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BACKGROUND TO MODERN THOUGHT

Professor of Education in the University of Tasmania, Mr. Hardie was born in Scotland, and was educated at Queen's Park School, Glasgow, and Magdalene College, Cambridge. After obtaining a first-class in both the Moral Science Tripos and the Mathematical Tripos he was elected to a research fellowship at Harvard. He is the author of *Truth and Fallacy in Educational Theory* and of a number of articles in philosophical journals.

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PREFACE

MANY factors are responsible for the situation in which man has found himself in the twentieth century, but one of the most important of these factors is the power of certain ideas which have originated in the past. It has seemed to me for some time that there was need of a book which would give a short account of the essence of these ideas and of their relevance to the present time. It may be that in attempting to be brief I have exaggerated one side of the story, but I would urge a hostile critic to remember Mark Twain: "The worst of me is that I exaggerate so; it is the only way I can approximate to the truth."

My obligations to those who have written on different aspects of the history of European Civilization are too numerous to detail, but I should like to make special mention of A. N. Whitehead and G. G. Coulton. I should also like to express my thanks to Professor A. E. Heath of University College, Swansea, and to Mr. Adam Gowans Whyte of the Rationalist Press Association, who suggested a number of improvements. For any mistakes or inaccuracies which remain, however, I alone am responsible.

Some paragraphs of Chapters XVI and XVII appeared in an article which I wrote for *Philosophy* in July, 1944, and I am grateful to the editor of that journal for permission to make use of them here.

C. D. H.

February, 1947.

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CHAPTER I

INTRODUCTION

" Begin at the beginning," the King said, gravely, " and go on till you come to the end: then stop."—LEWIS CARROLL.

IT is estimated by astronomers that the earth has existed for about two thousand million years. Palæontologists assure us that living matter has inhabited it for about five hundred million years, during the last few hundred thousand of which some of that living matter has had characteristics distinctive of human life. These first ancestors of ours were probably partly arboreal in habit, lived on uncooked fruits and vegetables mainly in tropical climates, and possessed nothing whatever in the way of arts and crafts. At the end of a period extending at least over a hundred thousand years we find, however, a creature with a very much larger brain who lived in huts, clad himself in the skins of animals, and who created for his æsthetic enjoyment some sculpture and painting. This remarkable transformation seems to have been brought about mainly by three practical achievements—the development of articulate speech, the discovery of the use of fire, and the invention of the bow and arrow.

The importance of the development of speech lies in the fact that human beings can be educated by precept as well as by example. Animals in general learn by being " conditioned," by " trial and error," and possibly by " example." Human beings certainly learn many things by these methods, but they learn also from communication with other human beings. In this way each individual can acquire knowledge at

an infinitely quicker rate, and with much less danger, than would be possible if communication with his fellows were denied him. It is possible for a parent to tell a child what to do in different situations where the child's life might be threatened, whereas an animal can at best attempt to shield its young once the danger is actually present. The discovery of the uses of fire can have been hardly less important. Mankind was enabled to move into colder but more stimulating climates, and to include meat and fish in his diet. We now know that these changes were probably of more significance than at first sight they appear. Progress depends so much on the influences of the environment that it is quite possible the human race would have been extinct by this time had it not been able to move to climates less enervating than those in which it had its origin. Similarly the invention of the bow and arrow enabled man not only to add to the variety and value of his food supply, but also to defend himself against beasts of prey. It also provided him with skins of animals to keep himself warm as he wandered into colder and colder lands.

At the end of this period mankind was ready for one of the most important changes that has ever occurred on the earth's surface. Probably not much more than ten thousand years ago mankind (at least in Europe) began to practise a rudimentary kind of agriculture and to domesticate animals. The day of the hunting tribe thus began to pass and the day of the settled agricultural community dawned, in which men kept herds of animals in preference to hunting for them and grew plants and crops in preference to searching for them. Within the next five thousand years or so this revolution had rendered it possible to produce a surplus of foodstuffs, whereby certain classes of individuals—specialized craftsmen, priests, traders—could be supported although they did not themselves contribute to the production of food. In this way stable urban civilizations grew up in which for the

first time a large number of human beings shared a common life. Whereas previously it had not been possible for more than a few people to live together in the same tribe, the new method of obtaining food meant that very many more could be provided for.

This new type of life, however, inevitably raised many new problems. In a small tribe any disputes that arose could be settled more or less by common-sense. But when the tribe becomes larger some form of government is necessary to settle the difficult questions that arise about the relation of different groups within the tribe and about the ownership of land, animals, and the means of production. For thousands of years such problems remained largely unsolved; indeed, it is only in the recent past that the dim outlines of a satisfactory solution have been envisaged.

About four of these early societies we now know a small amount—namely, those which flourished in China and in the valleys of the Euphrates, Nile, and Indus. The knowledge is necessarily fragmentary, for it depends not only on the chance that some records (sculptures, tombs, etc.) should have survived, but also on the chance that our interpretation of these records at the present time should be correct. But we do know enough about them to be confident that for hundreds of years a state of civilization was achieved in which life flourished with a moderate degree of comfort. Such knowledge is perhaps of some consolation to us at the present time, when we appear to be confronted with the problem of creating a stable international industrial society. It took hundreds of thousands of years to create the hunting tribe, but only about five thousand years to establish settled agricultural communities. These in turn made possible the development of cities with classes of specialized workers living on the produce of the adjoining land. Another five thousand years have now elapsed since the earliest of these cities, and within

the last hundred years or so it has become evident that mankind is entering on yet another stage in his development—the creation of an industrial civilization based on scientific knowledge. Whether he will be successful or not it is yet too early to say—two world wars have shown that a stable form of it throughout the world will be difficult to achieve—but there are many signs, especially the changes of the last twenty years in Russia, which give ground for great hope.

I have suggested that the early development of man from a state of savagery to the urban civilizations of Egypt and Babylonia was due to a very few important achievements—the use of spoken language, of fire, of the bow and arrow, and, perhaps most important of all, the practice of agriculture. What about the development of man since these early urban civilizations? Has he done anything comparable to these fundamental achievements? Although we know a great deal about what has happened since then, for our historical knowledge now goes back about three thousand years, it is perhaps salutary to remember what a very small fraction of the earth's history is covered by such knowledge. If we may use a form of comparison suggested by the late Sir James Jeans, and compare the age of the earth with the duration of life of the average Englishman (about twenty thousand days), then the age of human life upon the earth must be compared with (at most) ten days of the Englishman's life, and the age of history with less than an hour. Yet within this last hour, indeed in the last five minutes of it, it seems to me that there is one thing man has accomplished which is even more remarkable than any of his previous achievements. This is the development of scientific knowledge. Whether progress in any other sphere, such as art or ethics, has taken place at all since the dawn of history seems to me much more doubtful, but, whether it has or not, I do not think it is likely to be denied that the changes which have come over human life between the civilization of Egypt and

the present day are due more to the development of scientific ideas than to anything else. In other words, it is only by the progressive acquisition and dissemination of scientific knowledge that we can truthfully be said to stand on the shoulders of our ancestors.

For progress in scientific thought to have been possible, however, it was necessary that three additional inventions should be made—the invention of a system of writing and, later on, the inventions of the mariner's compass and of the printing-press. The mariner's compass supplied an almost miraculous guide across the surface of the earth, and enabled communication to be set up between regions which had hitherto been completely isolated. The printing-press enabled knowledge to be disseminated with a speed and cheapness previously unimagined. Yet neither of these was as epoch-making as the invention of a system of writing by which man could transmit a record of his actions and thoughts to all posterity. It was this invention which made possible that accumulation of knowledge concerning nature, religion, and social organization which we call history.

It is, perhaps, easy for us to dismiss the whole question of devising a written language by saying that all that is necessary is that meaning should be attached to certain things. But what does this imply? The commonest things to which meaning has been attached in the past are, of course, marks. For example, to the mark " cat " everyone who knows English attaches a certain meaning, and it is therefore part of a written language. It is in fact what is called a word, but it must be remembered that the word " word " is ambiguous, for it may mean " mark " or it may mean " symbol." In the former sense—that in which it is equivalent to " mark "—there are several words " the " on this page. But in the other sense—that in which " word " is equivalent to " symbol "—there is only one word " the " on this page. This distinction was first explicitly drawn by the American logician Peirce, who

used " token word " for the first and " type word " for the second sense. The latter is the more usual use. It is type word that is meant when it is said, for example, that Basic English has a vocabulary of eight hundred and fifty words. It is, nevertheless, true that type words are logically dependent on token words. For token words are grouped into one type by the relation of physical similarity or by convention. Hence " He wrote the word ' cat ' ten minutes ago " is equivalent to " He wrote a token word ten minutes ago which has the relation of similarity to the token word ' cat.' " The way in which meaning is usually attached to a given token is to give a set of rules or regulations which must be satisfied before any token similar to or conventionally associated with the given one can be used. These rules may then be considered to give a definition of the type word which has the given token word as an " instance."

Many of the regulations governing the use of words defined in this way will refer to things we can see or touch. Thus the set of rules which must be satisfied for the use of the type word " cat " will refer to those sense impressions which we normally associate with the word " cat." But it is possible to put words together in such a way that they do not refer to anything that can be perceived by the senses, and the strange thing is that some such words, or groups of words, seem to have much more influence over the behaviour of human beings than those that do refer to things that can be seen or touched. Thus people are quite willing to kill each other because of God, or Freedom, or Patriotism—they very rarely kill each other because of cats or oysters. Hence while it is true that the great triumphs of the human race, as exemplified in science, are due to the communication made possible by means of a written language, it must be remembered that so are some of the most tragic blunders.

It is often said that the present age is a period of

transition between two stages of civilization. From the sketch which has just been given it will be seen that in some ways this is a misleading point of view. If we divide the period of human life upon the earth into different stages (and it is sometimes convenient to do so, although it must be remembered that the stages may overlap by thousands of years), the first stage can most suitably be taken to be that period during which the fundamental discoveries of articulate speech, of the use of fire, and of the bow and arrow were made. The second stage saw the development of agricultural communities, which in their turn made possible the growth of settled urban societies. The third stage may be taken to begin with the invention of writing and to terminate with those of printing and of the mariner's compass. At last the time had become ripe for yet a fourth stage—the one in which we are now living and in which mankind should reach by far its greatest triumphs. It is characterized by an unparalleled extension of scientific knowledge. In the following chapters I shall try to outline the way in which certain ideas have developed during the last two of these stages—those ideas which seem to me to have been largely responsible for this progress of the human race, and which have enabled man to stand at last on Mount Pisgah and look into the promised land.

CHAPTER II

THE CONTRIBUTION OF EARLY GREECE

Bacon speaks highly of Democritus, who enjoys the double advantage over Aristotle that we know much less about him and that his admirers never succeeded in making him a public nuisance.—C. D. BROAD.

ALTHOUGH the present age of science is most conveniently taken to begin about the sixteenth century, the early Greeks were the first to formulate some of the problems, and their work exercised considerable influence for two thousand years. It is true that they owed a great deal to the Babylonians and still more to the Egyptians. From the former they got many of their astronomical ideas, and from the latter they obtained much of their medicine and geometry. Yet it was the Greeks who first subjected their knowledge to a rational examination and who first made explicit some of the characteristics of scientific method. Foremost among the early Greek thinkers was Thales of Miletus, who lived at the beginning of the sixth century B.C., and the problem which has been generally associated with his name is the problem of change. Among all the changes in the natural world which we see around us, is there any constant universal substance underlying them? Thales answered this in the affirmative and identified the universal element with water.

Early scientific speculations such as that are noteworthy contributions in the history of thought for a number of reasons. In the first place, they are a deliberate attempt to exclude the supernatural from a rational explanation of things. Unfortunately, after

more than two thousand years, the lesson which they tried to teach has not been fully learned, and we still find some men of science willing to use the supernatural when no scientific explanation is available. It cannot be too strongly emphasized that ever since the days of the early Greeks the ideal of science has been opposed to that, and hence, ultimately, opposed to the ideal of religion in so far as the latter attempts to give a supernatural account of the world. In practice, of course, scientific knowledge has fallen (and still falls) considerably short of its ideal, with the result that it is possible for some people to assert, without contradiction, that all events are not scientifically explicable. I shall return to this question in Chapter XVII in connection with some recent developments in physics, and wish to draw attention here merely to the fact that the rejection of the supernatural has been a characteristic of scientific thought from the beginning.

Another aspect of scientific method which these early speculations exhibit is that they are not a priori generalizations about the nature of things, but are essentially inductive. It is probable that Thales was impressed by such facts as that the food of animals and plants is moist, by evaporation, and so on.[1] Such a generalization may appear somewhat childish to us at the present time, but it is the first induction of really wide generality, of which we have record, to have been made on the basis of examining a few instances.

Yet a third way in which these early speculations are worthy of note is that they make it clear our senses are not always to be trusted, and hence imply a distinction which has played a great part in human thinking—the distinction between a thing and its properties. The different experiences which we get from stone and

[1] Aristotle puts forward two suggestions to explain the choice of water as the universal substance. The first is that moisture is necessary for the nourishment of organisms; while the second is that every animal's life begins in seminal fluid. Aristotle, *Metaphysics* A, 983b22–7.

iron, for example, are to be explained, according to Thales, by the fact that the substance water has many different properties, which, when experienced by our senses, lead us to call it at one time stone, at another time iron. Again it is true that this appears rather childish to us, but it is significant as the first attempt to make explicit—what has often been considered to be a fundamental category of thought—the distinction between substance and property.

Among all the speculations of the early Greek nature philosophers, however, perhaps the most interesting was that of the atomic theory, which was developed by Leucippus and Democritus in the fifth century B.C. It was in essence a continuation of the ideas first made explicit by Thales and the early Ionians. Once it has been realized what an immense aid the introduction of the substance-property category has been in rationalization of our experience, it is natural to inquire if further rationalization cannot be achieved by the skilful use of the category. For example, at one time we may observe what we call water with certain properties, and at a later time what we call ice with other properties. Now is it not possible to describe such experience in the following way? Let us assume there is one substance whose properties change with time. At the first observation the substance had the properties of what we call water and at the second observation it had the properties of what we call ice. Then it is fairly obvious that all the facts of experience are accounted for in this way, and the question whether we are going to *say* there are two different substances or one substance depends on whether one description enables us to correlate our experiences better than the other. Now the atomic theory makes the interesting suggestion that all our experiences can best be correlated by saying that there is only one substance. This substance is to be thought of as existing in the form of innumerable small particles, or atoms, which are allowed to differ in size, shape, position, and motion. The theory then

asserted that every observed thing and its properties can be explained by these atoms together with their differences in size, shape, position, and motion. The type of explanation envisaged was a purely causal one—that is, the experience of seeing, for example, a yellow flower was caused by the existence of atoms of such and such a size and shape in a certain position and moving in such and such a way. The theory was meant to cover the entire universe—matter, life, and consciousness all being subject to it. Germs of later theories could also be observed in some of the details. For example, it was held that motion persisted until it was opposed (compare Newton), and that atoms form systems which grow and decay, those which survive being those which have become adapted to the environment (compare Darwin). The individual atoms, however, did not decay, but existed eternally.

This theory, unfortunately, was purely speculative and had no experimental work to commend it. Nevertheless, like the earlier speculations of Thales, it was noteworthy, for it pushed the idea of substance and property to the limit by allowing only one substance with the four properties of size, position, shape, and motion. This in some ways may be regarded as the beginning of the scientific tradition, in which we attempt to explain the variety of our experience by means of a comparatively simple model. Clearly, if every time an event was observed it was described as a new substance with such and such properties, no progress in correlating our experiences could be made. What is necessary, if we are to achieve correlation, is for the apparent variety of our experience to be explicable in terms of some model that is very much simpler. Even in the twentieth century what that model will finally turn out to be is not known, but the theory of Leucippus and Democritus was the first contribution to the solution of the problem, and as such must rank as one of the really great achievements of human thought.

After such a brilliant start to scientific thinking, it might have been expected that progress would be rapid, the next step to be undertaken clearly being the introduction of the experimental method. If this had happened, it is possible that what was finally achieved in the sixteenth and seventeenth centuries might have taken place almost two thousand years sooner, with results which almost stagger the imagination. That it did not happen was due, at least partly, to Socrates and Plato, who, as I shall argue in the next chapter, were so impressed with the mathematical thought of the time that they stressed a theoretical, rather than an experimental, method of examining the problems of human behaviour. Thus arose a cleavage between what is scientific on the one hand and what is humanistic and ethical on the other hand, which, during the later ages, grew continually greater, and the existence of which has been a major disaster in the history of thought. Even the genius of Aristotle could not effect a reconciliation, and in his discussion of ethics he categorically says that the subject does not admit of completely scientific treatment.

Before we pass to Socrates and Plato, however, it is necessary to say a word or two about Pythagoras, or, more strictly, the Pythagoreans. For, as far as is known, Pythagoras himself wrote nothing, and Aristotle admits that it is impossible to distinguish the contribution which Pythagoras made to the history of Greek thought from the contribution of his followers. The Pythagoreans formed a kind of religious brotherhood during the latter part of the sixth century, and it was probably dissolved not long after the middle of the fifth century. There is little direct evidence about their beliefs, but they seemed to hold a theory about the immortality and transmigration of the soul, and it is sometimes held that parts of Plato's *Phaedo* owe much to Pythagorean teaching on this point. The rule which compelled members of the brotherhood to abstain from eating flesh of any kind may well have

been due to this view about the transmigration of souls.

It is, however, the Pythagorean cosmological ideas which are of most importance. Again the direct evidence is very meagre, but we can infer a good deal from the change which had taken place by the time Plato began to consider such problems. It seems likely that Pythagoras saw how inadequate were the speculations of men like Thales. If there is a universal substance out of which all things are made, what is its nature? It cannot be more like any one of the things that are made out of it than any other; and, if that is so, it cannot actually be any of the things that we can see—water, earth, fire, and so on. Hence it seems as if we can describe it only by what it is not. It therefore becomes difficult to distinguish the universal substance from mere space. If Pythagoras speculated in some such way as this, it is not hard to see how he arrived at the idea with which his name is always associated. For space has formal or geometrical properties, and it may be that the problem of change in the natural world is therefore to be solved by differences of geometrical pattern. Moreover, in a primitive numerical symbolism numbers are represented by elementary geometrical patterns—as they still are, for example, in dominoes. Consequently it would be tempting to arrive, as Pythagoras seems to have done, at the exciting conclusion that "number lies at the base of the real world."

This conclusion received striking confirmation in his numerical discoveries, where the change in the pitch of a note given out by a vibrating string could be shown to depend on simple arithmetical ratios. It is probably also responsible for the tradition that Pythagoras attempted to keep secret the discovery, always associated with his name, that the diagonal of a square is incommensurable with its side, as he believed that it undermined his basic faith about number. If so, he did not succeed, for the Greeks who came after

him, perhaps because of the devastating paradoxes of Zeno and Parmenides about the One and the Many, concentrated almost entirely on geometry, so that for almost two thousand years the study of arithmetic was largely ignored and the evolution of algebraic manipulation, on which so much in modern science depends, sadly delayed. It is undoubtedly true that the Pythagoreans pushed their ideas on the importance of number to ridiculous lengths and even attributed mystical significance to some numbers, but the importance of their fundamental idea cannot be exaggerated. They suggested for the first time that the natural world should be explained, not by the kind of thing out of which it was made, but by reference to geometry and arithmetic. Although Plato was sympathetic to this point of view, and is indeed sometimes classified as a Pythagorean, the doctrine, due doubtless to the influence of Aristotle, was at no time widely accepted during the ensuing two thousand years. But when in the fifteenth and sixteenth centuries a greater measure of freedom of thought returned to Europe, the Pythagorean influence was still at work and was partly responsible for the epoch-making discovery of Copernicus. And in our own day we do not need to be reminded how the writings of many modern physicists reflect in a remarkable way the spirit which animated Pythagoras. "All the pictures which science now draws of nature, and which alone seem capable of according with observational fact, are mathematical pictures." [1]

[1] J. H. Jeans, *The Mysterious Universe* (Cambridge University Press, 1930), p. 127.

CHAPTER III

THE PLATONIC PHILOSOPHY

Whatever the world thinks, he who hath not much meditated upon God, the human mind, and the *summum bonum*, may possibly make a thriving earthworm but will most indubitably make a sorry patriot and a sorry statesman.—BISHOP BERKELEY.

WHEN we consider the obligations which the civilized world owes to the ideas of Socrates and Plato, there are two opposing dangers against which we must guard. The first is that which seems to me to show itself at the present time in the writings of a few eminent scholars such as Sir Richard Livingstone. Livingstone believes that everything that is of most value in our present civilization is derived from one of two sources—Hellenism or Christianity, "the only sources of value in Western civilization."[1] If this is admitted it follows that we can hardly overestimate the value of what was admittedly the cornerstone of Hellenism—the contribution of Socrates and Plato. But anyone who accepts such a major premise about the sources of value in our civilization is surely demonstrating thereby his lack of touch with the present. I do not think that much can be gained from arguments about the nature of value, but it is certainly true that many people believe the benefits of modern science have been of much more value to man than anything he has derived from Hellenism or Christianity. And while I think that this also is perhaps an extreme view—being in fact the second of the dangers against which I said we must be on our guard

[1] Sir Richard Livingstone, *Plato and Modern Education* (Cambridge University Press, 1944), p. 32.

—it is essential we should remember we are not living merely in the Greek-Christian tradition, but have now the opportunity and the power to build, and are at present building, a new type of civilization.

Those who do hold the second of these, as they seem to me, extreme views naturally concentrate on the fact that Plato and, to a less extent, Socrates certainly retarded the growth of Greek science, while Christianity has notoriously attempted to stifle the rise and growth of modern science. The conflict between those who accept the first extreme position and those who accept the second is, I believe, at bottom a psychological one. Man from the earliest times has often found himself in a position in which he has been unable to satisfy his wants—either because he could not provide the object of his want, or because several of his wants were in conflict. How was he to be happy in such circumstances? "To want nothing," said Socrates, "is divine; to want as little as possible is the nearest possible approach to the divine life." Most adherents of Christianity have advocated the same course. A life of temperance and self-denial should be steadfastly pursued, for whether it leads to life everlasting in the world to come or not, it will give the highest chance of happiness in this world. Modern science, however, suggests that a different answer is possible. For not only is it possible to provide enormously more of the objects which satisfy people's wants, but it is often possible to control the wants themselves. In other words, the problem situation in which man has found himself from the earliest times may be solved by giving him plenty instead of by urging him to content himself with nothing.

However that may be, it seems to me that we should adopt a middle course between the two extremes, and realize that some of the ideas given to the world by Socrates and Plato have been of immense value, while others have been almost a disaster. Let us take the credit side first. I should be the last to suggest

that this exhausts the value of the Platonic philosophy,[1] but it seems to me that the following three elements in that philosophy have been of permanent value in the history of thought.

(1) The first is the importance of reason in human life. In Book IX of the *Republic*, Plato describes how within one human form there is really a threefold being—a man, a lion, and a huge, many-headed beast. Civilized life is possible only when the man rules, when the lion serves him, and when the beast is under absolute control. This emphasis on the supreme importance of reason is as important to-day as it was in Plato's time—perhaps even more important. There seems to be a growing tendency to let others do our thinking for us, and to be satisfied with the thoughts of others, provided these are dished up to us in a palatable form. This is partly due to the continually increasing specialization of life, whereby we are all compelled to take a great deal for granted, and partly to the attitude of certain intellectuals. An eminent philosopher writes, " My propositions are elucidatory in this way: he who understands them finally recognizes them as senseless." Similarly, an eminent critic, writing about some recent literature, says, " My first counsel to those who wish to approach modern writing is, from the outset to divest themselves of all preconceived notions of clarity or comprehension." The ordinary man can hardly be blamed for refusing to make any intellectual effort if that is to be the result, nor is it surprising that he satisfies himself with the ready-made conclusions of the popular scientific writers, conclusions rendered easily digestible by a vivid appeal to the imagination.

The importance of the place which reason ought to occupy in human life is not really denied, as far as I can see, by the recent findings of the psychoanalysts. It

[1] In what follows I make little attempt to distinguish what is due to Socrates and what to Plato.

is true that Freud and his disciples have shown that in most men the subjugation of the many-headed beast is far from complete, and that even when we think our actions are governed solely by reason we are often giving in unconsciously to merely another impulse. But psychoanalysis itself is an example of the triumph of reason in yet another sphere—a sphere which until recently had not been amenable to scientific investigation. It is true that the results obtained by psychoanalysis show how important the non-rational elements are in a man's life, but this itself is of first-rate importance, for the best way of controlling these elements is first of all to understand the place they occupy and how they can be controlled.

(2) The second idea of permanent value which the Platonic philosophy introduced was the description of the basic virtues of wisdom, courage, temperance, and justice. There is no need for me to elaborate this here. Such a basis for the Good Life has inspired many of the greatest deeds in European history through more than two thousand years.

(3) The third idea which I wish to emphasize is the importance which Plato assigned to education. It is probable that he owed this, at least partly, to reflection on the way in which Socrates had lived. For Socrates was first and foremost an educator. If by "philosopher" we mean someone who constructs an ethical or metaphysical system, then Socrates was not strictly a philosopher; and if by "teacher" we mean someone who imparts a certain body of knowledge or certain skills to other people, then he was not strictly a teacher. His task was "to rouse, persuade, and rebuke"[1]—perhaps as good a description as any of the task of the educator. The method which he adopted was a method which ought to be used far oftener to-day than it is—the method of dialectic. This had both a destructive and a constructive side. If Socrates wished to expose some common fallacy,

[1] *Apology*, 30E.

he might start from a proposition to which his hearer readily gave his assent and then draw deductions from it which were clearly inconsistent with the opinion which he wished to discredit. It is true that this destructive process often appears as the whole of the dialectic method in some of the Platonic *Dialogues*. But it must be remembered that there was also a constructive process, when Socrates attempted to arrive at what we should now call inductions by examination of particular cases; for example, he argues from the instances of horses and dogs that the best natures stand most in need of training.

