppage of bleeding is the first point to be attended to if it is serious. In the majority of wounds it is not. Bleeding may be from an artery, a vein, or mixed. From an artery the blood is bright scarlet and spurts out in a jerky stream, each successive jerk corresponding to a beat of the heart; from a vein there is a steady flow of a darker red colour; mixed bleeding is what is commonly seen from ordinary wounds, and comes from the small vessels, which are numerous all over the body.

The readiest means of stopping bleeding is pressure, which may be carried out by tight bandaging above and below the wound, or by placing a pad on the wound and bandaging over it (the pad may be lint, tow, a folded cloth), or for severe bleeding a tourniquet may be applied (to a limb) above the wound. This may be improvised by tying a cord or strip of linen round the leg loosely, and then twisting a stick in it till it is so tight that it stops the circulation. It must be remembered that this severe pressure cannot be borne for long without causing the leg to swell, and should be removed as soon as possible, and for ordinary wounds a simple pad and bandage over is usually sufficient to control the flow. If there happens to be a large vessel cut and the end exposed, it should be tied round with a clean thread which has been soaked in an antiseptic. For wounds with a small opening, where a large vessel has been cut (usually inside the arm and thigh), a large pin may be stuck through both lips of the wound and a twist of tow or lint tied round it in a figure of 8.

Bleeding stops because the blood clots in the mouths of the wounded vessels, and this having happened, all outside clots should be cleared and the wound dressed with an antiseptic.

Antiseptics.—An antiseptic is an agent which either kills germs or prevents them from growing on wounds; many are known, and although some may be preferred to others for special purposes, it is not as a rule of so much importance which particular one is used as that it should be thoroughly and intelligently employed.

In their application it should be remembered that some of them are irritating substances which when used in too strong solutions burn the wounds and retard their rapid healing, and they should, therefore, always be employed as weak as is consistent with efficiency.

The most satisfactory first aid wound dressing is Tincture of Iodine. Weak solutions of the various coal tar preparations are also commonly used. They are excellent antiseptics, but should always be used with discretion. There is a general tendency to guess the strength of the dilution, a practice which cannot be too strongly condemned. The strength of coal tar preparations for wound dressing should not exceed 1 per cent., *i.e.*, $\frac{1}{100}$.

Washing wounds.—When a wound is perfectly healthy with no discharge, water should be used as little as possible, but at the same time with wounds in animals it is generally necessary to wash them or the surrounding parts thoroughly with soap and water, and they should be dried carefully afterwards. In dry, hot climates this cannot do harm, but in damp weather it should be avoided if possible and dry dressings employed. Having dressed the wounds, they should be covered with a piece of antiseptic lint or tow, and a sufficiently thick pad of the same to soak up discharges and prevent any dirt getting on them ; but if a bandage cannot be applied, it is better to cover them with a thin network of antiseptic cotton wool, which will stay on by itself.

To irrigate wounds constantly, take a tin or bucket, make a small hole in the bottom large enough to admit a stout string, run the string through and fill with water. The water will trickle constantly down the string, which should be loosely looped round the place required to be irrigated.

Bandaging over wounds should only be carried out where there is no chance of causing swelling, and care must be taken not to draw any one portion tighter than another. For the legs loose pyjamas tied with a running tape at top and bottom and suspended from the surcingle or a crupper are most useful.

Stitching wounds in animals should only be undertaken when the parts can be kept at rest, and the wound, needles, sutures and operator's hands are absolutely clean ; it should not be done when there is the likelihood of much swelling round the injury or when the edges are badly bruised ; and, in addition, it must be remembered that over many parts of the body animals are able to twitch their skins violently and so dislodge or tear the stitches. Stitches should be as few as possible, every stitch separate with a good hold on each side and not drawn so taut as to cause any tension on the skin. Generally speaking, most wounds do not require it, and it often does more harm than good when dirty materials and hands carry it out. Needles, and everything else used on wounds, should be thoroughly cleaned, and boiled or kept in an antiseptic solution to prevent any chance of their conveying germs from one wound to another.