It was inevitable that the zeal with which Socrates pursued his mission in life made a deep impression on Plato. Hence we find him arguing that education must be compulsory for every child, and that the Minister of Education was by far the most important officer in the State. Nor did he think that education should be confined to the years of childhood—a notion which we in England are only beginning to abandon. He stressed the educational importance of the general environment as contrasted with the special environment during hours of instruction—an idea which is peculiarly relevant to-day, when the radio, cinema, and newspaper have much more influence than the school. And although in his later life Plato came to differ more and more from the views of Socrates, I do not think he ever lost sight of the latter's fundamental intuition that education must seek to improve the learner by leading him to distinguish the true from the false, the good from the bad.

Let us then pay full tribute to Socrates and Plato for these noble contributions to the history of ideas. But it is necessary now to look at the other side, and here it seems to me that they did have a reactionary effect on the progress of science. Socrates, it will be remembered, started his life work in the full knowledge of the tradition of Greek natural philosophy; indeed, Democritus was a slightly younger contemporary.

But these scientific speculations left him completely unsatisfied. He felt that the actions of mankind were of a very different nature from the motions of ordinary pieces of matter, and he refused to believe that the atomic theory could be adequate to explain the former. He held instead that the problems of conduct were to be solved by self-examination, and that knowledge was, in reality, recollection.

It is important to note that such an attitude is the opposite of what we now call the scientific attitude, and the divorce, which was quickly made absolute by Plato, between what is scientific and what is humanistic or ethical was started. Now what was the reason which led to this? It is obvious to us that Socrates was correct in maintaining that the atomic theory of Democritus could not explain in any intelligible way the phenomena of life. But a good scientist would at once have considered how it might have been improved. He would quickly have found that it could not explain at all intelligibly even the simplest mechanical facts, and he would have been led to the necessity of finding out a great deal more about the natural world before he constructed elaborate theories to explain it. He would then have been forced to experiment in the attempt to discover natural laws, and in this way he would have added the missing ingredient to Greek science. Unfortunately none of this came to pass. Socrates correctly alleged that the atomic theory could not provide an explanation of human conduct, but it does not follow that no scientific explanation can be found. Indeed, prior to Socrates the best thought of the time did not consider that different kinds of explanation should be offered for human behaviour and for the physical world. Pythagoras, for example, who did as much as any man before Socrates to advance knowledge, held that the essence of justice was a square number, indicating that his belief in the importance of number applied to human as well as to physical problems. What then

made Socrates turn his back on the possibility of a scientific answer to his problem?

The answer, it seems to me, is to be found in Greek mathematics. It is probable that by his time at least the equivalent of the first two books of Euclid, as well as some of the properties of numbers, had been discovered, and the somewhat startling character of mathematical truth seemed to entrance the minds of both Socrates and Plato. Mathematical knowledge appeared to them to differ completely from other knowledge, for it appeared to be knowledge which was independent of sense experience. It was independent in two ways, for it appeared to be about ideal or conceptual objects instead of ordinary physical objects, and it appeared to be completely certain instead of being subject to the uncertainties of sense knowledge. Thus geometry, for example, dealt with ideal straight lines to which the straight lines observed in nature were only approximations, and the geometrical truths about ideal straight lines were certain, and were not subject to the difficulties surrounding sense knowledge—difficulties that appear in such cases as when a " straight " stick is observed " bent " in water. This gave rise inevitably to the view that there was another world of " Ideas " or " Forms " that had two characteristics which were lacking in the world of sense—perfection and truth. The ideas were perfect in a way in which objects of sense were not—namely, that the former were limits to which the latter could only approximate; and knowledge of the world of ideas was true in a sense in which knowledge of the objects of sense was not—namely, that it possessed certainty to which knowledge of objects of sense could only approximate.

It is very probable, I think, that it was because mathematical knowledge was interpreted in a way which made it tempting to consider that there was another world different from the world of sense, that Socrates rejected the idea of a scientific account of

human conduct. Thus began a dualism between man and nature which has had the most far-reaching consequences in the history of thought. It has enabled some philosophers to remove certain ideas, particularly ideas of value, into a realm free from contamination with this world, and to hold that knowledge of them, like mathematical knowledge, was independent of sense experience or a priori. To anyone who protested they pointed triumphantly to geometry, a branch of knowledge which even scientists had to respect. If geometrical knowledge was a priori and yet synthetic, then what was there to prevent other types of knowledge being the same? For many centuries the only answer possible was "nothing," but in the next chapter we shall see how the development in recent times of the idea of deductive reasoning has for ever disposed of the notion of another world different from the world of sense.

CHAPTER IV

THE IDEA OF DEDUCTION

". . . Everybody that hears me sing—either it brings the tears into their eyes, or else . . ."

"Or else what?" said Alice, for the Knight had made a sudden pause.

"Or else it doesn't, you know."—LEWIS CARROLL.

PERHAPS the greatest contributions of Greece to modern thought were those made by Aristotle and Euclid. Aristotle's works were an encyclopædia of the learning of the ancient world, and it is probably safe to say that there was no subject which he did not, to some extent, advance. He stressed the need of observation and experiment, and himself made hundreds of observations on animals and plants. But even more important than the observational results which he achieved was the account which he gave of reasoning—an account which, so far as it goes, is to-day accepted as correct, and was for two thousand years accepted not only as correct but also as complete. Indeed, it is not too much to say that Aristotle's "doctrines and the terminology in which they are expressed have entered so deeply into the structure of Western thought and language, that an understanding of them is necessary for the proper appreciation of much great literature as well as of Western philosophy." [1]

The compilation of geometrical knowledge known as Euclid's *Elements* was, possibly, an even more important contribution to the world of learning.

[1] L. S. Stebbing, *A Modern Introduction to Logic* (Methuen, 1930), Preface.

Throughout the ages it has exercised a strange fascination, not merely on scientists, but on eminent thinkers in all spheres, many of whom have considered it to be the ideal towards which knowledge of all subjects should approach. Spinoza, for example, chose it as the model for his *Ethics*. Now the essence of Euclid's system was that from a few primitive propositions and definitions a large number of propositions could be derived by pure reasoning—that is, without making use of any empirical observations. Moreover, the nature of the primitive propositions was such that they were supposed to be self-evident to any normal human being. It was thus widely held that in the geometry of the physical world we could, by reasoning alone, derive a large body of knowledge which it would always be possible to verify by measurement if we cared to take the trouble. This provided a strong argument for those who sought to obstruct the advance of science, which depended on observation and experiment. For if it is possible to deduce the geometry of the physical world from a few self-evident propositions, there is no particular reason why a similar achievement should not be possible in other branches of knowledge. In particular, it might be possible from a few ethical propositions which are self-evident to deduce a whole body of ethical propositions.

The view that it is sometimes possible to deduce facts about the world by purely a priori means (or, in Kant's terminology, that synthetic a priori propositions are possible) has, I think, been one of the greatest barriers in the progress of science, and it is rather ironical that by far the strongest argument in favour of the view should have been drawn from mathematics—for long the most respected of the sciences. The precise definition of the terms "analytic," "synthetic," and "a priori" is by no means an easy matter, but for most purposes it is sufficient to define an analytic proposition as a proposition which can be affirmed from a mere knowledge

of the meanings of words and their rules of combination. Knowledge of synthetic propositions, on the other hand, requires in addition a knowledge of matters of fact. An a priori proposition is generally said to be a proposition which can be certified as true by thought or reason alone, while an empirical proposition can be asserted only with the aid of experience. The distinction between a priori and empirical propositions would be the same as that between analytic and synthetic if it were impossible to know any matter of fact by thought or reason alone. The impossibility would, I think, have been generally admitted had it not been for the serious problem presented by the propositions of mathematics. This problem has, however, been solved by the work which has been done in mathematics and the theory of deduction in the last hundred years, and it is a pity that some moral philosophers, who are so sensitive about the invasion of their domain by the biologists, should be so slow to realize the far greater damage done by the logician.

The first step in the solution was taken when in the first half of the nineteenth century Lobachevski and Bolyai, and also to some extent Gauss, developed independently a non-Euclidean system of geometry. Up to this time the term " geometry " had meant the geometry of Euclid, which was supposed to be an exact description of the space in which we lived. Its results were used extensively in astronomy, physics, and engineering, and were always considered to be the most certain of all our knowledge. Theoretically this certainty could be explained in two ways. The theorems of Euclid followed from, or were implied by, the original premises (that is, definitions, axioms, and postulates),[1] and if we could be certain of the latter, then the truth of the former would be guaranteed. Alternatively, we might be able to show that no other set of premises would give results consistent with experience. The first explanation was the one which

[1] See Appendix I.

for hundreds of years had been generally adopted, until increasing scepticism among mathematicians about the alleged certainty of the parallel postulate resulted in a serious attempt either to find a substitute more obviously certain, or to show the set of premises not to be unique. It was the latter which was eventually demonstrated by Lobachevski and Bolyai. They showed that premises different from Euclid's could, nevertheless, give results which would be observationally indistinguishable from those of the traditional system. This achievement naturally led to a fresh spell of activity among geometers. They became interested in developing the consequences of many different sets of postulates, with very little resemblance sometimes to Euclid's original set, and gradually it became quite clear that a large number of " geometries " existed, all internally consistent but, in general, inconsistent with each other.

Geometry thus throws no light at all on the nature of external space. It is concerned entirely with the implications of a set of postulates, and not with the truth of the postulates. Whether the postulates and theorems of Euclid hold of actual space is a matter for applied mathematics or physics to decide, and for that decision observations must be made. Thus no propositions about the world can be asserted on the sole strength of geometrical reasoning.

Shortly after the construction of the first non-Euclidean geometries Sir William Hamilton published his work on quaternions, a type of algebra in which the symbols obeyed laws different from those of ordinary algebra. This was followed by other developments, such as Boolean algebra, and then in this century by the remarkable expansion of deductive logic. As a result, the wider significance of sets of postulates has now become evident. They consist essentially of certain arrangements of symbols,[1] and the rules of procedure which should accompany any

[1] For an example, see Appendix I.

set allow these symbols to be rearranged in certain specified ways. The working out of the different rearrangements is called developing the implications of the given postulate set.

Now it may happen that when certain empirical meanings are attached to some of the symbols in a given postulate set, the set becomes a collection of true or false propositions. This is called interpreting the postulate set. Thus a set of postulates must no longer be thought of in the Euclidean way, as a set of propositions which are obviously true, but as arrangements of symbols which can be interpreted in such a manner as to make them true or false. Apart from interpretation the question of truth does not arise, but if some of the symbols in the set can be interpreted in such a way as to give a collection of true propositions, then the same interpretation will make the implications of the set true propositions. The set is sometimes called a deductive system, and such systems play a very large part in those sciences—for example, physics—which are relatively well advanced. The scientific function of deductive systems is to systematize, or order, the verifiable statements which have been discovered by observation and experiment. Their function, that is, is theoretical, not practical. Yet they very often are of great practical value, for some implications deduced from the system give, when interpreted, statements whose truth or falsity was formerly unknown. If it is found that they are true, new knowledge has been obtained, while if it is found that they are false, the deductive system must be altered to take account of such facts. For example, the deductive system known as Newton's theory of gravitation was altered by Einstein to take account of such facts as the behaviour of the perihelion of Mercury. But although the deductive systems are often of great practical value, their main function is, none the less, to correlate or systematize the knowledge we already possess.

Postulational theory, as thus understood, throws a flood of light on synthetic knowledge which is alleged to be a priori. By means of rules of procedure, from the few expressions with which we start, we are entitled to write down others which may be said to be derived from, or to be implied by, the original expressions. The development of a set of postulates, therefore, says nothing at all about the world, but is concerned solely with the implications of the given set—that is, with the implications of certain expressions involving variables, or, in more technical terminology, with the implications of certain propositional functions. For a set of postulates to apply to the real world it must be possible to find an interpretation of the initial postulates in terms of observable phenomena. When that is possible then all consequences of the postulates, when similarly interpreted, will give true propositions about the world.[1] For example, when the variables of a set of geometrical postulates are interpreted by means of physical straight lines, points, and so on, then all theorems deduced from the postulates when similarly interpreted give true propositions, which can be verified in the world of footrules and protractors. The implications of the original postulates are worked out in accordance with the rules of procedure, and for this no reference to the real world is necessary, so that the process may legitimately be called a priori but not synthetic. For an interpretation to be given to the original postulates, however (and hence to the theorems which are obtained from them), observation of the real world is indispensable. Thus the application of

[1] It should be noted, however, that in the interpretations of many deductive systems, especially in modern physics, it often happens that some of the statements cannot be verified. Indeed many of the postulates, which are the basis of quantum theories, when interpreted, are unverifiable, but there is no logical objection to this so long as all the implications which are verifiable are found to be true. This shows very clearly that such theories are constructed because of their systematizing value (*cf.* Chapter XVII).

any set of postulates, as in the geometry of the physical world, while giving synthetic knowledge, is not purely a priori, but rests on an empirical basis. The discovery of the nature of postulates consequently marked the end of a long-standing controversy. By no a priori method can we say what are or what are not the facts.

CHAPTER V

IDEAS INVOLVED IN CHRISTIANITY

"If we are to assume that anybody has designedly set this wonderful universe going, it is perfectly clear to me that he is no more entirely benevolent and just, in any intelligible sense of the words, than he is malevolent and unjust."—T. H. HUXLEY.

CHRISTIANITY is often classified as a "universal" and "individual" religion by students interested in the philosophy of religion. By a "universal" religion they mean one which claims for itself the support of all human beings irrespective of nationality, sex, or caste, and which professes to be, at least in some sense, absolutely true. By an "individual" religion they mean that it owes its origin, not to the folk-lore, traditions, and ritual on which some "natural" religions are based, but to a specific individual whose life was a concrete historical event.

Such a classification is, however, of more help theoretically than practically. In practice, Christianity has never appeared at all likely to be accepted universally. Indeed, the geographical diffusion of Christianity presents many interesting problems to the religious psychologist. It was founded in Asia by an Asiatic, yet apart from a relatively brief period of success in the country now called Iran, it has always derived almost all its support from Europeans, or from those descended from Europeans who have gone to other continents. It has achieved in India nothing like the success which has attended the spread of the Moslem faith; and even outposts of the latter in Europe have not proved at all amenable to conversion by Christians. It will be one of my contentions in a later chapter that the only ideas which can claim

universal acceptance are scientific, but however that may be I do not think it is likely to be denied that the prospects of Christianity ever achieving in practice its aim of universality are negligible.

The classification of Christianity as an individual rather than as a natural religion is also of more help theoretically than practically. A natural religion may owe a great deal to the achievements of some individual, and it is inevitable that an individual religion should owe a great deal to the traditions and beliefs of the community in which it is born. This is exemplified particularly well in the case of Christianity, which took over Judaism more or less intact, with the curious result that a large part of the sacred writings accepted by Christians—the Old Testament—is often inconsistent with the more distinctive parts of the teaching of Jesus. But although an individual religion necessarily accepts a great deal of the community life in which it first appears, it is generally an attempt to revolt against certain aspects of that life. And in this Christianity was again no exception.

Jesus, who possessed no advantages of wealth, birth, or education, undoubtedly had the much greater advantage of an outstanding personality, which could convey itself to ordinary people in language they could understand. He was not a theologian, philosopher, or intellectual, and, as far as the evidence goes, he accepted uncritically the view of the world as it appeared to the average man at the time he lived. But he revolutionized the outlook of the average man by his emphasis on certain ideas.

Perhaps the most fundamental conception which he stressed was the love of God and the love which we should, as a result, bear to our fellow man. The traditional system of morality in the Roman Empire—in so far as there was an acknowledged system—was intellectual. Socrates had explicitly identified virtue with knowledge, and, although there was considerable disagreement from the time of Plato onwards as to

what constituted the supreme good of man, yet there was an underlying agreement that the supreme good was to be found in the intellect. The Christian idea that the basis of morals is to be found in the heart and not in the head was completely new. Unless I love God and my fellow man, Jesus taught, I cannot lead a good life; and, on the other hand, if I do love God and my fellow man, all other goods will be added to me.

It is hardly surprising that such a doctrine should startle a world accustomed to the brutality of Roman life. It is indeed likely that present-day Europe, if it had not been so long conditioned to the sound of the Gospels, would be equally startled after the far worse brutalities of the second world war. Nor is it surprising that such a doctrine should at first be more popular with the common people than with the intellectuals. It is true that the Stoics had formed a conception of the brotherhood of man—all men, they held, were sons of God in virtue of the faculty of reason in them. But such brotherhood was the result of reflection and exhibited the Stoics' desire to preserve human dignity, as reason was what distinguished man from other creatures. To a Christian, however, the brotherhood of man is something much more vital, for it is the direct expression of the belief that love is the foundation of all the virtues:—

> "Though I speak with the tongues of men and of angels, and have not charity, I am become as sounding brass or a tinkling cymbal. And though I have the gift of prophecy, and understand all mysteries, and all knowledge; and though I have all faith so that I did remove mountains and have not charity, I am nothing. And though I bestow all my goods to feed the poor, and though I give my body to be burned, and have not charity, it profiteth me nothing." [1]

[1] The First Epistle of Paul the Apostle to the Corinthians, Chapter XIII.

The rise of Christianity in the Roman Empire in the first few centuries was due, however, not only to this fundamental idea, but also to the way in which it happened to suit the peculiar needs of the time. (It must be remembered that it was a time of great religious unrest when there were about as many religious cults as there are in California to-day.) At such a time several ideas in Christianity would prove very attractive and satisfying—one God, the faith in a future life open to the highest and the lowest, the devotion to a leader, and so on. None of these ideas is peculiar to Christianity and none is solely responsible for its success, but taken together they met the predominant religious needs of the age much more satisfactorily than any other system. Its success was also helped greatly by the enthusiasm of its followers, who were not content to appeal merely to one section or class or nation, but regarded the whole world as their province. Thus in spite of many difficulties and persecutions Christianity received more and more support, and the Emperor Constantine was eventually baptized in the year 337.

It is doubtful how far this triumph of State support for Christianity was beneficial in the long run. By the fourth century Christianity was the most vital movement left in the Empire, but when in the following century the Western Empire collapsed, the Church in the East became little more than a department of State. Even in the West, although it remained the chief civilizing and unifying influence, it was powerless to prevent, and to some extent it was responsible for, the centuries of darkness which followed.

(The view that Christianity must take some of the responsibility for the Dark Ages is, I think, an inevitable conclusion when one reflects that, from the death of Galen in A.D. 200 to the time of Roger Bacon one thousand years later, no scientific work of the slightest importance was carried out in any of the countries where Christianity had set foot.) It may be,

of course, that scientific genius shines brightly during certain periods and lies dormant during other periods in the history of the race, and that no explanation can be given of its coming and going. Religious genius, for example, reached its zenith in the thousand years between Buddha and Muhammed, and, with the possible exception of St. Thomas Aquinas, has languished ever since. There has not been even a religious renaissance in the way in which there was a literary one. It may, therefore, be dangerous to think that because science has progressed steadily in the last few hundred years, it will continue to do so—even if man succeeds in preventing his self-destruction.

(At the same time, it is impossible to resist the conclusion that the spread of Christianity was at least partly responsible for the decay. Early Christianity introduced a new outlook into the intellectual life of the period, which could hardly have had any other effect than to make people completely uninterested in secular learning.) The conception of sin, the individual's need of redemption, the hope of salvation, and the fear of eternal damnation are all ideas which, if not completely original to Christianity, were magnified by it to such an extent as to colour profoundly the thought of the time. These ideas were all related to the new ideal which Christianity substituted as the supreme aim of conduct in this world. Previously both Greece and Rome had, sometimes explicitly and sometimes implicitly, assumed that the safety of the State must overrule all other considerations and all other aspects of life. This was undoubtedly beneficial to scientific investigation. For when the safety of the State was assured some men (albeit only a few) had leisure and opportunity enough to pursue scientific questions for their intrinsic interest. If, on the other hand, the State was at war, as was so often the case with the Romans, there were many technical scientific problems which had to be solved. But, because of the importance attached to the fundamental idea—the love of God—

Christianity substituted the communion of the soul with God as the supreme aim in life, and, whatever may be said in favour of this, it must be admitted that it led the intellectually able to a life of contemplation rather than to a life of observation and experiment.

Moreover, an aspect of the Christian doctrine which was emphasized by St. Paul, the most famous Christian missionary, helped to reinforce an old Greek idea and helped indirectly the trend away from science. This idea was that the body, and anything connected with it, was not a fit object of study. Plato frequently shows that he despises purely manual work, and, in fact, the position in which slaves were held made it difficult to accept any other view; but such an attitude is very unfavourable to the development of science. The system known as Neo-Platonism, the most famous exponent of which was Plotinus, stressed this attitude of Plato to an extreme degree. According to Plotinus the only good of man is the purely intellectual existence of the soul, and it is the union of the body with the soul which causes all evil and error. Such a view, it will be readily seen, opens the door to mysticism and encourages belief in the supernatural and all sorts of magic. Plotinus himself followed Plato too closely to permit of him advocating the actual mortification of the body as a means to a fuller life for the soul, but such a step was taken by Porphyry, one of his disciples. This linked up with St. Paul's exposition of Christianity. Whereas the traditional Greek attitude had been that, as the body is a nuisance, it should be indulged when necessary and the intellectual life then resumed, St. Paul advocated that, as the body is a nuisance, it should be mortified. Thus arose the ascetic view of life which has always been popular among certain types of Christian. This measure of agreement between Neo-Platonism and Christianity led to a certain amount of interaction between them (indeed each accused the other of plagiarism), and in one important respect Christianity was modified.

Originally it had differed from most philosophies in ascribing importance to a number of unique events—such as the Creation, the Fall of Man, and the Second Coming. Under the influence of Neo-Platonism, however, it ceased to take the temporal aspect of events very seriously, especially as the promise of the Second Coming remained unfulfilled, and became in a sense more static and less revolutionary. But, in general, the more timeless a philosophy becomes the more remote it becomes from scientific thought, and Christianity proved no exception.

It is true that it has been argued by no less a thinker than Whitehead that these long centuries in which science stagnated, while Christianity spread farther and farther afield, laid the foundations of modern science, as they "formed one long training of the intellect of Europe in the sense of order." God, and through Him the order of nature, were held to be completely rational, and it is probably true that a belief in the order of nature—that is, a belief that there are regularities in nature which man can find out—is an indispensable psychological preliminary to scientific investigation. But the answer to such an argument is just the fact that the Greeks already held such a belief, and it is therefore little short of tragic that civilization should have required over ten centuries to re-learn something which it had forgotten. Moreover, the sense of order which governed belief at this time was by no means the same as the sense of order which is characteristic of the scientist's attitude. It came ultimately to be based on a scheme of the universe derived from Aristotle but modified to include the ideas of Christianity which I have just outlined. The possibility that some events might not fit into such a scheme was never seriously considered, and the necessity for exploring the unknown, which the modern scientist takes for granted, was never realized.

CHAPTER VI

THE INFLUENCE OF MONASTICISM

(There is no calling or pursuit which is a private road to the Deity.—F. H. BRADLEY.)

IT is often said to-day that conditions in the modern world render a true Christian life impossible. The advice, for example, that a man should sell what he has and give to the poor is very rarely taken, and even more rarely do we hear of what happened to anyone who does take it. Such advice tends to make the modern Christian rather uncomfortable, and he generally resorts to the old defence that it should be taken metaphorically and not literally. But however difficult a true Christian life may be in the world to-day, it must have been very much more difficult in Rome in the early days of Christianity. It is hardly surprising, therefore, that the early Christians should have turned towards the practice of monasticism.

(Monasticism, which is a way of living that was practised in the East long before the Christian era, seems to derive its attraction from its appeal to two fundamental human characteristics—the desire to achieve communion with God, and the desire to purify the soul by means of privation and self-denial.) Now we have seen in the preceding chapter that early Christianity stressed the value of both these desires, and while it is no doubt possible for a man to fulfil them in his own home, it is certainly easier for him to do so when he has withdrawn himself from society. Moreover, many of the sayings attributed to Jesus emphasized that each one must in some sense " work out his own salvation " and must, if necessary, forsake

kith and kin to do so. The existence of persecution and hostility in the surrounding world also rendered it often advisable for a Christian to seek isolation, where it would be easier to keep ideals clearly and steadfastly in front of him. Hence the custom arose in the Christian community of withdrawing oneself from society and of practising religious and ascetical exercises.

The first person of whom we hear who lived a life of this kind is St. Anthony, who in the second half of the third century retired to a deserted fort on the east bank of the Nile, and, according to report, lived for twenty years a life of seclusion, refusing to see any fellow creature. It seems, however, that in spite of this isolation (or perhaps because of it) he achieved a certain amount of fame, so that he eventually gave way to appeals to guide the lives of a number of admiring followers. (Thus began, in the early fourth century, Christian monasticism—a movement which for centuries had a deep and widespread influence.)

St. Anthony, except for the practice of severe asceticism, did not set any very fixed rules for the guidance of monastic life. This next step was taken by St. Pachomius in the first half of the fourth century, who in the course of his life founded nine monasteries for men and one for women mainly in the south of Egypt. The life in such monasteries was precisely regulated by detailed rules governing work (mainly agricultural), prayer, and meals. Monasticism did not survive long in Egypt after the Moslem occupation, but by that time it had spread and established itself firmly in Europe. It is probable that it was brought, at least to Western Europe, first of all by St. Athanasius, who is thought to have written the life of St. Anthony. But Antonian monasticism was probably too severe for the European temperament, or, it may be, for the European climate. Extreme bodily privations are borne more easily in a land where the sun is always shining. However that may be, it was

monasticism after the model of St. Pachomius which was eventually adopted, and, as formulated by St. Benedict, it was for several centuries the only form of Christian monasticism outside of Ireland.

St. Benedict's *Rule*, which was composed about the year 529, has been called "the most important document of the Middle Ages." Although this may be a slight exaggeration, the *Rule* was certainly an outstanding piece of work, and showed remarkable insight both in aim and method. The aim may be summed up in St. Benedict's own definition of his monastery, "a school for the service of the Lord," and he sought to realize this aim by enforcing the three principles of obedience, poverty, and celibacy.

The first of these principles was the most important, for by it the idea of law and order was introduced into monastic life. Previously the abbot had been allowed to exercise more or less arbitrary authority, and monks had been able to wander about from monastery to monastery. Now the abbot's life was to be regulated like any other, and monks were to remain permanently in the one monastery. Thus the monastery became much more like a large family whose members were bound to each other by ties that could not be severed.

St. Benedict did not look with favour on any of the more extreme forms of asceticism associated with Antonian or Asiatic monasticism. Under these it had sometimes been the practice for monks to compete with each other in the privations and sufferings which they inflicted on themselves. But, while such competition was categorically condemned, St. Benedict made it clear that the monk's life was to be a hard one. Each day there was to be a common act of worship, and the rest of the day filled in by work and reading. The work was almost entirely of three kinds: (*a*) agricultural, (*b*) relieving of the poor, and (*c*) copying manuscripts, and at least seven hours were to be spent at work and two at reading. This programme exhibits very clearly how St. Benedict considered it

best to obtain the purification of the soul, which we saw was one of the fundamental human desires tending towards monasticism. "Idleness," he writes in his *Rule*, "is the great enemy of the soul"; hence a man's soul can be purified only by keeping him continually busy. The weakness of such an outlook is not very hard to find, for it makes the value of work depend neither on the physical results obtained from it, nor on the mental qualities acquired by doing it, but rather on the characteristics which were *not* acquired by doing it. Such a negative attitude could not for long remain a strong incentive, with the result that the amount of work done in a monastery was often ridiculously small. Coulton sums up the position well :—

> "The actual amount of work done by monks is often ludicrously exaggerated. This Benedictine precept was soon neglected; and, often as monastic reformers recalled it, real manual work was short-lived in practically all these revivals. What the monks did for agriculture was far more as landlords than as labourers. Even such work as copying or binding books was scarcely ever practised by the majority in a monastery, and often for whole generations by nobody at all: this can be proved by their own records. Comparison of successive catalogues, even in flourishing monasteries, suggests the actual rate of increase was no greater than would be accounted for by one monk out of every fifty spending all his spare time as a copyist." [1]

But, although the amount of work which was done was often pitifully small, it cannot be disputed that the diffusion of Benedictine monasteries throughout Western Europe in the seventh and later centuries made a very definite contribution to human progress by Christianizing and educating the Teutonic races.

[1] G. G. Coulton, *Medieval Panorama* (Cambridge University Press, 1943), p. 267.

What happened to the monastic ideal after this? Why was it that in the later Middle Ages it seemed to lose some of its attraction, and why is it that it appeals to so few people to-day?

The fundamental answer to this seems to me to be that man came in the fifteenth and sixteenth centuries to adopt, at least vaguely, what we now call the scientific attitude, and to distrust, in consequence, all forms of mysticism. The most striking feature of the scientific attitude is probably the desire to test truth by experiment; (but how are we to test the soul's union with God—which is the supreme aim of the mystic—by experiment? If, however, doubt is once thrown on the very possibility of mysticism, one of the fundamental needs which gave rise to monasticism is no longer operative.) For we saw that the monastic movement sprang from the two basic desires for union with God and for purification by self-denial. It is certainly not true to say that the desire for union with God is never felt strongly in modern times, but I think it will be readily admitted that cases in which it is are comparatively rare. Thus whether I am right or wrong in thinking that the growth of the scientific outlook has brought about the change, there is no doubt that one of the reasons for the attractiveness of the monastic ideal has lost much of its strength.

The other reason, however, appears to me to be as valid as ever. There are, I believe, two tendencies in Christianity which may ultimately prove to be inconsistent with each other. One tendency urges a man to greater and greater self-denial, stressing that only he who is willing to lose his life can hope to save his soul; and the other tendency urges a man to more and more social co-operation, stressing that if he is to win souls he must be all things to all men. The two tendencies may not be logically opposed to each other, but in any actual community they seem bound to conflict. Those who follow the first realize that very few of those who, at any time, profess to be Christians are Christians in

any fundamental sense, and that Christ was speaking very seriously when he said, " Many are called, and few are chosen." They see the open neglect of his sayings by the leaders of the Christian Church, and, perhaps even worse, they hear these same leaders explaining away some of the more inconvenient ones. It is very difficult for Christians in this first sense to do anything but retreat more and more from the world of ordinary men—who regard them as fools—and to concentrate on saving their own souls. The position of the genuine Christian pacifist in the two world wars has brought out very clearly the extremely small number of people who try to fulfil Christ's teaching in this one respect at least. The second tendency, on the other hand, leads to the missionary spirit, to the spirit of toleration and compromise, and to the vast social influence of Christianity. It is not for me to judge the value of these two tendencies, but I think they both exist in Christianity and that they do often oppose each other. Now, although very few people seem to succeed in following the first tendency, I think that many of those who are sympathetic with the Christian way of life have felt that, if they could follow it, they would be better individuals, and have felt that sometimes there was a genuine conflict between the two tendencies.

Now the monastery, for many centuries, provided a solution to this conflict. It was a refuge to which believing individuals could turn and pursue in peace the quest for the purification of their souls. It may have been in addition " a missionary establishment, sometimes a bank of deposit, a hostelry for the refreshment of wayfarers, an improving landlord, a centre of education and scholarship, as well as of those arts and crafts which are enlisted in the conduct of any great establishment, a collector and recorder of current news, a storehouse of manuscripts, a depository of political knowledge, foreign and domestic, an organ for the reclamation of waste land and for the planting

of civilization in barbarous and pagan tracts." [1] But all such activities were subsidiary to the fundamental aim of purifying the soul; yet while there now exist other means of performing these subsidiary activities, no means exist, at least for many who hold the Christian faith, for the realization of the fundamental aim. It is therefore not surprising that some Christians are perplexed at the conflicts which confront them in the modern world.

No discussion of the influence of monasticism, however brief, would be at all adequate without some reference to the effect it has exercised on the course of thought through its influence on certain individuals. Foremost among these is St. Augustine, who was converted in the year 386 by a Christian, Pontitian, who related to him accounts of the asceticism practised by St. Anthony in Egypt. The effect which this had on his mind is vividly described by him in his *Confessions*. If monasticism had done no more than convert Augustine, it would still have been of great importance in the history of ideas, for few people have influenced succeeding centuries more than he. His most famous work, *City of God*, may be said literally to have dominated the Middle Ages.

He was a voluminous writer and gave permanent shape to several ideas which have been of cardinal importance ever since in the doctrines of the Christian Church. He dealt exhaustively, if dogmatically, with the ideas of the Trinity, of Immortality, and of Original Sin. He was involved in controversy several times in the course of his life, that in which he expounded his views on original sin being perhaps the most famous. To most people to-day it doubtless seems that Augustine, because of his somewhat boisterous early life, was led to exaggerate the inherent corruptness of humanity. On the other hand, the view which is accepted in many educational centres at the present

[1] H. A. L. Fisher, *A History of Europe* (Arnold, 1941), p. 250.

time, and which was first popularized by Rousseau, that the child will be all right if allowed to develop "naturally," is probably equally one-sided. (At any rate, a knowledge of Augustine's depreciation of the capabilities inherent in human nature would have been a useful corrective to those whose facile optimism has been partly the cause of the disasters which have overtaken mankind in the twentieth century.)

CHAPTER VII

THE CONTRIBUTION OF ISLAM

A religion, on its doctrinal sides, can thus be described as a system of general truths which have the effect of transforming character when they are sincerely held and vividly apprehended. —A. N. WHITEHEAD.

THE diffusion of the Arab race in the seventh century throughout Persia, Africa, and even Spain is one of those events concerning the cause of which historians hold divergent views. But there is no doubt that the most important factor in the development and consolidation of the Arab Empire, which was the result of this diffusion, was the Moslem religion, called Islam by its founder, Muhammad. Muhammad died in the year 632, when he was slightly over sixty years old. He had some familiarity with Judaism and Christianity, and considered himself to be the last of a succession of prophets to whom God had revealed himself. Just as God had chosen Moses and Jesus as his special instruments when he had revealed himself in the past, so now he had chosen Muhammad. The revelation is given in the *Koran*, which Muhammad wrote at the dictation of God. (God is the speaker during the entire one hundred and fourteen suras or chapters.) There are some inconsistencies throughout the Koran, but the official Moslem position is that a later revelation overrules an earlier one.

What are the fundamental ideas of Islam? Many accounts have been given, but the plea which some of the earlier followers of Muhammad made to the King of Abyssinia for protection can hardly be improved for elegance and simplicity. "O King," they said,

" we lived in ignorance, idolatry, and unchastity; the strong oppressed the weak; we spoke untruth; we violated the duties of hospitality. Then a Prophet arose, one whom we knew from our youth, with whose descent and conduct and good faith and truth we are all well acquainted. He told us to worship one God, to speak truth, to keep good faith, to assist our relations, to fulfil the rights of hospitality, and to abstain from all things impure, ungodly, unrighteous. And he ordered us to say prayers, give alms, and to fast. We believed in him; we followed him."[1]

These are the fundamental elements in the Moslem religion, which has endured for over thirteen centuries, and at the present time must have some three hundred million adherents. It is a religion which has given great help and comfort at all times, but it seems to be of particular value to primitive societies. Writing of the function of religion in connection with the formation of States, Sir John Seeley said: " Wherever a barbarous tribe has raised itself at all above the level of barbarism and taken any development, it has done so usually through conversion to Islam."[2]

Because of Muhammad's attitude to Moses and Jesus, whom he regarded as his predecessors, it is clear that Islam and Christianity will have much in common. But they differ on a number of points, and it is perhaps worth while to note the more important resemblances and differences. (1) While both the Moslem and the Christian believe in a future life, they differ about the character of that life. The Christian hopes to live in company with those whom he has known and loved in this world, but the Moslem expects to be with people who have never been on earth. (2) Again, both the Moslem and the Christian believe in the value of prayer as a religious exercise, but they differ about the nature of the prayers to be offered. The Christian

[1] S. Lane-Poole, *Studies in a Mosque* (London, 1883), p. 48.
[2] Sir J. R. Seeley, *Introduction to Political Science* (London, 1896), p. 63.

generally prays for particular things—either qualities which he would like to possess or events which he would like to happen—but the Moslem in praying uses merely certain conventional formulæ of adoration. Moreover, while the Christian is on the whole rather reticent on the subject of his religion and prefers to say his prayers in the privacy of his own home, the Moslem is not ashamed to bear witness to his religion by saying his in public. (3) There are many points common to the religious philosophy of Islam as developed by Ash'arī (tenth century) and Ghazzāli (eleventh century) and to the religious philosophy of Christianity as developed first of all by Augustine and later by the Scholastics. The problems of predestination and free will, of faith and reason, of sin and salvation, have caused as much difficulty in Moslem as in Christian theology. On the other hand, the Moslems have no use for the conception of the Trinity, and emphasize instead the unity of God.

What is usually considered to be the fundamental difference between Christianity and Islam is really, it seems to me, a difference between the two social systems which they have inspired. How far such a difference is in fact due to a difference between the ideas of the two religions is a matter of considerable doubt, for many other causes must also be at work. Certainly there are striking differences between Moslem and Christian society. Perhaps foremost among these differences is the position assigned to woman, which in Christian society is one roughly of equality with man, but in Moslem society is one of very definite inferiority. It is inferior in two important respects. First of all the Moslem woman has to lead a life of seclusion, which inevitably cramps and ruins the mental growth of half the population. In addition, it must have a deteriorating effect on the male population, because of the influence which women, in their position as mothers and wives, must always have over the behaviour of their children and husbands. The

second respect in which the position of women is markedly inferior is that of polygamy, which seems, however, to have become much less popular in recent years because of the great expense which it involves. In defence of Muhammad it may be urged that neither of these practices owes its origin to him, but had long been in vogue in oriental countries. While this is true, it brings us to the second important difference between Christian and Moslem society. This is the relative immutability of the latter. The practices of Moslem society are based not only on the *Koran*, but on what are called the *Traditions*.) God is supposed to have revealed himself not only in the *Koran* which he confided to the Prophet, but also in the manner of life which the Prophet led. Information about this was first of all obtained from the companions and disciples of Muhammad; and the people to whom they bequeathed their information gave it in turn to some of the next generation, and so on. For about a century these traditions seem to have circulated from mouth to mouth, but, because of the tendency of unscrupulous people to invent a tradition to justify any action which was convenient, written collections came to be made in the eighth and ninth centuries. These are now considered to be as authoritative as the *Koran*, with the result that the customs of the seventh century have been made the pattern for the social behaviour of the twentieth. There is thus a complete lack of elasticity in the system whereby adjustments could be made to suit continually changing conditions.

(At the present time there is yet a third striking difference between Christian and Moslem society, that lying in the idea of tolerance. It must be freely admitted that in the past Christian society has been perhaps the most intolerant of any. The pages of Moslem history are stained by nothing comparable to the Inquisition.) Indeed, one historian, writing of the capture of Jerusalem by the Khalif Omar, says:—

> " Omar's severity towards the Christians was so much below their anticipation that he figures in the popular memory almost as a benefactor of their religion. They were deprived of their church bells, but kept their Churches; and if large numbers of them embraced El Islam, it was through self-interest (or conviction) and not at the point of the sword, as has been represented. Indeed the toleration displayed by the Moslems towards the vanquished, though less than we should practise nowadays, is without parallel in Europe till many centuries later."

Nevertheless, in spite of its disgraceful past, Christian society to-day is infinitely more tolerant than that of the Moslem. The latter looks with contempt and even hatred on those who do not embrace his faith, and finds it almost impossible to realize that a difference of opinion is not necessarily a ground for bitter antagonism. Again, it may be somewhat unfair to attribute this difference to the difference between Christianity and Islam. It may well be true, for example, that the toleration which is characteristic of most Christian societies to-day is due more to the development of the scientific spirit than to the spirit of religion. Yet an impartial comparison between the *New Testament* and the *Koran* will, I think, reveal that the latter makes the ideas of revenge and hatred play a much larger part in the relations of man to man than does the former.

In these three respects, then—the position of women, the elasticity in the system, and the idea of tolerance—Christian society seems far ahead to-day of its Moslem counterpart. Yet, as the world grows smaller and smaller with continually improving means of communication, there are many indications that Islam may attempt a compromise with the modern world. To some extent this has already taken place in the Moslem community situated in the Soviet Union. Whether it

will be possible elsewhere remains to be seen, but the dead weight of tradition is not easily cast off:—

> " Still from the Atlantic Ocean to the Himalayas the muezzin calls the faithful to prayer at sunrise and sunset, the mosques fill with shoeless worshippers, the little children learn the *Koran* by heart, and in the shaded alcoves of the great Cairene University of Al Azhar groups of white-robed students, seated on the floor, swing back and forth in a mood of fanatical ecstasy, as they intone the sacred words of the polygamous Prophet to whom all wisdom and all modern science were miraculously revealed."[1]

The contribution of the Moslem world to the history of thought does not rest, however, solely on the ideas which have made Islam one of the leading world religions. The development of Christian thought which took place in the thirteenth century in Western Europe was made possible by certain Moslem scholars. As far back as the year 529, Justinian, the most famous of all the Emperors of the Eastern Roman Empire, had closed the schools at Athens, which could still trace their connection back to the days of Aristotle and Plato. Justinian did this partly because he did not wish to see any rivals to the University of Constantinople, and partly because he disapproved of what was still nominally pagan teaching. The effect was to force the teachers in these schools, many of them Neo-Platonists, to migrate to Persia and later to Syria. Their influence led eventually to Arabic translations of Aristotle and of his commentators being made, and a kind of fusion of Greek and Oriental philosophy took place which was carried throughout the lands of the Moslem conquests. In the early thirteenth century it was from Arabic that the com-

[1] H. A. L. Fisher, *A History of Europe* (Arnold, 1941), p. 141.

plete [1] works of Aristotle were translated into Latin—the first step in the great synthesis of Greek and Christian thought which was achieved by St. Thomas Aquinas.

There are also other debts which the civilization of Western Europe owes to the Moslems. (1) Although the Arabic system of modern arithmetic is really of Indian origin, it was introduced into Europe by the Arabs probably about the twelfth century. (2) From the eighth century to the eleventh they did much important work on optics, chemistry, and medicine. Latin translations of some of this work are known, for example, to have exercised considerable influence on Roger Bacon. (3) The work of the most famous Arabic philosopher, Averroes (1120–1198), became in the thirteenth century of great influence in the universities of Paris and Oxford, in spite of the fact that it was frowned on by the orthodox Christian thought of the time. Averroes was perhaps the first man to realize the profound difference between religious and other kinds of knowledge. For him religion was not a set of truths, such as one can obtain in science, but rather a source of power which enabled one to act. He argued that metaphysical reasoning detracted from the value of the *Koran*, which could be understood without any system of theology. (Theology indeed he considers to be a source of unmixed evil, as it attempts to treat scientifically what is essentially non-scientific. Averroes was so far in advance of his time that he was popular with neither the orthodox Christian nor the orthodox Moslem, but, as will be evident from a later chapter, I believe his distinction between the truths of science and those of religion to be fundamentally correct.

[1] Complete, that is, as far as was possible. Prior to this the only Latin translations of Aristotle which were available in Western Europe were the *Categories* and the *De Interpretatione*, both by Boethius.

CHAPTER VIII

THE IDEAS OF SCHOLASTICISM

Upon the whole I am inclined to think that the far greater part, if not all, of those difficulties which have hitherto amused philosophers, and blocked up the way to Knowledge, are entirely owing to ourselves. That we have first raised a dust, and then complain we cannot see.—BISHOP BERKELEY.

THE social system in ancient Greece produced a distinction between two kinds of education which has lasted to the present day, but which had particular significance during the later Middle Ages. The division of human beings into the two classes of freemen and slaves produced a corresponding division of occupations into those appropriate to freemen and those appropriate only to slaves. This in turn gave rise to the idea of two kinds of education—the first, a liberal one, giving knowledge of those arts suitable for freemen, and the second, an illiberal one, giving knowledge of those trades and mechanical skills which could suitably be practised by slaves. The distinction runs throughout much of Plato's thinking and is explicitly stated in the following passage of Aristotle:—

> "It is therefore evident that we shall have to teach our children such useful knowledge as is indispensable for them, but it is equally clear that all useful knowledge is not appropriate for education. There is a distinction between liberal and illiberal pursuits, and it is manifest that only such knowledge as does not make the learner mechanical should form a part of education. By

> mechanical pursuits we should understand all arts and studies that make the body, soul, or intellect of freemen unserviceable for the use and exercise of virtue. This is the reason why we call mechanical such arts as produce an inferior condition of body, and all wage-earning occupations. They allow the mind no leisure and degrade it to a lower level. There are even some liberal branches of knowledge, the acquisition of which up to a certain point is not unworthy of freemen, but which, if studied with undue intensiveness or minuteness, are open to the charge of being injurious in the manner described above. The object with which we engage in the arts or study them, also makes a great difference. If it be for our own sakes or that of our friends, or to produce goodness, they are not illiberal, while a man engaged in these very same pursuits to please strangers would in many instances be regarded as following the occupations of a slave."[1]

Gradually the tendency arose to regard the liberal arts as seven—grammar, rhetoric, dialectic, arithmetic, geometry, music, and astronomy—and this conception was taken over by the Christian Church as part of the heritage it received from the Greeks. Augustine (354–430), Capella (fifth century), and Cassiodorus (sixth century) all wrote treatises on the seven liberal arts, and these, in conjunction with translations by Boethius of Aristotle's *Categories* and *De Interpretatione* and Porphyry's *Isagoge*, were almost all the literature [2] which was available in Europe during the Middle Ages until the acquisition from the Arabs in the early thirteenth century of the rest of Aristotle. The general aim which the pursuit of these arts had at this time was to prepare the individual for the study

[1] Aristotle, *Politics*, 1337 b 4–21.

[2] There was also the *Origines* of Isidore (570–636), but it is in many respects very similar to the work of Cassiodorus.

of philosophy and theology, the medieval combination which has come to be known as Scholasticism.

Scholasticism differed both from the philosophical and theological speculations of the ancient world and from the corresponding speculations of the modern world. It differed from the speculations of the ancient world in that man's reason was not supposed to operate freely, but was supposed instead to justify certain conclusions which were given by the authority of the Church. On the other hand, it resembled the speculations of the ancient world by using the dialectic technique; that is, argument proceeded by the device of question and answer. It may, in short, be described as the application of dialectical reasoning to justify conclusions already reached by faith. Modern speculation on such topics differs in both respects, in that it does not generally use the dialectical method, nor does it consider that there is a fixed set of conclusions which must be accepted by faith. It is the importance attached to both reason and faith, and to the relations between them, which is the distinguishing mark of Scholasticism.

Scholasticism, in this sense, arose about the eleventh century with the attempt to apply certain distinctions of Aristotelian logic to the doctrines of the Church. Porphyry's *Isagoge*, or "introduction" to the Categories of Aristotle, deals with the notions of species and genus, property and accident, and so on, and in it the problem is raised about the ontological status of universals. The problem is perhaps best introduced in the words of Hastings Rashdall at the beginning of his *Universities of the Middle Ages*:—

> "The one fragment of 'the Philosopher' (as Aristotle was called in the Middle Ages) was a fragment of his Logic. And at the very threshold of Logic the student was encountered by this question of the reality of Universals—a question which 'common-sense' will undertake to clear up

in five minutes, or which it will indignantly pronounce too trifling to be asked or answered. Yet he who has given his answer to it has implicitly constructed his theory of the universe.

"In the introduction to the Logic of Aristotle which was in the hands of every student even in the Dark Ages, the *Isagoge* of Porphyry, the question was explicitly raised in a very distinct and emphatic manner. The words in which this writer states, without resolving, the problem of the Scholastic philosophy, have played perhaps a more momentous part in the history of thought than any other passage of equal length in all literature outside the Canonical Scriptures. They are worth quoting at length: 'Next, concerning genera and species, the question indeed whether they have a substantial existence, or whether they consist in bare intellectual concepts only, or whether if they have a substantial existence they are corporeal or incorporeal, and whether they are separable from the sensible properties of the things (or particulars of sense), or are only in those properties and subsisting about them, I shall forbear to determine. For a question of this kind is a very deep one and one that requires a longer investigation.'" [1]

Porphyry thus merely asked a question, and made no attempt to state an answer, but to the early Scholastics, who were ignorant of the problems of Greek philosophy and to whom Porphyry himself was known only through the translation of Boethius, it was a fascinating and stupendously important question. Three answers appeared to be possible. The first is that universals have no existence apart from the mind which thinks them; they are intellectual tools by which we shape and order our experience.

[1] H. Rashdall, *The Universities of Europe in the Middle Ages* (Oxford University Press, 1895).

If, however, universals do exist independently of our thoughts, then two other answers are possible. They may have an existence apart from sensible things, or they may not. The first answer gave rise to the view called Nominalism, and was expressed by the phrase *universalia post rem*. The opposite position—that universals have an independent existence—was called Realism, which was thus of two kinds, according as universals were held to be independent of, or had their only existence in, sensible things. The first kind of Realism was expressed by the phrase *universalia ante rem*, and the second by the phrase *universalia in re*.

To the Nominalist, abstract ideas such as "circularity" are inventions for the sake of linguistic convenience. Only this or that particular circle actually exists. Yet we can obtain general truths about circularity which remain true even when this or that circle ceases to exist. As we have seen, Socrates emphasized the importance of such knowledge, and was perhaps the first Realist. To the scepticism of Heraclitus, who argued that no man could ever step twice into the same river, for both the river and the man would have changed, Socrates replied, "The river passes and the man changes, but the ideas of humanity and fluidity remain." Ideas therefore are stable enough to provide a sure foundation for knowledge. If a further step is taken and sensible things are held to exist only in so far as they resemble the corresponding ideas laid up in heaven, then we have Realism of the Platonic type—*universalia ante rem*. If, on the other hand, universals are not separated from sensible things, we have Realism of the Aristotelian type—*universalia in re*.

The importance of this controversy in the Middle Ages came from its application to Christian theology. If the Nominalists are correct, then the orthodox doctrine of transubstantiation must be false, and so must the orthodox view of the Trinity. These heretical conclusions were urged by Berengarius (999-

1088) and by Roscellinus (1050–1122), and did much to convince the Church of the necessity of adopting Realism as its philosophical creed. This was expounded somewhat uncritically by Anselm (1033–1109), who for a time was Archbishop of Canterbury, but whose fame rests more on the proof which he gave for the existence of God. Thus eventually Realism came to be regarded as giving a spiritual view of the world and as favourable to the teaching of Christ, while Nominalism was held to be the doctrine of sceptics and heretics. Even the attempt of Abélard (1079–1142) to find a compromise, which came to be called Conceptualism, was sufficiently tinged with nominalistic doctrine to involve him almost continually in some kind of persecution. Hence when the second period of Scholastic philosophy commenced towards the middle of the thirteenth century the doctrine of Realism was well and truly established as the official philosophy of the Church.

This second period of Scholasticism was due directly to the influence of the Arabs. During the last few years of the twelfth century and the early years of the thirteenth translations of Aristotle's works were made from Arabic into Latin and introduced into France from Spain, and by 1210 or so it seems likely that the whole of Aristotle was available. Soon he was recognized universally as "the philosopher" and more literal translations were made from the Greek. The effect of this access to new knowledge was immensely stimulating, and this second period of Scholastic philosophy shows little of the narrowness of outlook so characteristic of the first. Yet the two fundamental characteristics of Scholasticism remain. The method of reasoning remains dialectic, and reason is used to justify what must be accepted by faith.