Wounds near joints should be touched with hands and instruments as little as possible and should not be fomented, poulticed or probed. Every joint is surrounded by a thin air-tight bag, the inside of which manufactures " joint oil " to lubricate the surfaces of the bones. Should this be punctured, an " open joint " results, and the escaping joint oil may be found running from the wound and clotting in a thick yellowish white mass below it. This is a very serious condition, and is best relieved by a constant stream of cold water, or, better, perchloride of mercury lotion 1–2,000, running over it. Frequent dusting of powdered lime over an open joint will sometimes stop the escape of synovia or joint oil.

Maggots.—Occasionally wounds get fly-blown and maggots rapidly appear. Such may be recognized by the angry appearance of the edges, and if the bottom of the wound be carefully observed, movement of the maggots or a little bubbling on the surface can be seen. Pick out all that are visible and swab out the wound with a pledget of tow which has been dipped in a disinfectant or turpentine or plug the wound with calomel. Cover all wounds to keep off flies when they are troublesome.

Abscesses are collections of matter beneath the skin caused by germs; a boil is a familiar example. Whenever matter is forming there is considerable inflammation of the parts around, which become more and more swollen. The swelling gradually becomes pointed as the matter presses its way through the skin, which ultimately gives way and the abscess bursts.

Treatment.—Foment or poultice continually to soften the skin and allow the matter to press its way easily; when pointed and soft at the top the swelling may be opened. When opened, cease fomenting and treat as an ordinary wound.

Scalds and burns are not common. In slight cases the surface skin is raised in a blister, which, when broken, exposes a raw and very painful surface. Do not wash, but apply or dress with tannic acid powder. A mixture of equal parts of lime water and olive or linseed oil will relieve the pain; subsequently ordinary wound treatment.

Stings from hornets and wasps are only of importance when they interfere with the saddlery. When observed rest should be given, if possible, till the swelling subsides; if this is not feasible, the saddle pad should be chambered over the injury for a day or two. A weak solution of ammonia applied to the swelling will relieve the pain.

Contusions, bruises when the skin is unbroken, are not, as a rule, serious. On the legs, especially on the tendons, they may cause lameness; fomentation will relieve the pain and probably enable the animal to continue work, though the accompanying swelling may not subside for some time. On the back, and in any position where they are liable to be pressed on by the saddlery, they will rapidly become worse unless relieved of the pressure. Gentle hand massage of such swellings promotes absorption of the fluid causing them. On the limbs an excellent form of massage is that to be derived from play, on the part, of a column of water applied with the hosepipe where such is available.

Fractures of the limbs among shod horses and mules are frequent, and usually occur from the animal being kicked inside the arm and thigh or on the cannon bone by the one next to or in front of it. In these places the bones are covered by skin only and are very liable to crack when struck. If the bone is not seriously injured the swelling which accompanies the injury subsides in a few days, but if it is cracked or badly bruised there is usually a persisting flat swelling rather hard to the feel, and lameness. Even though cracked right through, the broken bones may not come apart, as they are covered with a very tough parchment-like skin, and may unite again if rested. Tie up the animal to prevent lying down, as in rising a great strain is placed on the bones ; keep standing till the swelling disappears and the case is quite sound. Antiseptics to the wound.

In cattle, fracture of the horns is not uncommon, and when occurring in slaughter animals, they should be at once killed for food, but in draught animals they require treatment. If the horn is pendulous but the skin unbroken, replace it in position and tie a flat piece of wood across both horns to keep it so ; if the skin is broken it is generally best to remove the horn altogether and treat the wound antiseptically, but when practicable the animal had better be converted into beef.

Injuries to the eyes are usually due to blows or to small objects getting stuck on the front of the eyeball. The eye turns milky white, is closed, and weeps. Apply an eye-shade so padded above the eye that the cloth of the shade stands out from the eyelids or place in a darkened loose box if available, oil below the eye to prevent tears making the skin sore, and apply weak boracic water. To remove anything from the front of the eye, wipe it firmly with a smooth cloth over the finger ; *don't poke anything into it.* To save camels' eyes being injured, long tent poles should be carried with spikes to the front, pointing slightly upwards and not protruding beyond the head. The poles should be lashed behind to splay the spikes outwards in front.