The dominating figure of this period is St. Thomas Aquinas (1227–1274), sometimes called *Doctor Angelicus*. With the possible exception of Augustine, Aquinas has had more influence than any other theo-

logian on the history of thought in Europe, and as recently as 1879 Pope Leo XIII directed all Roman Catholic clergy to take the work of Aquinas as the official account of their faith. His greatest work, *Summa Theologiæ*, was intended to be a compilation of all known learning, designed to exhibit the fundamental truths of the Christian religion. He prepared himself for this work by studying with the greatest care the works of Aristotle and the commentaries on these which had been written by the Arab philosophers. He held that there were two sources of truth—the truths of reason, and the truths revealed in the Christian religion. The truths of reason were found by the application of Aristotle's logic, and the truths of revelation were found in the Bible and in Church tradition. Since both reason and revelation were means by which God made himself known, Aquinas held that the two kinds of truth could never be in contradiction, and he thus attempted a synthesis of Greek and Roman and Christian wisdom, which many people believe has successfully weathered all storms and is as unassailable to-day as ever. The *Summa Theologiæ* consists of three parts, of which the first two, dealing respectively with God and Man, are entirely the work of Aquinas, while the third was started by him, but finished by others in accordance with his plan. He proceeds by the dialectic method. In dealing with the nature and characteristics of God, for example, he expounds, via one hundred and nineteen different questions, not merely many texts from the Bible but a great deal of the Aristotelian philosophy. I do not think I can do better than quote the following passage from Coulton in which he summarizes the elaborate treatment which Aquinas employs to deal with each question:—

> "First, we shall find him always speaking as advocate for what seems the weaker side, alleging all that can be cited for that. Then he

> marshals similar evidence on the other side, often in many paragraphs, but often in the shape of a single Bible text. Then leaving advocacy on either side, he puts on the judge's cap, weighs the evidence, and pronounces sentence. But, finally, he will not leave the court until he has done his best to explain away everything that had been pleaded on behalf of the mistaken side."[1]

While such a method is logically impeccable, its value is seriously weakened by the fundamental assumption of Scholasticism that the framework of thought has been fixed by the Bible and the Church Fathers. In many cases the final answer to a question is really decided by a single text from the Bible, which some people may still claim to be an infallible source of divine revelation, but which many can see to be based largely on the traditions of a primitive community. Thus while, in one sense, it is right to call the Middle Ages the Age of Reason, it is so only in the sense that reason was constantly employed inside the framework of accepted beliefs. It was certainly not the Age of Reason, if reason is used in the sense of reasonableness. For the first essential of reasonableness is the willingness to question presuppositions.

Another notable figure in the thirteenth century was the Franciscan Roger Bacon. He lived approximately from 1210 to 1292, and after attending both the universities of Oxford and Paris he returned to Oxford as a teacher. His lectures there, however, roused such suspicion in the Church that he was forced to go back to Paris to be under supervision, and although he was allowed about 1268 to return to Oxford for another spell, he was eventually cast into prison and was confined for fourteen years. Bacon realized that among even the best of the Scholastics there was fundamental ignorance. It was little use erecting an

[1] G. G. Coulton, *Medieval Panorama* (Cambridge University Press, 1943), pp. 424–5.

imposing building on insecure foundations, and Bacon argued that the foundations of Scholasticism—the Bible and Aristotle—were often extremely insecure. This was because of the widespread ignorance of the essential languages Greek and Hebrew; indeed, the translations were so bad that "if I had the power, I would burn them all." Bacon thus cut himself adrift from the current stream of learning and devoted himself to languages and experimental work in science, and in this respect showed himself to be a forerunner of the Renaissance. Consequently, it is sometimes claimed that he was no Scholastic, but the founder of modern science, misunderstood because he lived so much before his time. There does not seem to me any justification for such a view. His criticism of Scholasticism was not that it rested on the authority of the Bible and Aristotle, but that it depended on wretched translations of these which often gave completely the wrong meaning. He seems to have been quite willing to accept the truths of faith—once these have been made clear by adequate translation. Even in this it is probable that he was unfair to the best of the Scholastics, for the translations which Aquinas, for example, used were not nearly as bad as Bacon would have us think. Thus while Bacon must be considered an outstanding figure of the thirteenth century because of his appreciation of the importance of experimental work, that fact should not make us refuse to classify Bacon as a Scholastic, but rather make us realize Scholasticism was itself partly responsible for the growth of that spirit among men which finally broke loose at the Renaissance.

Before we pass from the contributions which Scholastic theologians have made to the history of thought, we must glance briefly at what is perhaps one of the most important. Many people in all ages have felt the desire to have some absolutely convincing proof of the existence of God, and several ingenious arguments for this were put forward by the Scholastics.

From time to time they have been criticized, modified, and restated, and although from the day of Kant it is doubtful if any have been widely accepted, they have exercised great influence on Christian thought and even to-day are considered to have value by some Christian theologians.

The first of these arguments is due to Anselm, and is called the Ontological Argument. God is defined as " that than which nothing greater can be conceived." As this phrase has meaning, God has existence at least in the mind. But if God existed only in the mind and not in fact, we could think of something greater than God—namely, something which was also real. In this way we reach a contradiction unless we allow that God exists not only in the mind, but also in fact.

The second argument, known as the Cosmological Argument, was given by Aquinas but may be traced back to Aristotle. It reflects the popular feeling that the existence of the world can be explained only by postulating a God who created it. More strictly, the argument runs that each event is a link in a long chain of cause and effect. It is the cause of the event which follows it, and is the effect of the event which preceded it. In this way, either we arrive at a First Cause or God, or there is an infinite chain of cause and effect. As the latter is unintelligible, we must conclude that a First Cause or God exists.

A third argument, known as the Teleological Argument, was not, as far as I am aware, given by any of the Scholastic philosophers, but, as it belongs to the same intellectual atmosphere as Scholasticism, it may conveniently be given here. It was probably advanced first by William Paley (1743–1805) in his *Evidences of Christianity*, and is based on the evidence of purpose and design in nature. Many human organs, for example, fulfil a definite function, and it was argued that they had been designed by a Creator with that in view. The belief that the world is somehow or other

still fulfilling God's plan is even to-day popular among Christians.

I have stated each of these arguments in its barest outline. As I have said, the arguments have been criticized, modified, and restated times without number. Yet no amount of restatement has ever produced an argument that could not be easily refuted by any moderately clever undergraduate. Why then have the arguments survived so long and occupied such an important place in the history of thought? I think the answer to this is that they are an attempt to translate into intellectual language certain feelings which many men from the earliest times have considered important. The ontological argument is an intellectual expression of the feeling that the very idea of God must guarantee his existence; the cosmological argument of the feeling that only the existence of God can explain the existence of the world; and the teleological argument of the feeling that everything that happens is part and parcel of God's plan. If I am correct in this, it is hardly surprising that the logical refutation of these arguments has carried such little weight, for the feelings at the root of the arguments have been left as before. Yet there are signs that such feelings may eventually be brought into line with reason, and the painstaking and unpopular criticism of many philosophers at last rewarded.

> "The arguments for God's existence have stood for hundreds of years with the waves of unbelieving criticism breaking against them, never totally discrediting them in the ears of the faithful, but on the whole slowly and surely washing out the mortar from between their joints."[1]

It can hardly be doubted that Scholasticism contained within itself the seeds of its own destruction. Although completely in the service of the Church, it

[1] William James, *The Varieties of Religious Experience* (Longmans, 1912), p. 437.

roused men from the state of blind belief to that of reason and understanding. Even when it was arguing for the supremacy of faith, it was doing so by means of reason, and the absurd questions which it asked, the useless and arbitrary distinctions which it drew, were all part of the struggle to understand. It was inevitable that such a spirit should awaken a love of knowledge which would not be satisfied by the authoritative dicta of the Church, but which reaped a rich harvest only when the period of modern science began.

CHAPTER IX

THE EMERGENCE OF THE IDEAS OF NATIONALISM AND CAPITALISM

The fear of government may be the beginning of civilization.—G. B. SHAW.

WRITING of the Roman Empire under the Antonines, Gibbon says: "If a man were called to fix a period in the history of the world, during which the condition of the human race was most happy and prosperous, he would, without hesitation, name that which elapsed from the death of Domitian to the succession of Commodus" (A.D. 96–180). It seems doubtful if many people to-day would agree with Gibbon, for the level of prosperity was meagre indeed when compared with modern standards, but the factor which doubtless influenced Gibbon most in his choice was the rule of law within the Empire during these years. Except for a small garrison in Rome itself, the soldiers of the Empire were employed only on the frontiers, and the hundred million inhabitants of the larger part of Europe lived more peaceably together then than they have ever done since. During the many centuries of intellectual darkness and physical strife which followed, this vision of an empire, of vast extent and at peace within itself, continued to dominate the minds of a few men, and it was this vision which was at least partly responsible for the transmission to the different national States, that were one day to arise in Europe, of that unique contribution which Rome made to civilization—its system of law.

Whenever one or two human beings are gathered together, certain rules of conduct make themselves

apparent, and as the community grows in number, the rules grow both in number and in complexity. The rules vary greatly from one community to another, and vary inside the same community at different times, but once they have attained a certain degree of permanence they are dignified by the name of laws, and are then held to confer on the members of the community certain "rights" and "duties." Laws thus govern many of those situations in which an individual enters into some relationship with another—business, marriage, ownership of land and property, defence, and so on—and systems of law will differ not merely in this or that specific instance, but also according to the principles which decide the rights and duties. It is because of this that Roman Law has made such a contribution to the development of Europe. For it is not merely the law of the Roman Republic and Empire, a system the history of which can be traced in considerable detail, but it is also a body of rationalized legal principles which can be transplanted from the particular conditions in which they first grew and flourished, and made to blossom fruitfully in other soil.

Accordingly it was to Roman Law that men looked for help when the Western Empire fell. The first and foremost need of most of the population at such a time was protection—protection against wandering gangs of murderers and looters, protection against a neighbour who was taking advantage of the lack of government control, and so on. This crying need of the time brought forth the distinctive medieval idea of feudalism. If the government of the day is unable to provide protection, an individual must obtain it elsewhere and pay the price demanded. Now there were two institutions recognized in Roman Law which could be of help in such a situation. These were the *patrocinium* and the *precarium*. The former was the old Roman client–patron relationship. Under the changed conditions it came to mean that a helpless

freeman went to some powerful man in his neighbourhood and promised his services in return for protection and support. The *precarium* was a lease of land, given by one individual to another not for the sake of rent, but to discharge some obligation, or perhaps for the sake of friendship. It was accordingly such that the lessee had no rights at all with regard to the land. When the owner considered that he had done sufficient for the duties of friendship or had discharged his obligation sufficiently, then he would terminate the agreement. In the new conditions of the Middle Ages, an individual who owned a little land, but who was quite unable to defend it against predatory neighbours, would ask his "patron" to protect it for him. The strong man would agree to do this provided he became the legal owner and the weak man held the land only as a *precarium*.

This arrangement was strengthened by financial causes. We know that in the later Empire money was extremely scarce in spite of occasional debasements of the currency. Moreover, the arts and commerce of earlier days had ceased to exist, and practically the only industry was agriculture. Thus the holder of a small plot of land was notoriously at the mercy of the harvest. If a crop should fail he had no security and, with the shortage of currency, no money to see him through the coming winter. Hence the institutions of *patrocinium* and *precarium* afforded not only protection from physical violence, but, just as important, a certain amount of economic protection as well. Since, however, a man is "strong" or "weak" only in relation to other men, as feudalism developed a kind of hierarchy grew up with the sovereign and then the barons at the top, but the fundamental principle remained that each man owed service to the man above him from whom he held his land.

The system declined as conditions arose which enabled the government of a country to free itself from exclusive dependence on the barons. A professional

class came into being to administer the law, an increasing circulation of money made uniform taxation possible, and that taxation enabled the government to buy military service, which in turn removed the fundamental need for a feudal society. Yet although feudalism was dead or dying throughout Europe by the end of the thirteenth century, it had left its mark on European social ideas. Each individual held a rank higher or lower with respect to other individuals. The position held by an individual conferred upon him privileges which enabled him to enforce claims on those lower in the scale, and also conferred upon him obligations which entailed his performance of services and homage to those higher in the scale. All influence and power proceeded from above to below—nowhere was it less true that action and reaction were equal and opposite. We are all familiar with the extent to which such ideas have permeated the whole structure of society.

If feudalism arose because of the weakness of government, it could hardly be expected to provide an adequate substitute for government. Of the three elementary activities which are generally demanded of any government—an adequate defence against aggressors, a just legal system, and a revenue collected by taxation and used for the public benefit—feudalism attempted to provide only the first two, and these very inadequately. (It was not surprising, therefore, particularly when better facilities for communication made the exchange of ideas easier, that increasing centralization of government should take place with the monarchy as the central figure.) Conditions varied greatly in different parts of Europe, but in the west what began as a civil war in France ended after several centuries with the emergence of two distinct nations, England and France, with a national State in Spain not far behind. Such States were pitifully weak compared with their modern counterparts, and discharged few of the duties which are taken for granted

by people everywhere to-day, but they were national in the sense that by the sixteenth century men were for the first time beginning to think and act in national groups.

With the memory of two world wars fresh in our minds we may justifiably wonder whether this emergence of national States in Europe could not have been avoided. Those who worked for European federation between the wars and who failed so tragically must often have thought wistfully of the days when Europe was one vast Empire, and when the ideas underlying such phrases as " balance of power " and " diplomatic rivalry " had not yet been formed. Nevertheless it is difficult to see what else could have happened, and the factor which probably made nationalism inevitable, and at the same time increased immensely its potential dangers, was the growth of capitalism.

The spread of Christianity had affected commercial enterprise to a considerable extent. Under the Empire in pre-Christian times there had been no restrictive practices in trade. As long as a trader did not actually cheat he could buy and sell as he pleased and make what profit he could. But to the early Christian life was not as simple as that. To begin with he was almost entirely concerned with the problem of the salvation of his soul, and the teaching of Christ plainly emphasized the difficulty which a wealthy man would have in entering the Kingdom of Heaven. In addition there were clear injunctions to do unto others as you would like others to do to you. I do not know how business men at the present time who also profess to be Christian reconcile such advice with the practice of buying in the cheapest market and selling in the dearest, but the early Christians, at any rate, were quite clear that the two could not be reconciled. The most that they would admit was that a man who was going to make something could charge for his labour. That is, they condemned anyone who bought an article and sold it un-

changed for more than he paid for it, but they would allow him to sell it for more if he had worked on it to make it something different. That would appear to be a logical conclusion from Christ's teaching.

It seems inevitable, however, that all movements should, after a time, lose some of the freshness of their ideals and accept compromises which the founders would indignantly have rejected. Such was the case with the Christian attitude to trade. Instead of the condemnation of profit-making, we find rather the idea of the Just Price—an idea which underlay most of the economic theory of the Middle Ages. According to this a man was justified in selling at more than his buying price, provided he sold at that price which would just enable him to live in his station of life. If he sold at more than was reasonably required to maintain this, then he should be condemned. St. Thomas Aquinas makes this quite clear. He regards trade not as sinful in itself, but as being liable to corrupt. Some trade he recognizes as necessary for the general good, but when trading is done for the mere sake of gain and not for the necessities of life it is sinful. The difficulty about the idea of the Just Price is, of course, its practical application. Even in a hierarchical feudal society it is not easy to say what profit is necessary, on an average, to maintain a household in a given station, and it seems clear that while the idea of the Just Price was important in medieval theory, it had no great influence on day-to-day financial transactions. Indeed, during the second war to end war we, in England, have probably come nearer to the application of the idea of the Just Price than ever before. For maximum prices were fixed for many commodities, and profits controlled in a way which, I am sure, would be a source of immense gratification to St. Thomas if he is still able to take an interest in the affairs of this world.

In a similar way we find that the Church's teaching was unable to prevent the growth of what we now

call the capitalist system. In the early Middle Ages "usury"—the taking of interest for the loan of money—was universally condemned, but by the thirteent century the weakness of human nature allied to the growth of trade had made its practice widespread and openly approved by many in the Church. The practice is clearly inconsistent with Biblical teaching, but it is idle to deny that it may often be for the general good as well as for the benefit of the capitalist. Money, which might otherwise lie rolled up in a napkin, may, if loaned for some commercial enterprise, increase employment, increase production and capital goods, and generally help to raise the standard of life everywhere. So much must be admitted by even the most hostile critic of capitalism.

On the other hand, there are two grave weaknesses. In the first place, the system, if logically applied, leads to many cases of great hardship. If an investor has the choice of lending £100 either to a safe and prosperous business or to a "small man" to keep him going during the winter after a bad harvest, it is likely that he will choose the safe investment even if it means the possible destruction of the small man. In some cases, if promised an unusually high rate of interest, an investor may choose the less safe of two investments, but then the repayment may well prove too much for the borrower. The capitalist sees in this, however, nothing but good. If a small man is lazy or foolish enough not to make sure of his harvest then it is uneconomical to help him to survive for the next. Only those enterprises which have shown themselves successful, or likely to be successful, should be encouraged. Under capitalism, then, we can expect the successful to become more successful, while the unsuccessful are eliminated, and those who are neither very much the one nor the other will benefit from the steadily increasing standard of life made possible by the efforts of the successful. The history of capitalism in Europe and America has merely repeated this *ad*

nauseam. What is not always realized is the profound difference which exists between such a system and the system envisaged by the early Church. To balance the destruction of a human being against the increased prosperity of another is a way of thinking entirely foreign to the teaching of Christ.

The second grave weakness was the association of capitalism with nationalism. The growth of capitalism produced a strong middle class whose material welfare would be continually threatened by the insecurity attendant on feudal society, but which would benefit enormously from a strong central government. Thus the traders, bankers, and merchants all rallied in support of the new national States that were growing up. So far, so good. But the time came when the capitalists were no longer content to invest capital within the confines of their own States, but sought more profitable remuneration abroad. New countries rich in minerals and raw materials were discovered, but there was no attempt made to share the benefits equitably among all concerned. Instead there was a scramble among the leading States to get there first, and the period of international rivalry, the horrors of which are all too familiar to us at the present time, commenced. National armies were raised to defend the new territorial gains or to attack the acquisitions of a rival State, and perhaps the greatest opportunity which Europe has ever had or is likely to have for embarking on the peaceful development of civilization was lost.

CHAPTER X

THE INFLUENCE OF THE REFORMATION

It is with the mysteries of our Religion as with wholesome pills for the sick, which swallowed whole, have the virtue to cure; but chewed are for the most part cast up again without effect.—THOMAS HOBBES.

IT was in the new Europe of growing national States that the Protestant Reformation began. This was the movement inside the Western Church during the sixteenth century which led to its disruption and the formation of national Churches, but it is doubtful if such a movement would have succeeded had it been purely religious in origin. In the fourteenth century, John Wyclif (1324–1384) and his followers, the Lollards, had attacked many of the practices which were flourishing under the authority of the Church—the sale of indulgences, the celibacy of the clergy, and so on. He received considerable support from men like John of Gaunt, who wished to see some of the wealth removed from the hands of the Church and returned to the nobles. But the clergy had no great difficulty in suppressing the agitation, which under persecution rapidly died out in England, although it left some repercussions on the Continent. Very different, however, was the position when Martin Luther in 1520 publicly burned a copy of the Canon Law. By this time many of the princes and kings of Europe had come to realize the burden which papal taxation inflicted upon them, and by this time they were sufficiently strong to be able to assert their independence. Moreover, the confiscation of the property of the monasteries (in England the Church

possessed about one-third of the land) and the relief from taxation combined together to make a "reformed" king stronger than ever. The growth of national States, which has contributed so much to the structure of the world as we know it to-day as contrasted with medieval feudalism, was thus not only partly responsible for the Reformation, but was in its turn strengthened by it.

We must look, however, more closely at the ideas underlying the Reformation. It must be remembered that the Church of the Middle Ages exercised many of the functions which we now associate solely with a temporal government. Maitland has put this point very clearly:—

> "We could frame no acceptable definition of a State which would not comprehend the Church. What has it not that a State should have? It has laws, law-givers, law courts, lawyers. It uses physical force to compel men to obey the laws. It keeps prisons. In the thirteenth century, though with squeamish phrases, it pronounced sentence of death. It is no voluntary society, if people are not born into it they are baptized into it when they cannot help themselves. If they attempt to leave they are guilty *crimen laesae majestatis*, and are likely to be burned. It is supported by involuntary contributions, by tithe and tax."[1]

At the head of this all-powerful organization was the Bishop of Rome, or Pope, who claimed to be divinely appointed and to have power to judge all but to be judged by none. For centuries the claim of the Pope to be supreme authority on all religious matters was undisputed, and this carried far-reaching implications with it. For we have seen that one of the central

[1] F. W. Maitland, *Roman Canon Law in the Church of England* (London, 1898), p. 100.

ideas of the early Church was that of salvation. Consequently, however powerful a temporal ruler might think himself to be, he was none the less in the eyes of the Church a miserable sinner who needed salvation. The Popes thus wielded immense power not only in the realm of the spirit, but also in the courts of kings. Eventually, however, they were not content even with this, but claimed more direct power. (Nicholas II in the eleventh century propounded the view that Christ had given to Peter an earthly as well as a heavenly empire, while Innocent III taught that nothing less than the government of the whole world could suffice for the Pope.)

These remarkable claims undoubtedly weakened the authority of the Church in the long run. We need only recall such incidents as the annulling of Magna Carta by Innocent III. (In pursuit of his claim to be ruler of the whole world, Innocent published a papal bull in 1215 which declared Magna Carta to be null and void, and followed this by excommunicating the barons who had been responsible for it.) By actions such as that the Popes demonstrated that in the affairs of this world they were on the side of the conservatives, and against the development of civil or political liberty. In this they have perhaps been little worse than the leaders of other organized religious groups, but it told heavily against them when in the fifteenth and early sixteenth centuries there was ever-increasing agitation for economic and social betterment.

The most important idea, however, which underlay the whole Reformation movement was the idea of freedom from ecclesiastical authority. In comparatively recent times this has been denied. It is pointed out that in Luther's address *To the Christian Nobility of the German Nation respecting the Reformation of the Christian Estate*, his first appeal to the people of Germany, he deals with economic and social matters and hardly mentions religious. It is also argued that the Reformers were no more tolerant of religious

freedom than the Popes. While they no longer attached the same importance to images, to the Virgin Mary, and to the saints, they still held fast to the conceptions of the Trinity, immortality, the infallibility of the Bible, and so on. In other words, it is argued that they were just as dogmatic as the leaders of the Roman Church, but were dogmatic about different matters. There is undoubtedly considerable truth in this. The modern idea that, as no religious belief can be proved, a man should be free to choose any or none, as he pleases, is completely foreign to the Reformers' way of thinking, and they would cheerfully have consigned to a Hell, no less hot than that imagined by the Popes, anyone who entertained it. But while we must admit that, it still remains true that the underlying idea of the Reformation is the protest against authority. The apparent contradiction is, I think, easier to understand if we consider a modern analogy. There are no people to-day who are at the same time more dogmatic and yet more intolerant of authority than scientists. They claim that nothing should be accepted on authority, and at the same time dogmatize firmly on the results of their own branch of science. Now this seems to me perfectly reasonable. Their rejection of authority is determined by their belief that the method of experiment and demonstration must reveal the truth, but once it has done so, it can be verified by others, and hence we can legitimately dogmatize about it, for it is a matter not of individual but of public knowledge. Now there is a point of resemblance here to the situation created by the Reformers, as well as a point of difference. The Reformers emphasized the supreme importance of a man's own conscience over against the deliverances of the officers of the Church. In this they were protesting, as vigorously as a present-day scientist, against the evils of authority. And, if the consciences of all men spoke with one voice, then it would be as correct to be intolerant of any deviations from that voice as

it is to-day to be intolerant of anyone who refuses to accept scientific knowledge. The combination characteristic of the Reformers—the rejection of authority with intolerance—is not therefore logically unsound, although it was based, in their case, on a false premise. For, unfortunately, one man's conscience does not guide him to do the same as another man's. The Reformers were therefore right in stressing the importance of freedom from authority, but went too far when they assumed that the subjective certainty of one man would agree with the subjective certainty of another. It is precisely because these apparent certainties so often disagree that no science of religion is possible.

The effects of throwing off the shackles of authority were felt not only in the sphere of religion, but perhaps even more so in other branches of thought. The world of to-day began to assume a place of importance hitherto reserved exclusively for the world hereafter. Marriage, for example, had always been considered as inferior to celibacy, but now it came to be looked on as something ordained by God, while celibacy was considered unnatural and inferior. Similarly, poverty, the idea of which played a considerable part in monastic life, was no longer considered an end in itself—this fresh outlook on wealth being eagerly welcomed by the rising capitalists of the new Europe. But perhaps the sphere where the most important effect was found was that of education. The immediate effect of the Reformation on education was almost disastrous, but the long-term effect was of inestimable value.

A great deal of the bitterness which had been aroused against the Church extended also to the institutions which were either directly or indirectly under its control, and hence in particular to the schools. Moreover, as we have already noted, a powerful factor in influencing many of the kings and princes who supported the Reformation was the excuse to appropriate the endowments of the Church.