The eyelids of the camel are particularly liable to become inflamed, and for abscesses to form in them. They should be fomented, opened and treated with boric acid either in powder or lotion. The use of irritating lotions, such as carbolic acid and zinc, should be especially noted as not suitable for injuries in the neighbourhood of the eyes and mouth.

Injuries to mouth.—The tongue is sometimes cut by the snaffle being dragged across it, a twist of rope or chain placed in the mouth or through the horse getting its tongue over the bit. These wounds recover very rapidly if kept clean after feeding, but they generally leave a deformity of the tongue. The corners of the mouth are sometimes pinched between the snaffle and the first molar teeth ; this injury is aggravated if the tooth is sharp or rough. Boric acid lotion may be used as a dressing for them, but cleanliness is the main thing.

The bars of the mouth between the corner incisors and first molar teeth may be injured by the pressure of the portmouth bit, which, by allowing the tongue to escape through the port, exerts all its force on the bars. If the gum is merely bruised it will be found swollen, tender, and red, and the horse will probably be restive to handle, but a few days' rest from the bit will effect a cure. If, however, the jaw-bone *below* is bruised, or, as not unfrequently happens, is cracked, a *hole* will appear over the injury or possibly on the side of the jaw lower down, from which issues a fœtid discharge, the smell being characteristic of decaying bone, and an operation for its removal being frequently necessary. After the dead bone has been taken away the wound will heal rapidly.

Injuries to the nose.—The division between the nostrils is very apt to be injured in oxen and camels by the nose rope or stick which is passed through it, and if not attended to may become infested with maggots, and large pieces slough off. In the ox the cause is either too tight a nose rope or rough handling of it, and in the camel the practice of tying the nose rope to the animal in front is accountable for many injuries. Ordinary wound treatment and the addition of a drop or two of turpentine when maggots are present will be all that is required, provided the actual cause of the injury ceases. From the camel's nostril there occasionally issue large maggots which are not connected with wounds, and these are the larvæ (bots) of the gadfly of the animal.

Capped elbow is the term applied to the swelling which results from a bruise to the skin at the point of the elbow from lying on hard ground, sharp stones, and, in shod animals, sometimes on the heel of shoe. It also frequently occurs in India as a result of a horse kicking at the girth place with its hind foot to dislodge flies that settle in that area. In the horse it is most common. The camel is provided with a thickening of the skin at this point which usually protects it from injury ; but even this is not always sufficient. The symptoms are rapid swelling and inflammation of the skin, usually with a quantity of fluid beneath, and in very severe cases formation of any abscess ; it does not as a rule cause lameness, and the animal can generally be kept at work. Try and prevent re-injury by attention to the ground on which the animal rests ; in shod animals the inner quarter and heel of the shoe is sometimes removed. If the inflammation is very great, foment the place till it either bursts or the swelling gets smaller and keep the animal standing up to prevent re-injury. For the horse, a small sausage-shaped pillow, long enough to surround the pastern and about four inches in diameter, will be found to prevent the elbow touching the ground when lying down. As the enlargement gets older it becomes smaller and harder, but is always liable to re-injury.

Elbow brushing in the camel is a serious condition resulting from the friction of the elbow pad against the side in animals which are tied in at the elbow and whose toes are turned out. It is a constant trouble, and in animals at hard work impossible to prevent. No camel with any signs of it should be purchased for transport; such animals can be worked only for short journeys with light loads.

The chest pad of the camel and also any of the other horny pads on the elbow, stifle and knee are liable to be bruised and cut by contact with hard ground or rocks, and the injury is often aggravated by sand working into the fissures so caused, and matter not infrequently forms. When this happens care should be taken that there is a good opening for the matter to escape, and all channels from which it issues should be thoroughly syringed with an antiseptic. The most important detail, however, is to make sure that the wound is covered and protected from further injury, and this may be done by a soft pad of any material being fixed over the injured part. Tow, straw, bhoosa and sacking can always be obtained, and a large pillow with a hole in the centre will give ease and protection when the camel is lying down.

Broken knees are commonest among horses and mules, but working oxen also are liable to this injury. The term is used to include all injuries of the knee when the skin is broken, and these vary very greatly in severity. The skin on the knee-joint is very thick and freely movable over the parts beneath, and probably the majority of broken knees do not cut through its actual thickness; but the severity of the blow received is so great that large pieces of surrounding skin are often so badly bruised that they die and come away in the discharge; so that a wound originally the size of a half-crown may in a week's time be twice as large and proportionately deeper. Immediately beneath the skin are the tendons running over the front of the joint, and beneath them again the joint oil-bag and joint itself.

The causes of broken knees are—

(1) bad action;

(2) animals being tired from overloading or overdriving; especially is this the cause when they are not in good condition;

(3) long toes or too thick shoes, which have the same effect;

(4) saddle pressure from the burr of the side bar pressing on to and interfering with the action of the shoulder-blade; this shortens the stride and induces stumbling.

Attention to the two last points before starting on a march will often obviate this particular accident, which when it once occurs, is sometimes beyond remedy, especially on service.

Treatment.—General wound treatment, absolute cleanliness. *The place should not be probed.* If joint oil escapes from the wound, run a stream of cold water over it constantly until it ceases. Attention to saddle fitting, and shoeing and condition will prevent many of these accidents.

Speedy cutting, brushing and cutting.—These three accidents are all caused by the animal striking the inside of the leg with the opposite foot or shoe.

Speedy cutting occurs just under the knee on the inside, and is caused at the gallop by a blow from the inside toe of the opposite foot, horses with crooked legs being most likely to do it. There may or may not be an actual cut in the skin, but, in any case, the bruise is the most serious part of the injury. The leg swells, is very painful, and when the blow is often repeated a permanent enlargement remains. If very painful, foment and afterwards apply a cold bandage; shoe the opposite foot as close as possible at the inside toe and quarter, rasping off some of the wall if necessary, and rounding off the lower edge of the web of the shoe. This injury is only likely to occur in riding horses, and those which do it habitually are unsafe. *Brushing* is done at the trot and walk, and the inside of the fetlock is the point struck. It may be caused accidentally from animals being out of condition and overtired, by the shoes being too wide inside, or may be due to the conformation of the legs, those in which the toes turn outwards from the fetlocks being most likely to be injured. Protecting boots or pads may be made of numnah or blanket and tied round the leg above the fetlock, care being taken not to bind the string or strap so tight as to make the leg swell. For turned-out toes, brushing shoes should be fitted, these being thicker and narrower on the inside quarter and heel and well bevelled under the foot ("feather-edged"). The wound itself requires but slight attention, provided the cause be removed and the place protected from further injury, and it only becomes serious when from constant repetition of the blow the insides of the fetlock get enlarged. *Cutting* or low brushing occurs at the walk from the opposite foot striking the inside of the coronet just where the horn and hoof join, and is not as a rule serious.

Condition is the best preventive of these injuries.

Treads and overreaches are practically the same injury, with the exception that the overreach is caused by the animal striking its own foreleg with the hind foot, whereas the tread may be inflicted by another animal. Overreaches occur either above the fetlock of the foreleg (high overreach) or on the side of the coronet and back of the heels (low overreach) ; treads are generally found on the outside of the coronets and sometimes above the fetlock in the hind legs. When severe they are most serious injuries, the tendons being cut through, or the coronets severely lacerated and bruised. In all cases, the wound being inflicted by a downward blow, there is generally an underlip of skin hanging from it, and in bandaging it care should be taken to do so in such a manner that the lip is retained in its proper position, where it will sometimes heal, but should it be hanging by a small neck of skin only, it is better to cut it off at the outset. Treatment should consist of the application of antiseptics, and as a rule it will be found possible to bandage these injuries, which should be done from below upwards in order to keep the cut ends in position as described above, sufficiently thick pads of tow being placed under the bandages to prevent any undue pressure on the injured skin.

Many treads and overreaches occur when horses are suddenly and unexpectedly checked or when one rank rides into another, especially trotting down crowded and narrow roads. Extra care on these occasions will prevent a fair proportion.

Sprains may, of course, occur under all conditions, but they are not so common in transport animals as in those whose work is faster.