Both these reasons combined to make the immediate effect of the Reformation on education simply that of closing certain of the schools. It was mainly for this reason that Erasmus (1464–1536), who would have liked to see the Church reformed, disapproved of the whole movement. That the long-term effect was of great value to education was due in very large measure to the work of Luther. He early realized that in a society no longer under the authority of the Church education was more necessary than before. For, whereas in the past it was sufficient if the clergy and the political leaders had been educated, it was now necessary that the general public should be educated as well, not merely for the utility value of education, but so that everyone should be able to read the Bible. Hence after the German Church had severed its connection with Rome in 1521, Luther commenced his translation of the Bible into German. He also publicly declared that the State ought to provide schools and compel attendance at them if necessary. Large sums of money, he argued, were spent on roads, armies, etc., and the same ought to be done for education:—

> "If the magistrates may compel their able-bodied subjects to carry pike and musket and do military service, there is much more reason for compelling their subjects to send their children to school. For there is a far worse war to be waged with the Devil, who employs himself secretly in injuring towns and States through the neglect of education."

As a result of the efforts of Luther and later of Calvin (1509–1564) many schools came to be organized on a Protestant basis, and education, which had threatened to cease, became more universal than ever before.

Because of the emphasis which it laid on the individual, the Reformation must also be considered as a

valuable move in the struggle for freedom in general as well as for freedom from ecclesiastical authority. At the present time, when the second of two world wars, often alleged to be in defence of freedom, has come to an end, and millions all over the world have found that almost the only freedom which they have is freedom to die, we are inclined to listen somewhat cynically to panegyrics on behalf of freedom. Nevertheless it would be idle to deny that it is an idea which has, particularly in the spheres of civil and political life, on countless occasions stirred the mind of man. Yet these ideas are by no means simple.

Under the idea of civil freedom can be listed at least the following:—

Freedom (1) from fear as to my personal safety;
(2) from fear as to the safety of my property;
(3) to move when and where I please;
(4) to speak and write what I think;
(5) from fear of unjust imprisonment;
(6) from fear of economic insecurity;
(7) to worship as I please;
(8) to assemble with whom I like.

Under the idea of political freedom I should be inclined to list:—

Freedom (1) to advocate amendment of the laws;
(2) to criticize policies;
(3) to vote by secret ballot;
(4) to hold office in government if selected by one's fellows.

It must not be supposed that in any State at any time all these freedoms have been available. Indeed, it is fairly obvious that, at least in conditions that seem to be inherent in human life, some of them conflict with others. If fear of economic insecurity is to be removed over a wide area, then it is doubtless necessary to make

sure that certain essential work is done, which will therefore prevent everyone from moving wherever and whenever they please. Again, if my personal safety is to be secured, it can only be by subsidizing a police force, for which I will have to pay by giving up some of my property and so on.. It is therefore quite impossible that all of these freedoms will ever be attained. Yet most people at most times have, with sound instinct, striven for as much as possible of each one. And here, it seems to me, we come to the chief contribution which the English-speaking peoples have made to civilization. Ever since the thirteenth century, when the foundations of both civil and political liberty were laid, the English have been in the forefront of the struggle. It is unfortunately true that they have struggled much more for themselves than for others, such as the inhabitants of India, who have been dependent on them, but it seems probable that they are beginning to realize that when liberty is threatened in one place it is threatened everywhere. For this early lead in man's struggle to secure as much freedom as is possible, the English debt to the Reformation movement is a heavy one.

CHAPTER XI

THE TRANSITION TO THE AGE OF SCIENCE

If men cannot live on bread alone, still less can they do so on disinfectants.—A. N. WHITEHEAD.

THE Renaissance is the name which is sometimes given to the period of transition which occurred between the end of the Middle Ages and the beginning of the age of science. During this period a number of different streams of thought converged, and, once united in a common flood, they succeeded in forcing their way into a new world. One of the streams which contributed to the flood was the revival of ancient learning, a revival which by itself is sometimes given the name of Renaissance. The word "renaissance" literally means rebirth; in the narrower sense it is the rebirth of an interest in classical learning, in the wider sense it is the rebirth of the free exercise of man's faculties.

As we have already noted, the struggle to understand, which was typical of the best Scholastic philosophers, led to a loosening of the grip which the ideas of the Middle Ages had exerted over men's lives. In particular the doctrines of Averroes and the revival of Nominalism by William of Occam (1300–1349) had considerable influence in bringing about the decay in the Church which was characteristic of this period. But it is unlikely that any internal weakness by itself would have enabled man to throw off the shackles of ecclesiastical authority. Fortunately several other events occurred which helped.

Although the principle of the mariner's compass is supposed to have been known to the Chinese about a

thousand years before the birth of Christ, it was not until more than two thousand years had elapsed that it was introduced into Europe. Then we find a series of geographical explorations beginning which completely changed man's picture of the world. In the closing years of the thirteenth century Marco Polo travelled extensively in Asia, while in the early years of the fifteenth the Portuguese discovered the Azores and pushed down the west coast of Africa. But even these journeys paled into insignificance beside the later achievements of Columbus and Vasco da Gama. All these explorations not only produced a wider mental outlook, but permanently influenced life in Europe in two respects. In the first place, they opened up new sources of wealth which had previously been undreamt of. Not only were new markets made available, but new sources of supply for gold and silver were discovered. This led to an increasing currency circulation, with the familiar result that prices rose. Rising prices are an incentive to producers and traders, so the number of capitalists, in the modern sense, rapidly increased. In the second place, travellers returning from visits to these newly discovered countries told of the differing customs and religions of the natives. It was not so easy, in the light of such evidence, to be sure of the universality of the Church's dogmas. It will be remembered that it was to evidence of this sort that John Locke appealed when in the seventeenth century he launched his famous arguments against the view that certain ideas, such as that of God, are innate.

Another instrument bringing about the change to the age of science was the Revival of Letters, or the Renaissance in the narrower use of that term. This is generally considered to begin with Petrarch (1304–1374), who attempted to restore a taste for classical Latin in opposition to the Latin of the Scholastics, which had little beauty either of form or expression. But it was really not until 1453 that the Revival of Letters can definitely be said to have commenced. We

have seen that during the first part of the Middle Ages the study of the ancients had been severely limited to a handful of texts. Even in the second period, when more texts were available through translations from Arabic, few scholars took the trouble to learn Greek. (But in 1453 Constantinople, the capital of the first Christian Emperor of Rome, was stormed and taken by the Turks, and many learned Greeks fled to the West, bringing with them ancient manuscripts and, still more important, an enthusiasm for the spirit of ancient Greece.) The study of ancient writers from the original sources now became, if not exactly popular, at least fashionable, and the spirit of free inquiry in philosophy and science began to stir again in the hearts of men. This revival of ancient learning was also stimulated by the use of the printing-press. It is generally thought that paper was invented in China somewhere about the beginning of the Christian era, but it was not until after the Crusades that it was first produced in Europe. Then in the fifteenth century the introduction of movable type enabled books to be printed with comparative ease, so that copies of the newly discovered classics were quickly multiplied and for the first time fresh ideas could receive a wide circulation.

The most important movement, however, in this restless period of man's education was the coming into existence of natural science. Scholasticism had lived in a world of thought divorced completely from the world of sensible experience; and the interest which men gradually began to take in the workings of nature extended man's mental horizon even more strikingly than the voyages of discovery had extended his physical horizon. It is only since the Renaissance that natural science has become of historical importance, and only since then that it has possessed a continuous record of triumph. It has changed men's lives almost out of recognition and has become by far the most important influence at work in the world to-day.

The first epoch-making event which resulted from this new shift of interest took place in 1543, when Copernicus published on his death-bed *De Revolutionibus Coelestium Orbium*, a work the importance of which for mankind has perhaps been equalled only by Newton's *Principia* and Darwin's *Origin of Species*. At the present time it is difficult for us, brought up on relativity theories, to get very excited about the question whether the earth revolves round the sun or whether the sun revolves round the earth. But in 1543 the statement that the earth, instead of being the being the centre of the universe, was a planet revolving round the sun was sufficient to tear into shreds the whole scheme of the universe. Everyone believed that Heaven was literally above the earth and in Heaven lived God, the angels, and those spirits which had obtained salvation. Similarly Hell was literally below the earth, and there the lost souls of men were tortured and tormented while the Devil and his angels looked on. Thus a revolving earth meant that God and his angels were continually revolving. Moreover Aristotle had taught that the remote regions above the earth were perfect and changeless, but if the earth rotates round the sun the region above the earth is continually changing. The difficulties involved in the Christian creeds were also enormous. They clearly affirm that Christ descended into Hell and ascended into Heaven, and what are men to make of such statements if Hell and Heaven can no longer be geographically located?

There is a certain amount of doubt how far Copernicus himself realized the revolutionary consequences of his view. In his dedication to the Pope, he states that he was led to consider the possibility of a new theory of the heavenly bodies from the differences which already existed among mathematicians on the subject. Moreover it seems clear from some passages in the book that he held the view that his explanation was to be preferred to the orthodox one merely

because it gave a simpler account of the phenomena. This attitude to the world of science—that the simplest explanation of the facts should be adopted—was possible for Copernicus because a background of thought distinct from the Aristotelian–Christian scheme persisted throughout the Middle Ages. We have seen how Pythagoras attached great importance to a mathematical view of the universe, and this had considerable influence on Plato, especially in his later works, and still more on the Neo-Platonists. Now we have already noted the cordial relations which existed between Christianity and Neo-Platonism, and it was hardly surprising that when, in the early Middle Ages, a philosophy of the Christian religion was developed it should be largely in a Neo-Platonic cast. When, in the thirteenth century, after Aristotle had been rediscovered, and a magnificent synthesis of his philosophy and Christian theology had been achieved, Neo-Platonism became a kind of nonconformist doctrine which, while its followers were few in number, still retained a certain amount of influence. In the disturbed period which heralded the Renaissance this Neo-Platonic background played a large part, and it is generally held to be responsible for the revival of Pythagoreanism, which we find represented by Dominicus Maria de Novara, Professor of Mathematics at the University of Bologna and friend and teacher of Copernicus. Thus the discovery of Copernicus must partly be thought of as the culmination of the long-standing controversy between a Pythagorean and an Aristotelian outlook. According to the former the universe is fundamentally mathematical and the cumbersome Aristotelian–Ptolemaic system of astronomy is a horrible violation of mathematical beauty. According to the Aristotelians, mathematics is not a specially important tool with which to investigate nature. Only in a few of its aspects is nature quantitative, and the highest knowledge is logical rather than mathematical.

But whether Copernicus fully grasped the importance of his discovery for the intellectual future of the race, or whether he merely thought that he was helping to re-establish a Pythagorean–Platonic outlook against the prevailing errors of the Aristotelians, it was not long after his death before the full consequences of his view were realized and bitter opposition was aroused. For the first time the Christian Church found itself confronted by those who denied the truth of its teaching about the universe. There has rarely been a more critical period in the education of the human race than this. Now, if ever, was the time for the leaders of the Church to appreciate the errors of their ways. (By uniting Christian theology with Aristotelian metaphysics the Church had become committed to a view of the universe which had proved to be false. The sensible step was to sever all Christian teaching from the world of science.) As long as the Church professed to teach the truth about the universe there would always be the possibility of recurring conflicts as the scientific investigation of nature advanced. If, on the other hand, the Church gave up all pretence of legislating on the nature of the universe and confined itself to those personal aspects of experience which, as I shall argue in Chapter XVIII, are part of the province of philosophy, then it would be forever in an unassailable position. The decision not to withdraw from an untenable position must be considered a colossal tragedy. In mitigation of the Church's action it may be urged that it was distracted at the time by the internal conflict which came to a head in the Reformation. Yet there is little evidence that even without such a conflict wiser counsels would have prevailed. (The leaders of the Inquisition, equally with Luther and Calvin, denounced the Copernican outlook, and the battle between religion and science, which has distracted the minds and wasted the energies of so many generations, had started in earnest.)

The hundred and fifty years following the death of

Copernicus witnessed a remarkable development of scientific knowledge. During this period such fundamental discoveries were made as those by Gilbert on magnetism and by Harvey on the circulation of the blood. Yet these were overshadowed by the still more important work of Galileo and Newton. The new knowledge about the motion of the earth round the sun stimulated Galileo to consider the possibility that the movement of small portions of the earth might be describable in mathematical terms. This attitude to nature marked a great advance. Copernicus and Kepler, who made so many of the calculations which confirmed the Copernican theory, were both thoroughly medieval in their outlook. Kepler, for example, conceived the planets to be propelled on their courses by heavenly influences. Galileo discarded this anthropocentric view and originated the scientific procedure of asking, How can we describe the motion rather than why do things move? I do not think the popular view that science does not ask questions starting "why . . ." is borne out by scientific practice, but there is at least this truth in it, that there is no use asking "why . . ." until we have answered the question "how . . ." It was this fundamental achievement which we owe to Galileo and which justifies the description of him as the first modern scientist.

Another aspect of this change of procedure was the way in which science was beginning to free itself from metaphysical speculation. The medieval substances and causes which were alleged to give a teleological explanation of motion were renounced in favour of a mathematical description of motion in terms of the measurable quantities weight, space, and time. It is true that Kepler had discovered mathematical laws governing the motions of the heavenly bodies. But he thought of these laws as the cause of the observed facts; that is, as formal causes in the Aristotelian sense. This attitude led to some extraordinary

mistakes. For example, as far as the accuracy obtainable at the time permitted, it was found to be possible to fit the five regular solids between the spheres of the six known planets in the following way:—

Sphere of Saturn
Cube
Sphere of Jupiter
Tetrahedron
Sphere of Mars
Dodecahedron
Sphere of the Earth
Icosahedron
Sphere of Venus
Octahedron
Sphere of Mercury

Kepler argued that this was the cause of there being six planets, and consequently there could be neither any more nor any fewer. All this fantastic scheme was swept away by Galileo. He asserted that to find out the truth about nature we must not rely on the authority of Aristotle or alleged a priori arguments, but must carefully observe nature. "I know very well," he says, "that one sole experiment, or concludent demonstration, produced on the contrary part, sufficeth to batter to the ground these and a thousand other probable arguments." It was, I think, because of this new attitude to the study of the universe that the conflict with the Church centred round physics and astronomy. One might have thought that the anatomical and physiological work of Vesalius and Harvey would have disturbed the theologians very much more than the observation of inanimate objects conducted by Galileo. Yet these biological discoveries, and even the speculations of Descartes on the mechanical nature of animal behaviour, seemed to leave the Church quite unmoved. The reason was that these discoveries could be interpreted in a teleological way. After all, there are few things more

teleological than a machine, and if animals are machines then we have a first-class argument ready to hand to refute atheism! But Galileo urged that this whole point of view should be discarded. Matter in motion was not to be explained by means of such principles as causality, but by obtaining a mathematical relation between its position at one time and its position at a later time.

Thus Galileo pictured the whole physical universe as susceptible of mathematical investigation. Those characteristics which did not lend themselves to mathematical treatment came to be called secondary qualities, while those which did were called primary qualities, and it seems that Galileo considered the secondary qualities to be entirely subjective and due to the untrustworthiness of our senses, while the primary qualities were objective and true of the external world. Few scientists to-day would limit the external world to that characterized by Galileo's primary qualities, yet I think it is true that Galileo was the first person to look at nature from the same point of view as the modern scientist, and it is not too much to say that in doing this he started a new age in the education of the human race. (The problems involved in this idea of investigating nature by observation and experiment (often grouped together as the problem of induction) must be reserved for the next chapter.)

CHAPTER XII

THE IDEA OF INDUCTION

"She's a rum 'un is Natur'," said Mr. Squeers. . . . "Natur' is more easier conceived than described."—CHARLES DICKENS.

THE fundamental problem of induction is that of justifying a generalization based on the observation of particular instances. We are all so familiar with the process—although we may be quite unable to justify it—that it is not easy to realize the enormous advance that was made by the adoption of the attitude whereby knowledge about the world was to be obtained by observation and not by a priori reasoning. In one sense, of course, induction is as old as man. It would have been quite impossible for our ape-like ancestors to have adjusted themselves to the day-to-day changes in their environment unless they had used, in a rudimentary sense, inductive inference. But it was not until the time of Galileo and Bacon that it was realized that the ordinary use of induction could be systematized to give a scientific method of extraordinary power.

It is to Bacon, whose contribution tends to be a little despised at the present time, that we owe the first account of the method. He understood that, while in ordinary life men observed a few instances and made generalizations, much more than this was required from scientists. In the first place, they must experiment as well as observe, because it was often only from artificial conditions that the answer to questions about nature could be obtained. In the second place, they must organize their investigations in such a way that their observations contained

instances where the thing investigated was present, instances where it was absent, and instances where it was varying. When their observations had been classified in these three ways they must then eliminate anything which was present when the thing investigated was absent, anything which was absent when it was present, and anything which did not vary when it varied. Only after all these steps have been taken can scientists reach the generalization that whatever was present, absent, and varying when the thing itself was present, absent, and varying is always essential to the thing.

It is this systematization of ordinary experience that Bacon believed to be a new instrument—the *novum organum*—in the investigation of nature. The basic idea in it is that things which we find in experience to be present together, absent together, and varying together are universally connected. (This idea has been of immense value, and, as developed by Mill under the names of agreement, difference, and concomitant variation, is still the foundation of the inductive methods described in modern text-books.) The genius of Galileo used the method before it was formulated by Bacon, but it was the latter's explicit formulation which established induction as an essential part of scientific method.

It is true that Bacon's work, perhaps because he minimized the importance of deductive reasoning, did not have the influence on the practice of science for which he had hoped. For example, no part of Newton's *Principia* makes any reference to the work of Bacon, just as two centuries or so later Darwin's *Origin of Species* seemed to be quite independent of Mill's corresponding work. But this need not surprise us if we distinguish between the two questions of helping the scientist and analysing what the scientist does. Bacon, as we have seen, thought that he had discovered a new method of thinking which would revolutionize scientific discovery just as the mariner's

compass, to which he compared it, revolutionized geographical discovery. But few logicians have ever aspired to such a goal. Rather they conceive their task to be first of all the analysis of the way scientists think, and secondly the justification of that way. Although Bacon did virtually nothing to show how inductive thinking could be justified, he did great service, at a time when Scholasticism was far from dead, in showing that scientific thought could not be analysed as purely deductive. It was this explicit realization of the importance of superseding the deductive rationalism of the Scholastics by organized methods of observation and experiment that the world owes to Bacon.

This distinction between helping the scientist and analysing his practice may be noted also in deductive logic. Although, like Bacon, Aristotle developed his theory of the syllogism because he hoped it would be of use in science, it is very doubtful if any scientist in his work has ever deliberately made use of it. The distinction becomes even more evident in modern deductive logic. It is quite certain that no scientist when he has to do simple arithmetical sums goes through a proof of the type envisaged by the authors of *Principia Mathematica*. (The value of deductive logic from Aristotle to Whitehead and Russell lies in the fact that it exhibits the formal nature of such arguments, and makes explicit the premises and principles of inference which are involved.) It is this kind of goal which should also be aimed at by inductive logicians. Mill realized this clearly when, in the preface to his *Logic*, he wrote that his object was to generalize "the modes of investigating truth and estimating evidence, by which so many important and recondite laws of nature have, in the various sciences, been aggregated to the stock of human knowledge." The situation may be compared with that which occurs in the study of language. Few people, once they have learned to speak a language well, ever think of the

grammar of the language when they are forming their sentences. Yet the study of grammar is important, as it analyses the way in which words are used in sentences. Similarly the grammar of science may be conceived to be the logical analysis of the way in which scientists think, and Bacon was the first logician to appreciate fully that this could not be covered merely by the theory of the syllogism eked out by common-sense induction after a few observations.

While Bacon succeeded in analysing the essential steps to be taken in generalizing from particular observations, he did not succeed in providing a logical justification for the truth of the generalization so arrived at. It is this which is usually referred to as the modern problem of induction, and it can hardly be better posed than in the words of David Hume, who was perhaps the first person to urge explicitly the need of such justification :—

> "It is only after a long course of uniform experiments in any kind, that we attain a firm reliance and security with regard to a particular event. Now where is the process of reasoning which from one instance draws a conclusion, so different from that which it infers from a hundred instances, that are in no way different from that single instance? This question I propose as much for the sake of information, as with any intention of raising difficulties. I cannot find, I cannot imagine such reasoning. But I keep my mind open to instruction, if anyone will vouchsafe to bestow it on me."[1]

It is worth emphasizing the point that Hume did not consider the inductive method was wrong, but merely that no justification of it had been given—a comment which even to-day is singularly appropriate,

[1] David Hume, *An Inquiry Concerning Human Understanding*, Section IV.

in spite of the attempts which have been made from Kant onwards.[1]

Fortunately the failure to find a solution to the logical problem of justifying a generalization did not hinder the rapid development of modern science. One of the immediate results of Bacon's work was the growth throughout the seventeenth century of an enthusiastic interest in the study of nature. For the first time men began to look on nature as something to be inquired into, rather than as something to be accepted.

The traditional view is well described by Robert Boyle (" Father of Chemistry and Uncle of the Earl of Cork ") in his *Free Inquiry into the vulgarly received Notion of Nature.* Nature was a kind of " semi-deity or other strange kind of being ":—

> " Nature is exceedingly wise and all her works are performed with understanding . . . Nature always does what is best. Nature always acts in the shortest manner. Nature is never too lavish, never too sparing. Nature always preserves herself."

The new attitude was directly opposed to this sort of thing, and considered nature quite impersonally. Its advocates were eventually responsible for the foundation of the Royal Society in 1661, a date which must always remain a landmark in the history of scientific thought. Men, actuated by the new interest in and curiosity about nature, had formed themselves into groups so that they could pursue this study co-operatively. The two most famous of these groups were the ones that met at Gresham College, London, and at Christ Church, Oxford; they often corresponded and together were called by Boyle The Invisible College. From these was born the Royal Society which, in the words of its original members, was to be a collection of

[1] Some account of these attempts is given in Appendix II.

> " divers worthy persons inquisitive into natural philosophy and other parts of human learning, and particularly of what hath been called the New Philosophy or Experimental Philosophy, which from the time of Galileo at Florence and Sir Francis Bacon in England, hath been much cultivated in Italy, France, Germany, and other parts abroad as well as with us in England."

But just as deduction by itself had proved inadequate as a method for dealing with the actualities of our experience, so induction by itself was also not enough. Deduction broke down in face of the complexities of nature, which eventually forced men to study things as they are, and not as they would have been if certain simple presuppositions had been true. Induction, on the other hand, is inadequate because without the help of deduction it is impossible to develop those scientific theories which are the principal means by which we link together the laws discovered by induction. This will become clear in Chapter XVI, where I consider what the actual aim of science is and how it attempts to realize that aim. In the next chapter I turn to the man who first combined the deductive method of the Greeks with the inductive method of Bacon and thereby set modern science advancing along the road on which it has never looked back.

CHAPTER XIII

THE NEWTONIAN AGE AND SCIENTIFIC THOUGHT

Nature, and Nature's laws, lay hid in night;
God said, Let Newton be; and all was light.
POPE.

IF the new age of science was initiated by Galileo, and found its first philosopher in Bacon, it was Newton (1642–1727) who provided the sure basis for its subsequent triumphs. It is not the purpose of this book to give an account of all that later generations owe to him *qui genus humanum ingenio superavit.* From the point of view of the development of those ideas which have led to the modern world it will suffice if we consider what was his most important achievement—the conception of scientific law holding throughout the universe, and hence governing the movement of the smallest grain of sand as well as that of the largest star.

It is true, of course, that laws governing the motion of the planets had been formulated from the earliest times, and, as we saw in Chapter XI, Galileo pictured the whole universe as amenable to mathematical description. But no one, as far as is known, had ever considered the possibility that the laws which were true in the heavens were the same as the laws governing the motion of bits of matter on the earth's surface. To show that the force which kept the moon in its orbit was the same as the force which caused an apple to fall to the ground was the glory of Newton. The next two centuries witnessed an unparalleled development along the lines laid down by him. More and

more scientific laws were discovered, not only in physics, but also in chemistry and in biology. Even in those spheres where at first no law could be found, skilful and patient investigation would generally yield one, and if, in spite of the most painstaking search, no law could be found, it seemed reasonable to conclude that this was due to our deficiency as human beings. Gradually, therefore, a picture emerged of a universe in which nothing happened by chance, or in which everything was determined by the reign of law.

It is important to recognize that in one respect this picture of the universe was by no means new. The doctrine of determinism—that future events are already determined—was in the first place a theological and not a scientific doctrine. It was held by most Christian theologians to be implied by the omniscience of God. But the scientific doctrine of determinism differed in this important respect from the theological doctrine, that it could, at least to some extent, be verified. The omniscience of God may or may not imply that he has knowledge of all future events, but we have no means at all of finding out whether he has such knowledge or not. In other words, the theological doctrine is completely unverifiable. The scientific doctrine, on the other hand, received more and more confirmation as the Newtonian laws were shown to bring more and more of the experience of man under control.

The most famous description of the picture of the world held by many men of science at this time was given by Laplace:—

> "An intelligence, who for a given instant should be acquainted with all the forces by which Nature is animated and with the several positions of the entities composing it, if further his intellect were vast enough to submit those data to analysis, would include in one and the same formula the

movements of the largest bodies in the universe and those of the lightest atom."

It should be remembered, however, that even in the nineteenth century, when Newtonian science reached its greatest triumphs, this ideal was very far from being realized. There was, for example, a considerable gap between those bodies which were said to be alive and those which were said to be lifeless, and although many laws had been discovered in physiology, and a few even in psychology, there was little to suggest that Laplace's ideal would be easily attained. This was readily seized upon by those moral philosophers and theologians who wished man to escape from "the tyranny of determinism." They conveniently seemed to forget that their predecessors in theology had been as vehement in their assertions of determinism as any nineteenth-century physicist. Indeed, much of the controversy between scientists and philosophers at this time was vitiated by the failure to distinguish scientific knowledge from the scientific ideal. The latter may have asserted that all experience is theoretically predictable, but the former certainly did not.