In the camel, sprain of the muscles inside the thigh occurs from " splitting," *i.e.*, the hind legs slipping apart sideways on wet, slippery ground. This is so frequent an accident that it is advisable when camels are likely to slip, owing to the ground and weather, to tie their hind legs together sufficiently close to prevent them spreading widely, but allowing them play enough to walk.

Sprains of tendons and ligaments are most frequent in the back tendons between the knee and fetlock of the horse's and mule's forelegs, and may also occur in the camel and working ox ; the fetlocks and hocks are also liable to strains from slips and stumbles in bad ground. In all cases the general symptoms of sprains are the same ; swelling of the part, with pain on pressure, and unless these are present, the cause of lameness should be sought elsewhere. In addition, the part is hot, compared with the rest of the leg, but this is not so easily detected as the former signs. Lameness is always present, but many slight cases can work perfectly well at a walk when required to do so.

Sprains of back tendons, if taken at once, may have a pressure bandage put on them. This is applied as follows: a thick pillow of wadding, cotton wool or tow is placed evenly 'round the leg, care being taken to have it so thick that the subsequent pressure of the bandage will not injure the skin. Over this is wound, as tightly and evenly as possible, an ordinary bandage. It should exert an even, firm pressure over the whole of the injured surface and extend well above and below it. The padding should also project at each end to ensure that there is no cutting of the skin by the edges of the bandage. When this becomes loose it shows that the swelling is reduced and should be replaced. It is a simple and effective way of treating sprains when taken early and properly applied, but any treatment of severe sprains necessitates long rest from work.

Animals in *condition* are much less liable to all classes of sprain than those not fit.

Cracked heels are seen in the horse and mule in the hollow of the heel as painful transverse fissures having thickened edges. Lameness is present. The cause is usually washing and not thoroughly drying the heels or any condition exposing the animal to constantly wet heels.

Treatment.—The application of a lubricating yet astringent dressing such as glycerine and zinc oxide brings about healing of the fissures provided other conditions are favourable.

Greasy heels.—An eczematous condition of the heels and of the skin at the back of the fetlock affecting especially heavy horses. The skin surface has an inflamed weeping appearance, and after a time the skin may be very much thickened.

Treatment.—In slight cases thoroughly wash and dry the part and apply mild astringent applications. Serious cases should be treated in veterinary hospitals but frequently they do not yield readily to treatment.

Mud fever.—Is a somewhat similar condition affecting the skin of the abdomen and of the hind legs. It is due to washing off mud in a perfunctory manner and afterwards not drying the parts thoroughly. The mud and discharge cake on the skin to form a firm, scabby surface.

Prevention.—Mud should be left on until dry, when it may be readily and thoroughly brushed off.

Treatment.—Similar to that for greasy heels.

Tail sloughing is frequent among camels, and is sometimes seen in horses and elephants. Among camels the practice of tying the leading rope of the animal behind to the tail of the one in front is responsible for the injury, as the pressure is very severe whenever the hinder one lags. Any having this injury should be placed at the rear of the line and have the wound treated antiseptically and protected from flies. It occurs in horses when for any reason a bandage has been applied to the tail too tightly and left on too long.

Hip down, fracture of the point of the hips, may occur from animals falling sideways when playing with their neighbours in the lines or from being injured when passing through a stable doorway. It may be detected by standing behind, when the injured hip looks rounder than its fellow. Such cases may be lame for a considerable time, and should be kept standing up until sound to prevent any split pieces of bone from becoming separated by the effort of rising and lying down. They usually make good recoveries, and the slighter cases may only be sick a short time. It is, of course, safer when practicable to give them all a long rest.

Stifle slip, dislocation of the stifle cap, may occur in the horse, mule and camel from slipping, straining on heel ropes or when struggling to pull a load. It is not common in the Service, as it most frequently occurs among very young animals or those out of condition. The leg is dragged behind with the front of the foot on the ground and cannot be bent or brought forward ; there is an enlargement on the outside of the stifle caused by the displaced bone.

Treatment.—Put a rope round the pastern and pull the foot forwards, backing the animal at the same time and push the displaced bone forwards and slightly downwards into its place. When replaced tie the foot forward either to a surcingle or a rope passed round the neck for 24 hours.

Capped hock is the same class of injury to the point of the hock as takes place at the point of the elbow when bruised (*see* Capped Elbow). It is caused by kicking, and rarely incapacitates the animal for work.