Moreover Laplace's statement is rather an extreme form of determinism, what is sometimes called mechanistic determinism. All that is legitimately required of determinism proper is that all events (those involving living as well as those involving non-living matter) should be subject to universal laws. But determinism in this sense may be true without the further mechanistic assumption being true that the laws governing living matter are reducible to the laws governing non-living matter. At the present time, for example, all the known laws of physics do not imply Mendel's laws of heredity, but that is quite irrelevant to the truth or falsity of determinism, although it would be relevant to the truth or falsity of mechanistic determinism.

Thus the great achievement of the Newtonian epoch

was the establishment of that attitude among scientists which makes them seek experimentally universal laws in whatever region they are investigating, and makes them believe that such laws can and will be found. The success of this achievement implied the final liquidation of what A. Comte called the first period of science—that of animism. Anthropologists are agreed that at one stage in the development of man the events of the world are considered to be accidental in the sense that they are thought to depend on the caprice of personal beings. These beings are often considered to be more powerful than human beings, and magical rites are performed to influence their choice. If a human being dies because of the bite of a snake, such an event is ascribed to the will of a being who must be propitiated, or more, in all likelihood, will meet the same fate. An event is considered to have been " explained " when it has been ascribed to the volition of such a being. The child passes through a similar period when in answer to his question " why this? " he expects an answer in terms of the desires, pleasures, and so on, of some imaginary being. It is for this reason that Piaget correctly describes the child's world as being animistic. The Aristotelian–Christian cosmology of the Middle Ages had been thoroughly animistic, but Newton's work finally removed any possibility that there might be some truth in animism. For the world was shown to be governed by law to such an extent that it was incredible that those regions which were apparently exempt from the reign of law should really be fundamentally different.

This view was strengthened still further by the development of the theory of errors and probability. It is notorious that in certain simple mechanical processes the results are extraordinarily difficult to foretell. For example, many people have found to their cost that the results of rolling balls into holes or of tossing pennies are not always known for certain in advance. Is it necessary to invoke the caprice of some

supernatural being to explain the uselessness of Newton's laws in such examples? Such is not the case, for the difficulty is found to be not that the laws do not hold, but that the values of certain constants which must be inserted in the laws for the purposes of calculation are extraordinarily difficult to determine in these cases. Moreover it is found that very slight variations in the values of these constants produce surprisingly large changes in the results. It is found, however, that although individual results are very difficult to determine in this way, it is comparatively easy to construct a mathematical theory that will enable long-term results to be calculated. Indeed, the theory is so easy to construct and so easy to use that institutions like gambling-houses and insurance companies make large profits out of it. Thus even where individual events appear to be undetermined, it is quite clear that this is not because of the intervention of some being outside the law, but simply because we cannot in practice measure certain quantities accurately enough.

Newton's own account of the attitude which the scientist should adopt in investigating nature is described clearly in his Preface to the *Principia* :—

> " The difficulty of philosophy seems to consist in this—from the phaenomena of motions to investigate the forces of nature, and then from these forces to demonstrate the other phaenomena; and to this end the general propositions in the first and second books are directed. In the third book we give an example of this in the explication of the System of the World; for by the propositions mathematically demonstrated in the first book, we then derived from the celestial phaenomena the forces of gravity with which bodies tend to the sun and the several planets. Then from these forces, by other propositions which are also mathematical, we deduce

> the motions of the planets, the comets, the moon, and the sea. I wish we could derive the rest of the phaenomena of nature by the same kind of reasoning from mechanical principles; for I am induced by many reasons to suspect that they may all depend upon certain forces by which the particles of bodies, by causes hitherto unknown, are either mutually impelled towards each other, and cohere in regular figures, or are repelled and recede from each other; which forces being unknown, philosophers have hitherto attempted the search of nature in vain; but I hope the principles here laid down will afford some light either to that or some truer method of philosophy."[1]

Newton is here obviously hoping that all the laws which will eventually be found to govern the universe will be reducible to mathematical laws governing matter and motion, or perhaps, more generally, to the laws of physics. He is hazarding the guess, in other words, that mechanistic determinism will be found to be true. Three centuries after Newton's birth we are still unable to say whether his guess will turn out to be correct or not, although it seems doubtful now if it will. It should be noted, however, that a law which is apparently not one of physics may be reducible to a physical law in two sorts of way: (*a*) the ideas involved in it may be definable in terms of physical ideas, and it may then be found to be a law of physics; (*b*) the ideas involved in it may be definable in terms of physical ideas, and when this has been done, it will appear to be a law of physics, although it will be different from any known law of physics. In recent years, for example, we have seen chemistry " reduced " to physics in the first way; that is, chemical terms have been defined in physical terms (atomic numbers,

[1] *The Mathematical Principles of Natural Philosophy*, Motte Translation (London, 1803), p. x.

weights, and so on), and chemical laws have then been expressed as laws of physics. There is no doubt that it is this sort of reduction that Newton had in mind. But so far it has not been possible to reduce any other branch of science to physics in this way. What, however, about the second method of reduction? Can all scientific ideas be defined in terms of physical ideas? Opinions differ on this subject at the present time, and it is perhaps foolish to be dogmatic about it. It is, however, reasonable to argue that any branch of science must deal only with events that are " public "; that is, with events that are accessible in time and place to any and every observer. If that is so, then it follows that the terms used by any science must be definable in terms of physical happenings. On such a view all biological concepts, for example, can be defined in terms of physical ideas. But when that has been done, it will be found that a biological law translated into physical terms does not yield any of the known laws of physics. Thus I think the possibility must be admitted that all the laws of the universe are reducible to physical laws in this second sense, but at the present time there is very little evidence to suggest that they will ever be found to be reducible in the first sense.

Although Newton's guess about the special importance of mathematical laws governing matter and motion therefore seems unlikely to be verified, it must be emphasized that Newton himself regarded it merely as a guess. It is often argued that Newton substituted a new metaphysics for the discredited metaphysics of the Scholastics, but Newton himself certainly did not think so. His position is entirely that which would now be called positivistic; that is, he attempted to find, and believed he had succeeded in finding, scientific truths about the universe without making any philosophical assumptions. His attitude, indeed, is clearly expressed in the following passage of the *Principia*, where he has been discussing gravity:—

> " But I have not yet been able to deduce the reason of these properties of gravity from phaenomena, and I do not frame hypotheses. For whatever is not deduced from phaenomena, is to be called *hypothesis*; and hypotheses whether metaphysical or physical or of occult qualities, or mechanical, have no place in *experimental philosophy*. In this philosophy propositions are deduced from phaenomena and are rendered general by induction. So impenetrability, mobility, the impetus of bodies, and the laws of motion and gravity have become known. And it is enough that gravity really exists and acts according to laws explained by me, and suffices for all the motions of the heavenly bodies and of our sea."

It is, however, possible to maintain that such an attitude is itself a metaphysical one. In our own day we have witnessed the spectacle of the latest positivist school—the Logical Positivists—announcing that all metaphysical propositions are nonsensical. The orthodox metaphysicians have made the obvious reply that such a proposition as " all metaphysical propositions are nonsensical " is itself a metaphysical proposition and hence presumably nonsensical, and this has been readily admitted by Wittgenstein, who was largely responsible (perhaps unintentionally) for initiating this latest brand of positivism. So it has been with Newton. It must, I think, be admitted that although he strove hard to remain faithful to his positivistic ideal, he assumes as fundamental the metaphysical dualism of mind and matter.

Descartes (1596–1650) occupies a distinguished place in the history of ideas for several reasons, but for two in particular. In mathematics he introduced the idea of a variable which was never defined—not even at the end of a problem—and this enabled general mathematical problems to be investigated without

specifying any particular conditions. In philosophy he made a sharp cleavage between mind and matter, which came to exercise an enormous influence in all subsequent European thought. The world came to be pictured as a huge machine extended in space, containing only Galileo's primary qualities. On the other hand, his doctrine of minds, as independent substances, led to the view that each individual has a private world of experiences—a view which naturally led in later centuries to the idea of private worlds of morals. Newton, consciously or unconsciously, accepted implicitly this dualism of Descartes, and the tremendous success of his achievements helped inevitably to establish such a metaphysic. The change which came over the picture of the world can be compared only with that which took place after the discovery of Copernicus. It has been so well described by E. A. Burtt that I cannot do better than quote his words:—

> "The gloriously romantic universe of Dante and Milton, that set no bounds to the imagination of man as it played over space and time, has now been swept away. Space was identified with the realm of geometry, time with the continuity of number. The world that people had thought themselves living in—a world rich with colour and sound, redolent with fragrance, filled with gladness, love and beauty, speaking everywhere of purposive harmony and creative ideals—was crowded now into minute corners in the brains of scattered organic beings. The really important world outside was a world hard, cold, colourless, silent and dead; a world of quantity, a world of mathematically computable motions in mechanical regularity."[1]

[1] E. A. Burtt, *The Metaphysical Foundations of Modern Sciences* (Kegan Paul, 1932), p. 236.

Newton could hardly be expected to realize what he had done. He was a deeply religious man, and considered that his work merely demonstrated in greater detail than before the wonder of the universe, and hence the glory of God. He compared himself to a child finding pretty pebbles on the seashore while the still unknown ocean remained to be investigated. But the methods he had developed were so powerful that many who came after him had no such modesty. As one region of experience after another was shown to be subject to the reign of law many were inclined to agree with Voltaire that it would be very surprising if all nature, all the planets, should obey eternal laws, and yet there should be a little animal, five feet high, who, in contempt of these laws, could act as he pleased, solely according to his caprice. Several attempts were made to rescue the moral world from the doom with which the advance of science appeared to threaten it, the most noteworthy being that made by Immanuel Kant. Kant accepted entirely the system of Newtonian physics, but argued that the "practical reason" of man was excluded from its sphere. Ethical precepts, driven from the world of nature, Kant held to be valid in the region of man's will. The difficulty about the interaction between the physical world, where Newtonian physics holds, and the world of practical reason, in which the will is free, he attempted to avoid by a distinction between knowledge of phenomena and knowledge of things-in-themselves. Knowledge obtained by Newton's methods is knowledge only of phenomena, but the real world is the world of freedom. Worse, however, was yet to befall the moral philosophers with the publication of Darwin's *Origin of Species*, but we must delay consideration of the place of ethics until we have dealt with some of the ideas of the eighteenth and nineteenth centuries.

CHAPTER XIV

SOME EIGHTEENTH- AND NINETEENTH-CENTURY IDEAS

JACK.—That, my dear Algy, is the whole truth, pure and simple.

ALGERNON.—The truth is rarely pure and never simple. Modern life would be very tedious if it were either, and modern literature a complete impossibility.

OSCAR WILDE.

1. *The Romantic Revival*

ANY important intellectual revolution has effects not only on men's opinions, but also on their attitudes; that is, it influences not only what they believe to be true and false, but also the way they feel about different things. It alters the values which men assign to ends and to the means for realizing these ends, and consequently it alters their preferences—the things they are prepared to sacrifice for other things, and so on. It also changes their hopes and desires, and determines what they can trust and by what they will be frightened. The Newtonian revolution was no exception in this respect; and ever since the publication of the *Principia* men have been trying, often unsuccessfully, to acclimatize themselves to the new outlook on the universe.

The central fact that emerged in the years succeeding Newton was that control of nature was going to be possible in a way that had never even been imagined before. Tremendous progress, brought about by the increasing specialization which the advance of science demands, made it inevitable that the average person would be called upon to face situations quite different from any that had happened before. Consequently,

the medieval idea of the fixed person for fixed duties quickly became obsolete. The ancient prayer

> God bless the squire and his relations,
> And keep us in our proper stations

became, indeed, a positive danger—at least if there were any possibility that it might be effective. For what now became of prime importance was that men should learn to understand so that they could face any situation, rather than that they should be trained to face one particular situation. It is therefore not surprising that most people should have become confused in their outlook to an extent which would not have seemed possible in medieval times, and, although two and a half centuries have elapsed since the publication of Newton's *Principia*, it does not seem that much progress has been made in clearing up this confusion. Many of our problems at the present time are due, I believe, almost entirely to this, and I shall argue in Chapter XVIII that the great need to-day is a reformed system of education to deal specifically with the scientific outlook on the world—an outlook which, however it may have been changed by modern physics and biology, is still in spirit that of Newton.

The conflict that arose in men's minds in the years after Newton can be seen most easily in the literature of the eighteenth and nineteenth centuries, and particularly in poetry. For it is above all in poetry that men's attitudes to the world are revealed. They are not revealed in the sense that they are described, as they might be described, for example, in a modern novel or psychology text-book. But they are revealed in the sense that they are shown. Poetry arises out of the poet's attitude to the world, and it is designed to elicit a similar attitude in a comprehending reader. Now we had occasion to note in the preceding chapter that the world view which anthropologists believe arose with the beginnings of civilization, and which in a Christian–Aristotelian framework continued until

the time of Galileo and Newton, was that which has conveniently been called "animism." This view means, roughly, that there is a world of Spirits, which controls things and events in the ordinary world and which can be propitiated and to some extent influenced by the behaviour of human beings. Such a view is extremely congenial to the poet, as it is indeed to the ordinary man. For it satisfies his emotional needs in a remarkably complete way, affording him opportunities to love, to hate, to fear, and to hope.

With the advent of the scientific outlook on the world, however, the intellectual basis of this view was completely discredited. Yet for some time we find in the poets, and particularly in the poets of the Romantic Revival such as Wordsworth and Tennyson, no recognition of this, but rather a greater insistence than ever on the importance of the animistic view of nature.

> The world is too much with us; late and soon,
> Getting and spending, we lay waste our powers;
> Little we see in Nature that is ours;
> We have given our hearts away, a sordid boon!
> This Sea that bares her bosom to the moon,
> The winds that will be howling at all hours,
> And are up-gathered now like sleeping flowers,
> For this, for everything, we are out of tune;
> It moves us not—Great God! I'd rather be
> A Pagan suckled in a creed outworn—
> So might I, standing on this pleasant lea,
> Have glimpses that would make me less forlorn,
> Have sight of Proteus rising from the sea,
> Or hear old Triton blow his wreathéd horn.

Such a reaction against the new cosmology could not last long, however, and we do not find any of the modern poets supporting it. That kind of poetry depends on an animistic view of nature and is quite impossible without it.

People who have not even yet acclimatized themselves to the changed outlook may regret that scientific progress has altered the characteristic ways in which

people express their feelings. It is not uncommon to hear reactionaries argue in some such way as this: while scientific progress will assuredly lead to a more comfortable world in which man can live, the comfort will not necessarily bring rest to his mind, while it was precisely such restfulness which the animistic view offered. Man lived, not in the universe of the mathematical physicist or of the mechanistic biologist, but in a world friendly and interesting, a world in which even the forces which were inclined against him could sometimes be made instead to act in his favour. It is true that the animistic view will not lead to the extension of man's control over nature, but it is not necessarily true that man's greatest happiness can be obtained only by the extension of such control. Science tells us that this earth is an infinitesimal speck in the vastness of the universe, and that man has inhabited this speck for a mere fraction of the time which it has existed. It tells us that the future of man is extremely uncertain, but that in all probability life will one day vanish from the earth. Such a picture is hardly likely to satisfy human emotions. Some philosophers, realizing this, have tried to make good the deficiencies by suggesting various forms of deity that have emerged with the evolution of man. But such a God is not the God which people want. When Paley's teleological argument for the existence of God —that mechanism presupposes a God who is the author of nature—was first propounded, Hume had already replied to it—that mechanism can at most imply merely a mechanic. Similarly, a God subject to the laws of evolution or to the principles of Indeterminacy and Relativity is not the sort of God that people want to pray to or to worship.

What are we to reply to such an argument? I think there are two things which can be said. Even if—an assumption which I do not believe to be true—poetry demands an animistic outlook on the world, then, confronted with the choice of poetry or science,

man will, I believe, choose science. In doing so he will be forever giving up the comfortable universe in which his forefathers have dwelt for so long. But I believe that in the end he will have no reason to regret the choice. While the universe described by science is not such as to satisfy his emotions, these may receive adequate satisfaction in the excitements accompanying research and discovery. On this view the comparative poverty of the last century in poetry may be attributed to the fact that man has already made the choice and has chosen science in preference to poetry. Many individuals who might in previous centuries have been recording for posterity their more intense emotional experiences have instead been quietly leading a satisfying life in a physical or biological laboratory. In the second place, I think we should remember that the cosmology of each age provides the basis for its own characteristic ways of expressing feelings. Consequently, there is no reason at all to despair of the future of poetry, provided the ordinary man keeps pace with the change in cosmology which has taken place. For a poet's appeal depends mainly on the effectiveness with which he expresses what other people feel.

2. *The Meaning of Success in Scientific Thought*

When it is said that some particular period in history was distinguished for its scientific thought, any of three things may be meant. It may mean that the period contained a number of people who made outstanding scientific discoveries. Thus the hundred and fifty years or so between the death of Copernicus and the publication of Newton's *Principia* included such eminent figures as Vesalius, Harvey, Gilbert, Galileo, Descartes, and Boyle. Even if no outstanding discoveries are made, however, a period may be distinguished for the way in which scientific knowledge is applied to increase the standard of life and the

Copernicus - 1473 – 1543
Newton – 1642 – 1727 'Principia' in 1687

happiness of the people. Thus under the Roman Empire there were no important discoveries, but the knowledge which did exist was well utilized in engineering, public health, agriculture, and so on. The third sense in which an age may be said to be distinguished for its scientific thought is when society is such that the majority of people do attempt to correlate their experiences as rationally as possible. It seems to me quite certain that no period of history has so far been distinguished in this respect. Even the age from Copernicus to Newton, which produced a galaxy of scientists probably unequalled before or since, records a dismal tale as regards the general level of thought throughout the world. The whole of Europe at that time was devastated by the belief in witchcraft, and it has been estimated that about a million women were killed as alleged witches. Even William Harvey is reputed to have taken part in the medical examination of women accused of the practice. Similarly, I think it will be admitted that the general level of thinking by which most people to-day organize their lives is not at all high. Many, at least in Europe and America, are perfectly willing to use, for example, the conceptions of religion or astrology to assist them in correlating the experiences they have of the external world.

The problem of producing an age which will be distinguished for its scientific thought in this third sense is the one with which we shall be concerned in the last chapter. But here it is perhaps opportune to make a few remarks about the ways in which distinction in the first or second senses may be achieved. It is extremely unlikely that there is any method by which brilliant scientists can be produced, but a comparison of the social characteristics of those ages which have produced outstanding men is, in some ways, instructive. For example, if we consider history up to the beginning of the twentieth century there are three periods which are specially distinguished in this sense.

These are the age of the Greeks, the Copernican-Newton period, and the time of Darwin. Now all these periods were such that they afforded ample opportunity for leisure to a proportion of the population. It is true that the proportion of the population in all cases was small, and that it was chosen by a method which strikes horror in the heart of anyone holding sacred the idea of equality of opportunity, but the fact remains that there was this small proportion of the population which led a life completely free from economic cares and anxieties. It was rendered possible in the days of Greece by the existence of a large supply of slave labour; in the second period, which followed the break up of the feudal system, it was possible because of the great acquisition of wealth which accrued from the recent voyages of discovery; and in the third period it was possible because of the increase of production which was initiated by the Industrial Revolution. It can hardly be chance that Aristotle, Archimedes, Newton, and Darwin all belonged to this small proportion of mankind who could devote the whole of their time to scientific work. It is perhaps of importance to remember this fact at the present time, when there is so much talk, at least in England, of " service to the community." The greatest service which it is possible for some people to render can be given only when they are set completely free to follow whatever line of thought they choose.

A detailed study of the social characteristics of those periods in which progress has been made in applying the results of scientific discoveries would also be instructive. The late eighteenth and early nineteenth centuries saw an unprecedented advance in technology. Prior to this inventions had generally been made by chance, and were the signal for a burst of scientific investigation to rationalize and generalize what had been discovered. But now the order was reversed. Scientific investigation, in the modern sense of research in pure science, became widespread, and instead of

following in the rear of invention suggested inventions. Unfortunately it has to be admitted that the benefits of this improved technology were almost always introduced only when it was profitable to do so. Thus the manufacturers of the early nineteenth century in England were quick to introduce steam power to increase their production, but when the population of the country flocked to the towns that grew and grew round the factories, the manufacturers (with the magnificent exception of Robert Owen) did not think of providing decent housing, decent hospitals, and decent schools, because such benefits were not going to yield a profit to them. It is indeed remarkable that the arguments which carried most weight in the discussions about compulsory education prior to 1870 in England were those which emphasized that a moral and religious education was the best antidote to social and industrial unrest. Many similar examples could be given. Although the miner's safety lamp would appear to be an unmixed blessing from science to society, yet after its introduction the death rate in colliery accidents increased. The mine-owners saw that with the introduction of the lamp more dangerous seams could be worked than had been possible before, and did not scruple thus to increase their profits at the expense of the lives of the miners. The only way, it seems to me, by which this kind of result can be avoided in the future is by rendering it impossible for any group of individuals to use the discoveries to exploit any other group. The benefits of science should be applied first of all to satisfy as many human wants as possible, and secondly to attain as much efficiency of production as possible. This has, according to some reports (although not according to others), been very nearly achieved inside the Soviet Union, and if the world is willing to learn, there seems to be no reason why we should not be entering upon an age far more distinguished for the applications of science than any the world has yet known.

3. *Liberty and Equality*

In Chapter X, I enumerated what seemed to me to be the basic ideas of both civil and political liberty. From the time of the thirteenth century, when these ideas in England began to shape institutions such as Magna Carta, Parliament, Trial by Jury, and so on, they have exercised a profound influence on the machinery of government and on the relations which have existed between man and man. In the last century and a half, however, another set of ideas, grouped together under the general concept of equality, has sprung into prominence, and now threatens to become the dominating influence in social life. It seems to be often assumed that this comparatively new set of ideas may be added without inconsistency to the set of ideas grouped under the term liberty, but when we remember that several in the latter set are themselves sometimes found to conflict, we shall not be surprised to find serious difficulties arising in the social structure of any State which professes both the ideals of liberty and equality. It is perhaps appropriate to recall here Lord Acton's judgment on the French Revolution:—

> "The deepest cause which made the French Revolution so disastrous to liberty was its theory of equality. Liberty was the watchword of the middle class, equality of the lower. It was the lower class that won the battles of the third estate; that took the Bastille, and made France a constitutional monarchy; that took the Tuileries, and made France a Republic. They claimed their reward. The middle class, having cast down the upper orders with the aid of the lower, instituted a new inequality and a privilege for itself. By means of a tax paying qualification it deprived its confederates of their vote. To those, therefore, who had accomplished the Revolution, its promise was not fulfilled. Equality did nothing for them.

> The opinion, at that time, was almost universal, that society is founded on an agreement which is voluntary and conditional, and that the links which bind men to it are terminable, for sufficient reason, like those which subject them to authority. From these popular premises the logic of Marat drew his sanguinary conclusions. He told the famished people that the conditions on which they had consented to bear their evil lot, and had refrained from violence, had not been kept to them. It was suicide, it was murder, to submit to starve, and to see one's children starving, by the fault of the rich. The bonds of society were dissolved by the wrong it inflicted. The state of nature had come back, in which every man had a right to what he could take. The time had come for the rich to make way for the poor. With this theory of equality, liberty was quenched in blood, and Frenchmen became ready to sacrifice all other things to save life and fortune."[1]

But however acute the problem may have been at the time of the French Revolution, it arose in an even more intense form with the Russian Revolution of 1917. To many of those who exalted the ideal of liberty it seemed that a new kind of slavery had descended over one-sixth of the surface of the earth. The revolutionaries in an attempt to establish by force economic equality were held to be arch enemies of liberty in any form. For it was argued that equality, whether it be of mental or of physical ability, was quite unnatural to the human race. If equality was to be superposed on all men, it could only be by putting fetters on the more capable and industrious so that they would not be able to outrun their inferiors in the economic struggle. For there were no known rewards or inducements which would drive on the inferior to compete on equal terms with those who

[1] Lord Acton, *Quarterly Review*, January, 1878, pp. 133–134.

were naturally more capable. On the other hand, to those who exalted the ideal of equality it seemed that a new era in man's development had commenced. The people had secured power and, after some inevitable teething troubles, had shown that they could maintain themselves in power. Private ownership in industry, the exploitation of man by man, the whole idea of working for profit had been swept away. There were to be no more rich and poor, landowners and labourers, masters and servants. The parent would no longer have authority over his child, the teacher over his pupil, the husband over his wife. All conventions of the capitalist world were to be swept away. Religion and sexual taboos were to be abolished. A new international order based on the equality of man throughout the world was to be established.

It is sometimes urged that this conflict between the ideals of liberty and equality can be resolved by the third term in the French Revolution cry of Liberty, Equality, Fraternity. It is argued that if man would regard his fellow man as a brother, then the evils associated with excess of liberty on the one hand, and with excess of equality on the other, would be kept in check. It is very likely that such is the case, but the underlying assumption that man can be persuaded to regard his fellow creatures with brotherly affection seems destined to remain merely a pious hope. The exponents of Christianity urge that if all men became Christians, then it would happen at once. But we have already seen how remote is the possibility of such a conversion; and, even if it did happen, the behaviour in recent years, and indeed throughout history, of professing Christians has hardly been such as to convince an unbiased observer that the brotherhood of man would be nearer realization. I think, therefore, it is virtually certain that we must look for the solution of the conflict in some other direction.