Heel galls, from getting the heels over the picket rope or head rope or tied up in the heel rope, may occur in both fore and hind feet, those caused by getting the hind feet over the picket or head rope being much the most severe. They should be cleaned and treated antiseptically. If much inflamed a warm-water bandage will give relief from the pain, and daily exercise should be enforced to ensure the skin being kept supple during the healing process, or it may subsequently crack across as badly as before. They may be prevented by attention to the length of head and heel ropes when picketing.

Injuries to the Feet.

Pricks or stabs occur from nails being driven into the sensitive parts of the foot or from accidental injury from sharp stones, etc., on the road. *Presses* are caused from nails being driven too near the sensitive parts and causing inflammation of them by pressure.

The symptoms caused by these injuries are lameness, heat of the feet and pain on pressure with pincers; when very severe the horse may rest the foot on the toe and the pain may be so great that the appetite fails. The cause should be thoroughly searched for as follows:—Press the foot with pincers at intervals of about $1\frac{1}{2}$ in., commencing at one heel and going all round; then try each side of the frog in the same manner: grip plenty of horn between the pincers, and especially try over all the nail holes. Next, clean the horn with the rasp, or take off a thin shave with the knife and see if any injury or coarse nail hole can be detected; if not, search every nail hole down by removing the horn from its inner side until it is certain that it comes out of the hoof without causing injury. The sole, especially at the seat of corn and both sides and cleft of the frog, should also be cleaned and thoroughly examined when the cause of lameness is suspected to be in the foot and cannot be located easily.

"*Matter in the foot*" may result from any penetrating injury, and is a common result of such. It is generally produced by dirty objects which cause the wounds to fester although the hole made in the horn may have closed completely. Unless discovered and let out from the ground surface of the foot, it gradually works its way up to and out at the coronet. The pain caused by the formation of matter in the foot is intense, the animal is extremely lame and the foot hot. The quantity may be trifling, and the colour is greyish. A good opening should be made in the horn to admit of a free discharge, and the wound syringed with antiseptics, care being taken to keep it open till all discharge has ceased, and dirt should be excluded by a tow pad and boot on the foot. The foot may be stood in warm water to relieve the pain and soften the horn. To retain dressings in the sole of the foot a piece of tin may be slipped under the edges of the shoe and pressed flat, and this will be found useful when boots are not available and the injury is to the sole or frog.

Bruises to the sole are not common when the horn of the sole is left uncut, as it is usually sufficiently thick to protect the sensitive parts effectively; they may, however, occur in stony ground and when animals are heavily loaded. They may be detected by pain on pressure over the injury and by a red stain on the horn caused by the blood from the bruised fleshy sole soaking through. A leather sole nailed on beneath the shoe is usually sufficient to give relief, and it is important not to pare out the sole, but allow it to grow its full thickness.

Corns are bruises to the fleshy sole at the angle of the heel between the wall and the bar. They are caused by any undue pressure on this part, and both low flat-heeled feet and narrow high-heeled ones are liable to them.

Short or narrow-heeled shoes which do not take a fair bearing on wall and bar, or the wearing of shoes for too long a time without removal, so that they are carried forward by the growth of the foot and become short, are all frequent causes of this injury.

Treatment of corns should, in the first instance, be directed to the removal of the pressure, whatever may be its cause. In slight cases removal of a small portion of the bruised horn and seating of the heel of the shoe may be found sufficient, but the more serious require poulticing or soaking in hot water, and where the bruise has been so severe that matter has gathered in the heel (festering corn), this must be given a free exit and subsequently treated antiseptically. A broad bearing shoe with the heel well seated, or a three-quarter shoe, are the most serviceable for such cases.

The feet of working oxen which are shod are liable to pricks and the soles may be bruised; they are also likely to suffer from sores between the claws when working or standing in wet ground for any length of time, and in some cases these may extend beneath the horn at the coronet. The principles of treatment are the same in all cases; any horn which is underrun should be removed, a free opening given to any matter, and the wounds treated with antiseptics. A figure-of-eight bandage with a pad of tow underneath may be conveniently bound between the claws, and should not be too tight or so bulky as to spread them much.