This other direction lies, I believe, in the realm of State action. Some enthusiastic advocates of the

ideal of liberty are inclined to think that all State action should be eliminated or, at least, reduced to a minimum. But that way surely lies chaos, with the eventual negation of all liberty. Instead the State should be strengthened to secure three primary aims. (*a*) It must provide protection for its citizens both internally and externally; that is, it must be secure against both domestic and foreign enemies. (*b*) It must aim at satisfying as many wants of as many of its citizens as it possibly can; that is, it must secure an economy of abundance. (*c*) It should educate all its citizens to the limit of their ability. If these three aims were realized, then it seems to me that most of the conflict between the ideals of liberty and equality would disappear. For it would be found that, while the ideal of equality had not been sacrificed, each individual would be confronted with a larger number of alternative avenues of enjoyment and activity than he would have access to in any other way, and he would therefore enjoy greater liberty. It is this function of the State, whereby it attempts to organize liberty, that is the clue to the problem; and people must begin to realize that only by increasing the power of the State will it be enabled to exercise such a function. It is a profound mistake to imagine that if the State grows in power, then the activities of individuals and other organizations must be limited. In the present century we have seen a vast extension of the power of both the State and voluntary societies such as Trade Unions, and it is in this co-operative development that we must look for the reconciliation of liberty with equality. If we give up the idea of liberty as a conjunction of negatives—that is, as composed of ideas such as not to be forced to do this, live here, and so on—and think of it instead as the number and kind of ways in which individuals may actively enjoy themselves, we shall recognize that in the modern world it is only by increasing the power of the State that true liberty can increase.

CHAPTER XV

EVOLUTION AND THE NATURE OF ETHICS

When, therefore, we find ourselves entertaining an opinion about the basis of which there is a quality of feeling which tells us that to inquire into it would be absurd, obviously unnecessary, unprofitable, undesirable, bad form, or wicked, we may know that the opinion is a non-rational one, and probably, therefore, founded upon inadequate evidence.—W. TROTTER.

IN Chapter II we saw that the Greek Atomists held the view that only those groups of atoms survived which became adapted to their environment. This remarkable intuition foreshadowed the essence of the theory of evolution, first propounded by Charles Darwin (1809–1882), although it is only fair to add that some aspects of the theory can be traced in the writings of such philosophers as Leibniz and Kant. When, however, it is claimed that philosophers have sometimes held views that are accepted only years later by scientists, as is the case, for example, with both Evolution and Relativity, it must be remembered that it is not the scientist's business to consider theories apart from their observational and experimental evidence. And it took hundreds of years to make the theory of evolution worthy of careful consideration by scientists. That it was accepted as soon as it was must be regarded as due very largely to the prodigious work of Darwin, who collected the evidence and marshalled the arguments in favour of it so successfully that although expert opinion was against the theory in 1850, it was virtually unanimously in favour of it fifty years later.

During these fifty years the theory was the domina-

ting influence in the intellectual life of Europe, and now that the turmoil has died down, it is not easy for us to realize what a profound effect it had on man's outlook. Let me summarize briefly the position as it existed just prior to 1859, the year in which Darwin published the *Origin of Species*. Most people had by this time become more or less acclimatized to the Newtonian conception of the world in so far as it applied to inanimate nature and to animals. That is, they were willing to admit the universality of natural law with two exceptions. They believed that at least part of man's mind (that part which was called the "soul") was exempt in the sense that men were free to will as they pleased, and they believed that God had framed the laws at the time of the Creation and that he presumably could modify them at any time, if he chose to do so. As the advance of science had completely upset the Aristotelian–Christian doctrines about the universe, most people were willing to admit the truth of what was discovered by the methods of experimental science, but they held that such methods were not applicable to the nature of God or to the soul of man. The truth about these had been revealed in the Bible once and for all. Thus a kind of uneasy truce had been achieved between science on the one hand and philosophy and theology on the other. As long as science kept clear of what was taught in the Bible about God and the soul of man, it was acceptable to the moral philosophers; and as long as moral philosophy concerned itself merely with the soul of man and its relationship to God, then it was acceptable to the scientists. It is true that a few scientists felt that no part of man should be outside the scope of Newtonian science, but no evidence could be found to establish such a conclusion. Thus the relationship between the two sides was somewhat easier than it had been for a considerable time.

The details of Darwin's work are irrelevant for our present purpose. The essence of it from the point of

view of the history of ideas is that the nature of man was shown to be continuous with that of the animals, from which, indeed, he had evolved by the familiar processes of variation and selection. Just as Copernicus had deposed the earth from the centre of the universe, and just as Newton had shown that the laws of nature are no different on earth from what they are in the heavens, so Darwin showed that the mind of man was not due to a unique act of creation. The implications of this were enormous. On the basis of biblical evidence Archbishop Ussher had assigned the Creation to the year 4004 B.C., and it was believed that the world was created, as far as the different species were concerned, in much the same condition as it existed in the nineteenth century. But Darwin's evidence implied that the world had existed for a very much longer period, and that the doctrine of specific acts of creation for all the different species must be abandoned. Thus once again, as in the sixteenth century, the Church's determination to dogmatize about the external world—this time about the nature of man—led it into a conflict from which it emerged vanquished and immeasurably weaker. It fought its losing battle with its customary skill. It was even contended that God had put fossils into the earth at the time of creation so as to mislead mankind and provide a test of faith! But, as I shall argue in Chapter XVII, science will inevitably win any battle which is concerned with the common experience of mankind, and by the end of the nineteenth century Darwin's theory was nowhere seriously disputed. The quickness of its victory was partly due to the reinforcement it received from the application of scientific method in two other fields. These were anthropology and biblical criticism. The pioneer work of E. B. Tylor and of J. G. Frazer threw a flood of light on the mind of primitive man and on the origin of religious rites. No less effective was the critical treatment of Scripture by Bauer and Strauss.

Hence the Church appeared to be attacked from every quarter, and the issue could not long be delayed. The result was that the whole nature of man became as completely the subject-matter of science as the composition of the moon.

It would be natural to suppose that with the work of Darwin, the ideas of ethics, as a means of understanding human behaviour, had become superfluous. The nature of man had been shown to be continuous with that of the animal world, and if scientific thought was held to be capable, at least in theory, of understanding animal behaviour, there was no very obvious reason why it should be held incapable of understanding human behaviour. Yet some moral philosophers refused to admit defeat. The situation which confronted them was this. If ethical precepts are to have any validity in regard to human behaviour, then either they must be complex notions which have been built up from simpler elements which we can ascribe to our prehuman ancestors, or else they are mere inventions belonging to our present stage of evolution. If they are the former, then ethics has been reduced to a kind of natural history, and if they are the latter, then ethics is a kind of verbal game. Ethics thus becomes either part of science or a waste of time—at least for those who do not like games. The reply which was sometimes made to this by moral philosophers was to distinguish the origin of ethical ideas from their validity. It may be true, they argued, that ethical ideas have evolved from simple behaviour patterns of our animal ancestors, but this question has nothing to do with their validity at the present time. They then go on to argue that ethical ideas cannot be defined in terms of what can be empirically observed, and that knowledge of them is therefore a priori. Ethics, therefore, becomes a series of deductions from premises whose truth is supposed to be given a priori. There are, I think, two fallacies in this. First of all, it is not true to say that the question

of the origin of ethical ideas is irrelevant to their validity. If I can show that someone believes an action to be wrong simply because it was forbidden by his old nursemaid and for no other reason, then it seems to me quite clear that I have destroyed the validity of this person's ethical ideas as regards this particular action. Secondly, we saw in Chapter IV that recent developments in mathematics have clarified the nature of alleged a priori knowledge, and there is little doubt that the tendency to believe that some of the propositions of ethics were a priori was encouraged by the belief that such knowledge was possible in pure mathematics. The discovery, however, that pure mathematics consists in working out the consequences of arbitrary postulates on the basis of previously agreed rules of procedure makes it no longer possible for philosophers and theologians to point to mathematics as the model for their work.

The upshot of this has been that that view of ethical propositions is steadily gaining ground which makes them amenable to rational treatment in that their " natural history " can be traced, and which indicates that their function is not to state facts but to communicate feelings, which in turn depend on what may be called the " culture pattern " in which they occur. The history of ethics, indeed, has demonstrated clearly enough the hopelessness of any non-scientific account of our behaviour. It is to the great credit of some philosophers that they have realized this and that they have given an account of ethical propositions which not only yields to science that which is its due, but also makes clear the important part which ethical propositions play in all our lives.

It is convenient first of all to make a distinction between propositions which are verifiable and those which are unverifiable. Ethical propositions fall in the class of unverifiable ones. It is true, of course, that propositions involving such words as " good," " bad," " right," " wrong," can sometimes be verified;

for example, " good doctors are rare " clearly states something which can be confirmed or refuted once empirical criteria have been settled for what constitutes a good doctor. If, moreover, any meaning in terms of natural characteristics can be given to ethical terms, then it follows that the propositions of ethics can be verified in the same way as any scientific proposition. It is, however, generally agreed that there are some usages of ethical terms for which no naturalistic meaning can be found, and propositions involving such usages are consequently unverifiable. They are, it should be noted, unverifiable not merely in the sense that we are not practically able to verify them, but in the much deeper sense that we cannot conceive what it would be like to verify them. Such propositions as " knowledge is good " and " killing is wrong " are possible examples. It is sometimes said that " knowledge is good in itself " or " knowledge is intrinsically good " in an attempt to bring out this meaning, implying that there is something ultimate or indefinable in this sense of good.

If such propositions are unverifiable, how can we know their truth or falsity without bringing in the traditional conception of a priori knowledge or some equally obscure notion? The answer given to this is of fundamental importance. It is, briefly, that such propositions are neither true nor false, as they do not *state* anything. Language, at our present level of civilization, is used for a number of different purposes, only one of which is to communicate information. It is used also to direct the movements of people and animals (as in commands), and to express feeling and emotion (as in exclamations and expletives). It is this last use of language which characterizes ethical propositions. They do not assert anything—that is, communicate any information—but they express something. The proposition " killing is wrong," for example, does not ascribe a predicate to a subject, but expresses what is asserted by the proposition " I

dislike killing." But it also expresses more than this. For it is an attempt to influence other people, and it is on account of this further aspect that disagreement in ethics is so common. "Killing is wrong" expresses what is asserted by the whole proposition "I dislike killing and I want you to do so as well." In other words, when I make an ethical proposition I am attempting to influence the likes or dislikes or desires or interests of some other person, and to bring them into agreement with my own.

This view about the nature of ethical propositions explains many of their rather peculiar characteristics. It shows how disagreement about ethical propositions is much more difficult to resolve than disagreement about scientific propositions. For the latter are verifiable, at least in principle, but disagreement about ethical propositions implies opposition in interests. It also explains why anthropologists find moral behaviour to vary in different kinds of society. For the interests of an individual depend on the nature of the society in which he lives, and consequently his moral judgments will also vary.

The upshot of this chapter is to show that the wheel has come full circle since the days of Democritus. With the rejection of the scientific method of explanation by Socrates and Plato, mankind for over two thousand years attempted to use the concepts of both science and ethics in his explanation of the world. For much of that period science made virtually no progress, and at the close of the Middle Ages the two types of explanation were almost hopelessly interwoven. But in the last five hundred years science has made such tremendous advances that it has come to be realized that nothing less than the whole of our common experience is its field. This was, I think, substantially the view held by Democritus.

CHAPTER XVI

THE PRESENT AGE: I.—SCIENCE

DUCHESS OF BERWICK: Do, as a concession to my poor wits, Lord Darlington, just explain to me what you really mean.
LORD DARLINGTON: I think I had better not, Duchess. Nowadays to be intelligible is to be found out.

OSCAR WILDE.

IF the most important factor in modern life is the growth of science, it is of prime importance that we should be as clear as possible about the nature of scientific thought. In this chapter I shall consider first the starting point of science, and then the aim of science. If we know the kind of propositions from which science starts, and if we know the goal towards which it strives, then we should at least have clarified our minds about those aspects of experience which are amenable to scientific treatment and about those aspects which at present are not. While it is necessary to admit that at the present time parts of our experience fall outside what is called science, that admission must not be considered to be any encouragement of obscurantism. All our experience is capable of rational study, but only part of it at present can strictly be labelled scientific, although, as we shall see, that part is steadily increasing.

What, then, is the distinguishing mark of the propositions from which science starts? A number of different answers have, in the past, been given to this question, and I propose to state what seems to me to be the correct one, and then to defend it against some of the criticisms which have been urged against it. *All propositions which form the basis of scientific know-*

ledge are of such a nature that universal agreement could be obtained about them.

There are two points in this statement which it is important to note. (1) The propositions must be of such a nature that universal agreement *could* be obtained about them. This does not imply that universal agreement has been obtained. It would certainly be impossible for the development of science to wait until everyone had assented. But we do not need to have acquired a very sophisticated outlook to realize that, broadly speaking, our lives are composed of two sorts of experience—that kind about which we can at once secure agreement with our fellow-men, and that kind about which disagreement is always arising. I can at once secure agreement about my judgment that the figure of Nelson is at the top and not at the bottom of the column in Trafalgar Square, but my judgment that the pigeons which keep him company should all be destroyed is liable to provoke considerable disagreement. It soon becomes relatively easy to see the kind of experience about which it is possible to secure agreement and the kind of experience which leads to disagreement, and it is from the former that science starts. (2) It is only those propositions which, as I have said, form the basis of scientific knowledge for which universal agreement is claimed. Perhaps it would be better to say *a* basis, for there is not a unique set of propositions from which science can be derived. It is generally agreed that it is necessary to make certain observations to start science going, but that different initial selections of observations are possible. The propositions which describe any of these observations may, however, be called a basis for science, and it is these which I believe are such as to secure universal agreement. The propositions which are derived from these basic propositions and which form a large part of our scientific knowledge are, of course, such that universal agreement cannot be obtained about them.

This is due mainly to the fact that most people are quite unable to understand them, and consequently can neither agree nor disagree. There is, however, sometimes quite genuine disagreement among scientists. For example, at the present time in the physical sciences there is disagreement about the origin of the solar system, and in the biological sciences there is disagreement about the inheritance of acquired characteristics. But such disagreement is always about propositions which have been derived from earlier propositions about which there was agreement. We have seen that the technique of scientific thought cannot be reduced to a mere matter of following certain rules, and that progress often consists in forming good "inductions." It is inevitable that these should sometimes produce disagreement, but it cannot be too strongly emphasized that this disagreement does not apply to the propositions from which scientific thought starts. It is, indeed, this character which the basic propositions have that leads to the description of science as the study of the external world; a judgment which secures universal agreement being assigned to the external world, while one about which disagreement exists is said to be emotional, æsthetic, and so on.

To sum up, the point of view which I believe to be correct is this. (Among all the elementary judgments which we make, some secure universal agreement and some do not. Those which do form the basis from which scientific thought starts, and those which do not are irrelevant to science.) I shall attempt to justify this point of view first of all by considering some of the difficulties which have been urged against it, and secondly by adducing certain facts in its favour.

(1) It might be urged that it is quite impossible ever to secure universal agreement, if this means that every individual has to give his consent before a proposition can be judged suitable as a basis for science. Moreover it is not possible to avoid the difficulty by limiting the agreement to be obtained to those individuals

competent to judge. For who are those competent to judge? The objection, however, loses its force against that form of the view which I have given. For I have expressly stated that it is not necessary for universal agreement to be obtained; what is necessary is that those propositions which are judged to apply to the external world or to be scientific should be of such a nature that universal agreement *could* be obtained. It may be asked how we know that there are any propositions for which such agreement could be obtained without actually obtaining it. The only answer which I think can be given to this is just that all our experience seems to support it. It does seem to be true that some propositions have the characteristic that other people as well as myself acknowledge their truth, and I believe the behaviour of children, mental defectives, and savages implies that they also acknowledge their truth. Even the behaviour of animals is such as to indicate their tacit acquiescence. My dog will jump across a stream at the same place as I would.

(2) A second objection arises in connection with those sensations about which there is disagreement. For example, about five per cent of people in Great Britain have what is called red-green colour blindness; that is, they would disagree with the remaining ninety-five per cent about some propositions of the form " this colour is different from that." A similar situation arises with regard to the taste of phenylthiourea, which approximately seventy-five per cent find to be intensely bitter in concentrations as low as fifty parts per million, and the rest find to be tasteless. Does such disagreement mean that these propositions must be kept out of scientific knowledge? If so, how is it that psychology deals with colour blindness, and genetics deals with the taste of phenylthiourea? This kind of difficulty has weighed so heavily with Professor Dingle that when he wrote *Through Science to Philosophy* he abandoned the criterion of universal consent which he had adopted when he wrote *Science*

and Human Experience. Yet it does not seem to me that these facts are at all inconsistent with the criterion. The proposition that some people find phenylthiourea to be bitter and others find it to be tasteless is one for which universal agreement can be obtained, and it is this proposition which is dealt with by the geneticists; it being thought that those people who find it bitter differ genetically from those who find it tasteless. The proposition about which there is disagreement—namely, phenylthiourea is bitter (or tasteless)—does not itself enter into genetics at all. It will be found that this is typical of many other situations. When two people disagree about a proposition *p*, science deals with the situation not by starting from *p* as a premise, but by starting from the premise "*A* asserts *p* and *B* asserts not-*p*." For example, if two equally mature art critics disagree about a painting, it may be possible to explain such disagreement by the different infantile experiences to which each was subject. What science starts from in such a case is not "this painting is good (or bad)," but "*A*, with such and such a past life, asserts this painting is good, while *B*, with such and such a past life, asserts this painting is bad." By starting in this way from what can secure universal agreement, science often succeeds in narrowing the disagreement. For if *A* and *B* understand the reasons which make them judge as they do, they are much more likely to modify their original judgments and reach an agreed verdict. In this way, as I mentioned at the beginning of this chapter, regions of our experience which were formerly thought to be outside the range of science are gradually passing inside.

(3) A third plausible objection is that such a view makes science impossible on a desert island—assuming we could imagine some individual transported at birth to such a place and brought up there in the absence of all human beings and animals. Would it be possible for such an individual to develop

scientific knowledge at all? Campbell has indicated some of the difficulties with which he would be faced arising from those sensations which are generally called abnormal:—

> "Thus, when the patch on the ceiling turned green after he had gazed at a red patch the change would appear to him of precisely the same nature as the turning green of a bunsen flame when a copper wire is heated in it. We, on the other hand, by comparing the sensations of others know (as we put it) that the change of colour, in one case, is due to a real change in the observer, not in the ceiling, and, in the other case, is due to a real change in the flame, not in the observer."[1]

It is possible, as Campbell points out, that our desert islander would be able to discover the relation between colour and refrangibility, and hence find that the refrangibility of the light from the bunsen changed, whereas that from the ceiling did not. Campbell then suggests (although with some reluctance, I think) that he might in this way reject observations based on colour in preference to those based on refrangibility on the alleged ground that the laws of refrangibility are in some sense or other more "satisfactory" than the laws of colour. It does not seem to me that there is any particular reason why he should. Why should he give up judgments of colour which express the changes in his sensations for judgments of refrangibility which sometimes remain the same even when his sensations change? We do so in ordinary life, because by doing so we can bring our own observations into line with those of other people, but our Robinson Crusoe would surely have no reason at all for doing so. It seems to me, therefore, that whatever knowledge he acquired it would certainly be very different from the body of scientific knowledge which we possess,

[1] N. R. Campbell, *Physics, The Elements* (Cambridge University Press, 1920), p. 35.

and as it is the latter with the analysis of which we are concerned, speculations about alleged castaways are irrelevant.

These are, I think, the strongest of the arguments which have been advanced against the view that science starts from propositions for which there is universal agreement, and I do not think any of them are at all fatal. On the positive side the following considerations may be urged.

(1) There is little doubt that, in the minds of most people, scientific knowledge is distinguished from ethics, æsthetics, theology, and other types of knowledge by the fact that it does command agreement in a sense that these other types do not. Indeed, when people refer to a report as "scientific," it is, I think, this characteristic which they have in mind. No doubt they also have in mind the formal characteristics of deductive and inductive reasoning, but some at any rate of these might also be found in a theological treatise. The distinguishing mark of the scientific is surely just that it starts from what is universally accepted.

(2) There is little doubt that the reason why psychical research wins such slow acceptance among scientists generally is that the facts from which it starts have not been universally admitted. The methods employed in psychical research are unquestionably scientific—the fact that a number of first-rate scientists have themselves taken part in these investigations has ensured that the methods are at least as good as those employed in physical and biological research—but unfortunately universal agreement cannot be given to the observations on which it depends. The main reason for this seems to be that many of these phenomena are not reproducible at will, and consequently scientists who do attempt to verify that the phenomena can be observed often meet with completely negative results. As this situation has not so far arisen in any of the older sciences, it is therefore tempting for many

investigators to adopt a sceptical attitude. I am not concerned here either to support or condemn such an attitude. What I am concerned with is the nature of scientific thought as that is at present understood, and the reason psychical research has not been accepted as a well-established science is, I think, that it lacks the characteristic of starting from observations which have secured universal agreement.

Let me turn now to the second question which we had to consider—the aim of science. We have considered the kind of proposition from which science starts, but what is the goal towards which it is striving?

There are, I think, three main views which have been taken about this. There is the view that scientific activity results from social conditions and is directed to the improvement of social conditions. "Social conditions" must be interpreted, of course, in a very wide sense, and when so interpreted there is a great deal of truth in such a view. Science has always been stimulated by such important social events as wars, geographical discoveries, epidemics, and so on. On the other hand, I think it is true to say that throughout the whole of history there has always been some scientific activity which has arisen purely out of intellectual curiosity. It is difficult to see any other reason for most of the work of Pythagoras, Euclid, Archimedes, Leonardo, Copernicus, and Galileo, to mention only those who lived before Newton. And since Newton's day it is fairly obvious that some scientific work—for example, almost all modern physics—has had little or no connection with social conditions. Thus while there is a great deal of truth in this view, it is, I believe, inadequate.

A second aim of science has often been put forward under some such phrase as the discovery of laws of nature. This appeals to common sense and is consistent with the type of science which is taught in schools and in the junior classes of universities. It is also the view of science which is held by most logicians

who write text-books on induction. I should think that until the end of last century such a view would have been almost universally accepted, and it is still the view accepted either explicitly or implicitly by many scientists. This view holds that science, starting from propositions about which there is general agreement, attempts to extend and generalize them—this extension and generalization requiring, as a rule, the aid of experimental work.

It is obvious that again there is a great deal of truth in this view, but again it is not the whole story. For that we must turn to the third aim, which has been steadily growing in popularity among scientists in recent years. This view is that the aim of science is to extend and to correlate as far as possible those experiences which we share with other people. It is not enough to know that if such and such an operation is conducted, then so and so will be observed, which is the knowledge we get from scientific laws. Scientists often want to know why it is that so and so will be observed, and much of their activity is directed towards satisfying that curiosity. Now, as far as I can see, such curiosity is satisfied in two ways. It may be satisfied by an appeal to a more general law. For example, there is a law to the effect that iron sinks in water; if the question is asked why does it sink, then an explanation may be offered by appealing to the more general law that any piece of matter whose weight per unit volume is greater than the weight per unit volume of water will sink when placed in water. There is no doubt that a great deal of explanation in science is of this type. But it is always possible to ask a question about the more general law similar to the one about the less general law, so that unless there is some other type of scientific explanation, this kind of question will never be answered. Now there is a school of thought—the extreme positivist school—which holds such a view. It maintains that science should make no effort to answer questions starting

"why . . . ," but should seek only to obtain such connections between phenomena as can be stated in a general law. It maintains, in other words, what I described as the second aim of science. The answer to this seems to me to be that no one has any right to say what science should or should not do. All that anyone can say is what science actually does; and there is no doubt that it does often attempt to answer questions starting "why . . ."

This second way in which science attempts to satisfy our curiosity is by constructing abstract deductive systems, which, when suitably interpreted, give laws which are known to be true. The most famous example of this is, of course, Euclidean geometry. We find in the world of ordinary experience, for example, that the sum of the angles of any physical triangle is approximately two right angles, and that the angle in any semi-circle is approximately a right angle; and we can explain why these laws are true by the abstract system known as Euclidean geometry. This system, starting from a group of axioms, deduces by the ordinary rules of inference a large number of consequences such that, when the axioms are suitably interpreted in terms of our experience, the consequences become laws of nature. We are thus able to correlate a large number of laws with each other by showing that they are all interpretations of consequences deduced from the same set of primitive axioms. It is also possible that hitherto unknown laws will be discovered in this way. For if the primitive axioms, when suitably interpreted, give propositions which are laws of nature, then all possible consequences of the axioms, when suitably interpreted, ought also to give laws of nature. But whether the system does lead to unknown laws or not, it is of value in satisfying our desire for an explanation of the known laws—the explanation showing that the laws are connected with each other by means of the deductive system.

Now the system of Euclidean geometry is the oldest and is, in some ways, the most successful of all such attempts at explanation—even if it is now thought that laws relating to distances of an astronomical magnitude cannot be explained by such a system. But from the time of Newton onwards, and particularly in physics, the most developed of the sciences, there have been many deductive systems constructed which have some of the laws of physics as their interpretation. This fact seems to me to make it quite clear that the third view of the aim of science is a much more accurate statement of what science does than either the first or the second. According to this view science attempts to extend and to correlate our common experiences as much as possible, and it achieves this in two sorts of ways—first of all, by trying to find inductively those uniformities in our experience which are called scientific laws, and secondly, by constructing deductively axiomatic systems which link the laws together.

CHAPTER XVII

THE PRESENT AGE: II.—PHILOSOPHY

"You may call it 'nonsense' if you like," she said, "but *I've* heard nonsense, compared with which that would be as sensible as a dictionary."—LEWIS CARROLL.

THE view of the aim of science expounded in the previous chapter raises the important question of the relationship of scientific to philosophic thought. For it has to be admitted that one of the aims often put forward for philosophy is the correlation of different fields of experience. For example, Whitehead says, "The useful function of philosophy is to promote the most general systematization of civilized thought."[1] Are we to say, then, that the view which I urged about science makes it co-extensive with all that was formerly called philosophy?