The feet of the camel are liable to sustain injuries from sharp stones when marching, and cracks sometimes extend through the horny pad or the sole of the foot and cause severe lameness. These should be thoroughly cleaned, and if underrun by matter, sufficient of the horny pad removed to allow free drainage, subsequent treatment being as for all other injuries.

In addition to the antiseptic dressings previously mentioned, Stockholm tar should be added as a very useful one in wounds of the foot. It should be applied with a pad of tow after the wounds have ceased to discharge and are healing, until the horn has again grown hard over the injured parts.

Foot soreness may occur in all animals, and is due to the horn of the sole in horses, mules, and oxen, and the horny pad of the foot in camels and elephants being worn unduly thin. This may be caused by working on wet or stony roads or over-marching. In the case ot those which can be shod, that is the obvious remedy, the shoes being seated to avoid pressure on the soles. In the elephant and camel less work is the only remedy, and the feet may be hardened by an application of " chobe " (tarry preparation).

LAMENESS.

Lameness may best be detected at a slow trot when the animal is not excited, and it should be led straight away from and back towards the person examining it. When any animal is lame, it takes as much weight as possible off the injured or painful limb and places it on the opposite one. The extra weight placed on the sound side gives an uneven appearance to the action. If lame of a foreleg the animal will be seen to " bob " its head, when trotting towards you, every time the sound foot comes on to the ground. If lame behind, you will see that the hock of the sound leg rises higher and dips lower than that of the lame one when the animal is trotting away from you. In each case the bobbing of the head and the dipping of the hock are caused by the extra weight placed on the sound side. Animals lame of both fore or both hind legs take short strides with both, " potter " along instead of striding out. The disability is most difficult to detect when the lameness is not severe. An animal very lame of one foreleg appears to be lame of the diagonal hind leg also when trotting away ; this appearance is deceptive to the beginner, and practice alone will enable any one to recognize it.

In horses the majority of causes of lameness occur at or below the knee and hock ; lameness in the shoulder and hip are comparatively rare, and the foot is the most common seat. In all cases where no apparent and sufficient cause of trouble can be detected, the foot should be thoroughly examined, and the case regarded as foot lameness till the cause is discovered.

Splints are bony growths on the cannon bones of horses and mules, chiefly on the insides of the forelegs, but they may occur on the outside. They lame as a rule only whilst they are growing, and become callous as they get older ; in animals which work slowly they are not a common cause of lameness, and they do not usually cause trouble in animals over six years old.

Sore shins may occasionally occur after severe marches. The lower part of the cannon bones are painful and hot and the animal lame ; there may even be some swelling over the place, which is "doughy" to the feel. Hot-water applications until the pain is gone, followed by a cold bandage, will relieve the condition, and rest is essential till recovery is complete.

Ring bones are bony enlargements of the pasterns anywhere between the fetlock and coronet, and they occur on all four legs. In mules and horses, which are constantly shackled by the hind legs, they are often seen as a result of the irritation of the hobble, and this particular variety is much less serious than when they occur in the forelegs. They may occasion severe and continuous lameness which incapacitates the animal for all fast work, though often capable of working at a walk, and in consequence they may not always militate against usefulness for transport.

Side bones are occasioned by the cartilages at the sides of the foot being converted into bone, and are most common among heavy horses. They seldom prevent animals working at a slow pace, but may occasionally cause lameness after unusually long marches, when the feet should be wrapped in cold-water cloths. The cause of lameness from side bone is the concussion caused by the want of spring in the bony cartilages, and, as before remarked, animals not required for fast work may be perfectly useful notwithstanding their presence.

Navicular disease is the cause of a form of chronic lameness almost invariably confined to the forefeet. It is due to an inflammatory condition of the navicular bone and its surrounding structures. Horses suffering from navicular disease usually have contracted heels and a shrunken frog, and when standing at rest, the affected foot is "pointed," *i.e.*, it is placed in a position slightly in advance of the other forefoot with the heel only just touching the ground.

In the early stages the lameness may be intermittent, or it may wear off after the horse has had a little exercise.

Laminitis, "fever in the feet," is an inflamed condition of the fleshy leaves which are found beneath the wall of the hoof and covering the coffin bone. It is generally caused by over-exertion and concussion, particularly when the animal is in an unfit state to undergo it ; horses which have been at rest for any time, especially if they have been overfed, being very likely to suffer if suddenly put to heavy work. In animals which are unshod it is often a sequel to foot-soreness, and after a sea voyage it is of frequent occurrence unless care is taken to graduate the exercise given immediately on landing. The symptoms are heat and pain in the feet, usually both forefeet, and severe lameness ; the patient stands still and is unwilling to pick up either foot as the pain in the other is thereby greatly increased, and when forced to move the heels are markedly brought to the ground first. The blood-vessels at the fetlock may be felt throbbing, and in severe cases the appetite fails and there is fever.

Treatment.—Give a physic ball and sloppy bran and green food only. Take off the shoes and replace them by a pair of thick, wide-seated bar shoes; make the animal take a little exercise several times a day, a few minutes at a time, and keep cold swabs over the hoofs. If the animal will lie down and rest make it comfortable. In all cases keep the bowels freely open. After recovery, continue to use broad-seated shoes for a considerable time.

Condition is the sole preventive for laminitis on service.

In bad cases of fever in the feet, the coffin bone is often forced downwards and bulges the sole of the foot (dropped sole) just in front of the point of the frog, and as such cases are not sufficiently useful to be kept in the service, they are cast or destroyed.

Sand-crack is a splitting of the horn of the wall of the hoof which occurs at the inside quarter of the forefeet and occasionally at the toe of the hind feet. It commences at the coronet and extends downwards, the depth of the crack being right through the thickness of the wall into the fleshy leaves beneath. It occasions lameness from the pain caused by the split closing on the sensitive parts beneath, and may sometimes cause bleeding.

A simple method of treatment for sand-crack is first to clip the hair off the coronet immediately above the crack, then make a horizontal line 1 in. long and about ¼ in. deep with a hot iron just below the coronary band, through the upper end of the crack.

Afterwards a blister of 1–8 red iodide of mercury should be applied to the coronary band above the sand-crack.

Before shoeing, the ground surface of the foot where the sand-crack would normally end should be cut away to relieve pressure.

Seedy toe is a separation between the inner and outer layer of the horn of the wall of the hoof generally occurring at the toe. The hollow thus formed is filled with a powdery, greasy substance.

Treatment.—Consists in rasping away the detached outer horn, and after cleaning and dressing the part with Stockholm tar blistering the coronet to expedite the growth of horn.

Thrush is an inflammation of the fleshy frog which results in a stinking discharge from the cleft; it is caused by dirt, wet, and neglect, and is particularly liable to occur in shod animals whose frogs are cut about. When severe it may cause lameness. The cleft of the frog should be thoroughly cleaned, and a dressing of boric powder applied dry will stop the discharge. Cleanliness, dryness, and frog pressure are the points which demand particular attention. It is largely preventable.

Bog spavin is a distension of the joint oil-bag of the hock at the inner and upper part of the joint; it rarely causes lameness except in animals which are worked with heavy loads in a hilly country, when it becomes a somewhat frequent cause of trouble. When causing lameness the enlargement will be found tense and hot and sometimes painful to the touch, and should be fomented till the pain disappears.

Bone spavin is the growing together of the small bones at the inner and lower part of the hock, so that they become a solid mass; the enlargement caused by it may be most easily observed by comparing the hocks one with another, standing outside each foreleg in turn to look at the insides of the hocks, or it may be felt by the hand. When once the bones have grown firmly together it does not often incapacitate animals from working, nor does it always cause lameness; when it does there is usually a dragging of the toe of the affected limb.

Curb is a sprain of a ligament at the back of the hock, about 4 or 5 in. below the point, and may be best observed by standing at the side of the animal. It usually causes lameness when it first occurs, and the place is swollen and painful, but subsequently it rarely causes trouble.

Wind galls are enlargements of the joint oil-bags above and at the sides of the fetlocks, where they may be seen as small, round, soft swellings, which are easily compressed and painless. They rarely occasion lameness, and most hard-worked animals have them, but they may become inflamed if the animal brushes them.

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