To answer this it is necessary to glance briefly at the activities of philosophers. I think it might be safe to say there are two main schools of thought about what philosophy should do. The first school is what may roughly be called the analytical school, and is in line with the tradition of English empiricism which goes back through Mill to Hume and Locke. It has attained considerable popularity at the present time, chiefly through the writings of Moore, Russell, and the Logical Positivists. Although the philosophers of this school differ considerably among themselves, I think it would be admitted that they do hold roughly a common aim for philosophy. I take this aim to

[1] A. N. Whitehead, *Process and Reality* (Cambridge University Press, 1929), p. 23.

rest on their view that philosophical problems are, in some sense or other, primarily linguistic. That is, they do not consider that philosophy should deal with facts of a special kind, but should rather accept the deliverances of common sense and the special sciences, and attempt to analyse their meaning, particularly with a view to removing any feeling of puzzlement, which may sometimes arise in even the best people. For example, if I glance out of the window on a rainy day, and someone asks me, " How many raindrops did you see? " I may be conscious of a sense of puzzlement. If I did see a particular number, then presumably by paying more attention I could have said how many I saw. But this seems impossible. If, on the other hand, I did not see a particular number, is it possible to see a number, but not a particular number? And so the discussion goes on and on. The philosophers I have mentioned try to remove such feelings of puzzlement by a study of what may be called logical grammar. Thus their attitude to such a proposition as " other human minds exist " is to accept its truth, but to compare its syntax with the syntax of such propositions as " billiard balls exist," " unicorns exist," " billiard balls are white," and so on. The preceding chapter of this book, for example, would be called philosophical in this sense, as it is concerned with the logical grammar of scientific propositions.

The second school of thought about the aim of philosophy, which I shall call the speculative, is exemplified by the quotation from Whitehead given above. This school regards philosophical thought as in some sense or other over and above common sense and the sciences, and it considers that the aim of philosophy should be to obtain general conclusions which are consistent not only with all the sciences, but with our whole experience. This seems to be the aim which has been held by most of the eminent philosophers throughout history and which has been

advocated in the present century by people of the calibre of Whitehead, Alexander, and McTaggart.

The views which I have advocated about the aim of science and the first, or analytic, view about the aim of philosophy are not likely to cause any serious disputes between scientists and philosophers. For philosophers accept the truth of the propositions asserted in science, and are concerned only in clarifying the meaning of them, and in making explicit the methodology implied. Philosophers will also, of course, pay attention to propositions outside the scope of science; that is, to propositions for which universal agreement has not been obtained (or which have not been derived by scientific method from such propositions). But the same can hardly be said about the speculative view of philosophy. Indeed, we need go no farther back than the end of the nineteenth century to find a heated controversy taking place between groups of scientists and philosophers. Some scientists considered that the inductive generalization "the movements of all material bodies are subject to universal laws" was very probably true, although they had to admit that such laws had not been discovered for those bodies which were ordinarily said to be alive. They thought, however, that this gap in the proof was due merely to the complexity of the problem and that it would be filled in due course. Some philosophers, on the other hand, held that the truth of such a proposition was inconsistent with other aspects of experience, in particular with ethical experience, and, as they considered it their business to correlate all aspects of experience, they had to deny that the proposition in question could possibly be true.

On this issue of the aim of philosophy it seems to me unquestionable that it should be both analytical and speculative. As I have said, those philosophers who have held an analytic aim for philosophy have not come into conflict with the views of scientists, and although it has caused conflicts with science in the

past, it still seems to me that what I have called speculative philosophy is both valid and valuable. The sense in which I think it is valuable is that in which it attempts to correlate those experiences of the philosopher which he does not share with other people. Philosophy, in this sense, becomes an attempt by each individual to link together those desires, hopes, expectations, and so on, which play so large a part in the lives of each of us. It is this, I believe, which is meant in ordinary discourse when we talk about a person's philosophy of life, and, as we all know, such a conception is an extremely important one. It seems to me to be here, for example, that all so-called ethical systems have their value. Speculative philosophy in this sense becomes invalid only when an attempt is made by a philosopher to extend any scheme of correlation beyond what is justified by common agreement.

This attitude to the aims of science and philosophy will, perhaps, become clearer if we consider a specific example, and the obvious one to choose is, I think, the situation created by what is sometimes called the New Physics. (By this is meant the developments in physics associated with the names Einstein, Planck, Rutherford, Heisenberg, Dirac.) It is a commonplace that some scientists and some philosophers hold that these developments have consequences of great importance for philosophy, while other scientists and other philosophers believe that they have no relevance at all. Such disagreement can be resolved only when the respective aims of science and philosophy are realized.

Suppose, for example, the aim of science is considered to be the discovery of laws of nature, and suppose that the aim of philosophy is to find out general truths about the universe. Then it will be urged that the new physics has come about because, through technological advances, it has become possible to explore regions hitherto unknown—the regions of

the very large and the very small and the very fast. In these regions it has been found that the laws of nature are different from those which were thought to apply in the ordinary world of experience. In other words, any view we may hold about the universe in general will have to be altered on account of the discoveries of the new physics. For example, it may be necessary to think of the laws of nature, not as universal generalizations at all, but as statistical generalizations. In this way the universe becomes, with the new discoveries, more and more mysterious, and we are prepared for all sorts of philosophical consequences.

With the view which I have been urging, however, there is no need for such obscurantism. We have seen that the aim of science is to extend and to correlate as far as possible all those experiences which we say are of the external world. One of the techniques adopted for this was the construction of a deductive system, and the new physics is essentially an attempt to construct such a system or systems. At the end of last century and at the beginning of this century, certain experiments, such as the Michelson–Morley one and those on electrical discharge through gases, showed that some laws of physics could not be correlated with others by means of the deductive systems then in use. These were the systems known as Newtonian mechanics and Euclidean geometry, although even then there were some laws of physics which could not be correlated by either of these systems—in particular some of the laws of light. Consequently the deductive system had to be altered, either by altering the postulates or the interpretations of the postulates. The new physics attempts to do this, and will be successful or not according as it does or does not correlate to a large extent the laws recently discovered, as well as the laws which were known last century. In this respect it seems to me to have been remarkably successful, for not only does it have among its consequences

(when suitably interpreted) those laws which were interpretations of consequences of the Newtonian system, but it has also consequences which (when suitably interpreted) give statistical laws when statistical laws are all that can be observed. (I mean by this that it may predict that so many flashes will be seen on a fluorescent screen in a given time, but that it does not predict when a flash will occur, nor, moreover, can any law be found predicting anything more than this.)

Does the new physics have any consequences for philosophy? We saw that new laws in the regions of the very large and the very fast and the very small had been discovered which were different from the laws of nature previously thought to be universally true. But it must be remembered that, according to the view here presented, the "very small" and the "very large" and the "very fast" are part of a certain interpretation of a certain abstract system. If the laws alleged to be about the very small, etc., are to be verified, they are verified by going through a series of observations and noting the results, but at no stage of the process do very small or very large or very fast bodies, in the ordinary sense of these terms, play a part. Thus what has happened is that further experiences of the external world have been correlated with what was already known by throwing overboard the old deductive system and introducing a new one. Moreover, the interesting thing about the new one is that it suggests limitations in the amount of correlation which can be achieved in scientific thought. In the nineteenth century it was possible for science to hold that eventually all the events of the universe would be intercorrelated by the systems of Newtonian mechanics and Euclidean geometry, so that eventually a scientist would always be able to say what he would observe when he performed such and such an operation. It is true that in practice science was a long way from such an ideal, especially as regards what was called living

matter. But there seemed no reason to doubt that this was due to the great complexity of all that was alive, and that just as with sufficient study and care it would be possible to predict, from the initial conditions, which way a coin would fall so it would be possible to predict the behaviour of living matter from sufficient knowledge of the laws governing its behaviour and of its initial conditions. The new physics suggests that this ideal must definitely be abandoned. It has obtained correlation between those events which are ostensibly uniform, such as the fall of an apple to the ground, and those events in a gas discharge tube where there is no uniformity as regards the individual flashes seen, although there is statistical uniformity over a period of time. Hence while correlation has been secured between fields of experience which were previously uncorrelated—namely, the field covered by Newtonian mechanics and the field opened up by recent experiments—it has been at the cost of limiting the correlation which can be secured between events in this latter field.

It may be urged that the deductive system in the new physics will sometime be superseded by another system which not only secures correlation between different fields of experience, but also secures complete correlation among the events inside each field. It would then be possible to say when a flash would be observed in a tube under given conditions, and at the same time such events would be correlated, by the abstract system of the newer physics, with the established uniformities of classical physics. I do not think such a possibility can be ruled out. On the other hand, the new physics has suggested for the first time by the methods of science that the universe is such that, if we are to achieve a wide correlation of our experiences, there will be events inside this correlation which remain uncorrelated. This conclusion, however, is a conclusion about the external world, and according to the point of view adopted here belongs to

science and not to philosophy. It implies that the nineteenth-century ideal for science, whereby all events were thought to be scientifically explicable, may be illusory, and, as I have said, the important thing about this is that such a view has been reached by the ordinary processes of scientific thought and not by philosophical speculation.

The conclusions of this chapter may be summarized as follows. We find that among all the elementary judgments which we make some have the characteristic that other people agree with them. These judgments we then say are judgments about the external world and provide a basis for science. The aim of science is to extend the field of such judgments and to correlate them with each other as far as possible. The former it achieves by means of experiment and improved technology, and the latter it achieves by means of the deductive and inductive techniques of scientific thought. Thus correlation of particular observations is obtained by formulating laws, and correlation of laws is obtained by formulating still more general laws or abstract deductive systems. The aim of philosophy, I have suggested, should be (*a*) the analysis of propositions, in which case part of philosophy—the part, namely, that deals with the analysis of the propositions of science—will be the study of scientific thought; and (*b*) the correlation of those judgments which are not considered to be about the external world. It seems to me that this description of what both science and philosophy attempt to do is a fairly accurate account of the activities of scientists and philosophers.

CHAPTER XVIII

THE PRESENT AGE: III.—EDUCATION

The saddest memories of political life are of moments at which one had to stand by when golden opportunities were being lost, to see the wrong thing done when it would have been easy to do the right thing.—JAMES BRYCE.

AFTER this rapid survey of some of the ideas which have made the modern world, we may well ask where do we go from here? Although the present scientific age is some three hundred years old, people are still far from realizing what it means, and are preserving habits of thought which would have been much more appropriate three thousand years ago. It is becoming increasingly obvious that this will lead to man's self-destruction unless something drastic happens. Religious leaders stress the need of a religious revival, and argue that only a change of heart will save civilization from destruction. It seems to me clear that, if civilization is to depend on that, then nothing can possibly save it, for no change of heart is ever international, far less universal, and those whose hearts are unchanged are likely to have the best of any contest which employs atomic energy. What, then, is to be done? I think there is one thing which we can and must do, and that is reform our ideas of education, much more radically than we have yet done, to take account of the ideas on which this modern world depends.

Many different views about the nature and purpose of education have been held explicitly or implicitly throughout history. But it is probably true to say that at all times these different views have agreed that education must render it easier for some or all members

of society to attain certain ends. The ends may be entirely practical, or they may be ethical or religious, or they may be purely intellectual, or they may even be a mixture of all these. The nature of the education given will clearly depend on the end which is accepted. Plato's guardians studied mathematics for ten years because it was alleged that the ideal of the Good could be comprehended only after a thorough grasp of mathematical knowledge had been obtained. Early Roman education had as its ideal the conservation of a certain way of life, with the result that from the age of seven onwards boys accompanied their fathers on their daily business, and even listened to meetings of the Senate. They thus learned to copy their fathers in everything in the hope that the preservation of the *status quo* could be maintained. Hence the attitude which is adopted towards ideas—whether they be scientific, ethical, or religious ideas—determines the whole character and scope of education. It is, therefore, fundamental that we should consider the kind of education that is implied by the system of ideas which, I have argued, fashioned the world as we know it to-day.

In a previous chapter we have seen that the aim of science is to extend and correlate all those parts of experience which we share with other people—the experience, that is, of the external world. It follows that, whatever view is accepted about the end for which education should strive, scientific knowledge must be considered fundamental. For it is only through the acquisition of such knowledge that the child can understand and communicate about the world in which he and other people live and move and have their being. This conclusion appears so obvious as to be scarcely worth mentioning. Yet the sad fact remains that educational theory and practice is incredibly slow to realize it, and, in spite of compulsory universal education in most European countries for the last fifty or a hundred years, there is little evidence to show that

people's lives and experience are more rationally ordered as a result. Indeed, the evidence is rather the other way. In spite of universal education, the people of Europe have been unable to prevent two wars in the last thirty years. Moreover, these wars have been remarkable for the ruthless way in which slaughter has been carried out on both sides. Although the bombing of civilians was a clear violation of international law, both sides indulged in it when it was advantageous to do so, and each side accused the other of having started it. Threats were made throughout the whole course of the second world war about the damage that would be inflicted in the future on the cities of the opposing side if it were foolish enough to continue fighting, but if it decided not to fight, it must surrender unconditionally. Each side boasted that its bombs were " bigger and better " than those of its opponent, and each side threatened to use gas warfare should the other do so. There is little doubt that the majority of the population on the two sides approved of its own government's policy, yet such behaviour could hardly be called " educated." By way of contrast it may be recalled that in India, where education was so lacking that the level of illiteracy was at least eighty per cent, the population considered that the best way of expelling the army of occupation, imposed on them by another nation, was not to rise and tear the soldiers limb from limb, as would have been expected of an " educated " country, but to practise non-co-operation.

If, therefore, universal education is the method by which we are going to attempt to create a society in which people think and act in accordance with the precepts of scientific thought, it will have to be somewhat different from the education which we have at present. That seems to have been powerless to create what was wanted. In Chapter I, I said that the difference between civilization to-day and the savagery of the hunting tribe was due more to the development

of scientific ideas than to anything else. If that is so, one would have expected education, at least in Europe, to have concentrated for the last two thousand years or so on the dissemination and advancement of such knowledge. Yet it has notoriously failed to do so. There are doubtless many reasons for this, but it is worth while considering what is perhaps the fundamental educational reason.

One report of the Consultative Committee of the Board of Education in England discusses three reasons for the teaching of science.[1] (1) It gives the pupils some knowledge of the natural laws which operate in the universe and of their application. (2) It reveals the influence of scientific thought and achievement in the evolution of our present-day civilization and the possibilities in the future of the human race. (3) It gives the pupils an introduction to scientific methods of thought and investigation. The report claims that most of the teaching of science up to the present has been influenced by the third of these aims and has paid too little attention to the first and second, and urges that science should be taught " as Latin was taught in the Middle Ages, because it is useful—useful to the individual as an element in his own life and useful to him as the indispensable background of much current thought."[2] With this we can heartily agree. It is also of interest to note that the Report quotes with approval the definition of General Science as " a course of scientific study and investigation which has its roots in the common experience of children,"[3] a definition which, I should have thought, had much more important consequences for education than the Report envisages.

Now why is it that most educationists have been influenced by the third of these aims and have paid little attention to the other two? The answer, I

[1] *Spens Report on Secondary Education* (H.M.S.O., 1938), pp. 244–5.
[2] *Ibid.* [3] *Op. cit.*, p. 243.

think, goes back to the distinction which Plato drew between vocational training (or the learning of useful knowledge) and cultural education, which, being useless, became the ornament of the leisured, or slave-owning, class. Consequently when educationists feel compelled to justify the introduction of a new subject into school or university curriculum they do so by trying to show that it has the same uselessness as Classics or Moral Philosophy. As even the most ingenious can hardly demonstrate that about science, they ignore entirely its usefulness and concentrate on the value of the methods of thought employed. But we have seen that scientific thought is characterized particularly by the fact that it deals with those experiences which we share with other people; that is, by the fact that it deals with the external world. Consequently to teach science solely from the point of view of giving pupils an introduction to scientific method is to ignore the distinguishing mark of scientific thought. In truth, the three aims which the Spens Report put forward for the teaching of science cannot be justifiably separated, and taken together they constitute the strongest possible reason for making science the centre round which all education should revolve.

In the last ten or twenty years we have heard a great deal about the marvellous possibilities in the future of the human race which scientific knowledge has opened up. Utopia appears to be only round the corner. Atomic energy, hydro-electric power, and the properties of new chemicals, such as artificial fertilizers, ensure a productive capacity unknown in the past, and the revolution in communication brought about by aviation and radio enables populations to be rationally distributed throughout the world without the dangers of intellectual isolation or insanitary overcrowding. Yet it is quite certain that this Utopia will be realized, and the present series of world wars terminated, only if there is a serious attempt

to educate people to understand what science has achieved in the past and what it may achieve in the future. This will not be brought about as long as educationists and scientists talk about scientific knowledge as an end in itself. It is, I have already admitted, perfectly true that some people, including perhaps the most eminent, take up a scientific life out of sheer intellectual curiosity. But such a fact has no relevance at all to the education of the mass of the people. Scientific knowledge is important for the average citizen just because it is the only way by which he can learn to understand and to control the world in which he and all his fellow-citizens have to live. In so far as he acquires such knowledge he is to that extent understanding the world which he shares with others, and in so far as he neglects to acquire such knowledge he is to that extent making sure that misunderstanding will arise with his fellow citizens. Thus it is time educationists stopped making a distinction between knowledge acquired for use and knowledge acquired as an end in itself. The latter may, at one stage of the process of social evolution, have had some importance in understanding the problems of the time, but it is, I think, not unfair to say that to-day a branch of knowledge is justified as an end in itself only when no other justification can be given.

Unfortunately recent tendencies in England are hardly such as to cause much optimism in this respect. While there has been a growing realization of the necessity of education for citizenship, this has not expressed itself in the desire for more scientific knowledge—the only thing that will give the future citizen the slightest help. There has been little tendency indeed to change the content of education in England for a long time. It is true that the proportion of the population now attending school is considerably higher than it was a hundred years ago, but for those sections of the community who always have attended school

and university there has been no fundamental change. A certain amount of science has been given to those who are going to the relatively new professions of engineering and chemistry, and the proportion of pupils studying dead languages is probably smaller, while Euclid is no longer taught as Euclid, and is sometimes not even taught to young ladies. But the framework is the same, and unfortunately looks as if it will remain the same until the series of economic crises and world wars shatters the whole system. One glimmer of enlightenment that appeared in one small corner when, after the first world war, the Civil Service Commissioners made a paper on Everyday Science compulsory for entry into the Higher Grades, disappeared when, shortly before the second, this paper was abolished.[1] It is just as possible to-day as a hundred years ago for men, who have no knowledge at all of scientific thought, to occupy posts of supreme importance in the lives of their fellow citizens.

Those who have concerned themselves recently with what they call " education for citizenship " have been interested primarily in what at other times is called " education for leisure." They appear to think that contemporary adolescents are in danger of being demoralized whenever they have a few hours free from office or factory, and they are determined that during these few hours the poor adolescents will be taken care of by an appropriate Youth Movement. Fortunately at the present time many of the adolescents are showing equal determination in ignoring all Youth Movements, but how long they will be able to withstand pressure from the government, from the Press, and from educationists it is difficult to say. It is, I think, particularly tragic that there

[1] This is not meant as criticism in any way of the Civil Service Commissioners. From what I have heard, the examination was extremely unsatisfactory. It is meant as criticism of the universities which did not take advantage of the opportunity offered.

should have been found some people in the educational world who attempt to justify all this nonsense. I suspect that such people feel that, in permitting youth once a week to discuss democracy, they are thereby atoning for their own failure to make democracy work. They eagerly pass on to youth problems which they have not the least idea how to solve themselves. They are then able to write to the Press and call this the Century of Youth, although there has probably been no time when power was so concentrated in the hands of old men. The hypocrisy of it all is most readily seen when we inquire into the social conditions of those for whom these inspiring Youth Movements are designed. We find that they are the youth of the lower middle classes and of the city slums. No one worries about the deadly dangers to which the youth of Eton are exposed in the hours of leisure which they attain after leaving that ancient seat of learning. It is not they who are considered to be in need of lectures on democracy, musical appreciation, or sex morality. One recalls the story of the young Eastern Prince who, having been introduced to the pleasures of love, said, "But surely everyone is not able to enjoy this. It is much too good for the poor." The real problem is obviously not one about the use of leisure, but how to cure poverty. The trouble is not that people do not know how to spend their leisure time, but that they often are not sufficiently well off materially to be able to satisfy even the few wants which they do have. People with country houses to which they repair from the city for week-ends lasting from Friday to Tuesday have no problem of leisure unless some urgent business necessitates their presence in the city on Monday! The difficulties of "education for leisure" are the difficulties of abolishing poverty. But the way to do this is the rational use of science, and a system of education built around the study of science.

While I have said that recent tendencies in England

are such as to make one pessimistic about the possibility of such a change in education, I think it is possible that one change might be made within a reasonably short time, and I think that it would have considerable influence. This change is a change in the universities, whereby students would attend some course dealing with the history and nature of scientific thought. At present scarcely any of the universities in the British Isles provide lectures on the history of science. This is all the more surprising in that lectures are universally given on topics such as the history of economics and the history of ethics, and it can scarcely be maintained even by economists and moral philosophers that science is a less important branch of human activity than these. Yet the fact remains that most students, including science students, leave the university with only the vaguest idea of the way in which scientific thought has developed. The few who have studied the question are generally science students who have taken a broad view of the subjects in which they have specialized. Nevertheless ignorance does not prevent people who should know better from dogmatizing on the subject. Thus the late Professor Bowman, referring to the writings of Russell and Broad, who have done as much as any two men to clarify the nature of scientific thought, says:—

> "The name 'science' seems to mean nothing but the class of sciences, and the word 'scientific' nothing but what is characteristic of science so understood. In this the enormous differences between the sciences—the incommensurability between their respective defining standpoints and between their respective methods—are lost sight of. That such oversight should be possible for highly trained minds is at first sight surprising."[1]

[1] A. A. Bowman, *Studies in the Philosophy of Religion* (Macmillan, 1938), vol. 1, p. 15.

A similarly patronizing and equally ignorant attitude is exhibited by Sir Richard Livingstone in his recent book *Education for a World Adrift*. One cannot help feeling that such intellectual howlers would have been avoided if the universities had conceded to science the place which, as the Spens Report has it, Latin occupied in the Middle Ages.

Such a reform in the universities would probably be resisted by a few professors in the Faculty of Arts. I know of no valid argument against it, but the following two might perhaps be typical of the invalid ones. (*a*) It will be argued that science is a matter for specialists, and the person who is not going to be a specialist need not concern himself with it. This argument, at best, could justify only the view that lectures on the history of science be confined to scientists, not that there should not be any lectures. For, as I have said, economists and philosophers receive lectures on the history of their respective subjects. We make quite certain that our professors of Philosophy have heard of Plato, but we do not care whether our professors of Physics have heard of Archimedes. But the premise of the argument is quite untrue. Both the results and the methods of science are of the utmost importance for everyone, and it is only by realizing the extent to which the development of science has shaped civilization that the average citizen can realize the immense possibilities in the future of the human race. (*b*) It may also be argued that the history of science does not bear the same relation to science as the history of ethics does to ethics (or even the same relation as the history of economics does to economics). The history of ethics, it will be said, is a vital part of ethics, in that the problems of ethics to-day are very largely the same as they were two hundred or two thousand years ago, whereas the problems of science to-day are very different from what they were even twenty years ago. In other words, an understanding of the history of

science has almost nothing to do with an understanding of science to-day. There is a certain amount of truth in this, but the truth that is in it has no relevance at all to the education of the average undergraduate. The methods employed in scientific thought have remained substantially the same throughout the history of science, and there is no better introduction to them than a study of the way in which science has developed. Thus there is no justification, as far as I can see, for the neglect in many universities of the history of science, and at the present time it seems to be true that if a subject is neglected at the universities it is neglected everywhere.[1] To that neglect must be attributed, at least partly, the dismal failure and the sickening complacency of the educated classes in the last thirty years.

While I believe that education must be concerned mainly with the dissemination and advancement of scientific thought, it would be wrong to suppose that there is no place for what may be termed ethics in education. But it is very important to be clear what that place is. We have seen in previous chapters how philosophers have been driven out of one position after another, as scientific thought was able to bring more and more experience into its scheme of correlation. While from Aristotle onwards there have always been some philosophers who have realized the essential difference between science and ethics, the general tendency among philosophers has been to claim as the field of philosophy all those regions of experience with which science was unable to deal. Driven from the material world by the triumph of Newtonian physics, the concepts of ethics were then supposed to apply only to the phenomena of human life. When human life was shown by Darwin to be continuous with animal life, the moral philosophers

[1] This does not mean that the universities are more powerful than they were. It means that the day of the amateur researcher is past.

took refuge in the region of the a priori. The nebulousness of this region has been demonstrated by modern logicians, who have consequently clarified enormously the place and function of ethics in education.

It is now clear that the methods of science apply to all those parts of experience which are shared by other people. Thus it is from the outset hopeless to teach ethical maxims as if they were scientific truths which applied to our common world. Such has been the method more or less universally adopted in the past, and everyone knows how hopelessly it has failed. But, as I mentioned in Chapter XVII, besides that part of experience which we find is shared by other people there is another part which we find is not shared but is peculiarly private. Thus part of my experience when I look at a surrealist painting, when I listen to boogy-woogy, or when I read James Joyce, I find is not common to all my fellow-men, and is therefore at present outside the scope of scientific knowledge. But just as scientific thought is the method by which we attempt to correlate all those aspects of experience which are common, so moral or ethical philosophy should be the name given to the method by which I attempt to correlate those aspects of my experience which are not so obviously shareable with others. Those aspects with which it is concerned may be indicated in this way.

I find that, generally speaking, I have feelings of approval when I keep those promises I have made, when I strive to make other people happy, when I tell the truth, and so on; and I find that I have feelings of disapproval when I break a promise, make someone else miserable, tell a lie, and so on. Such experience, however, I find is not shared by other people, and therefore I cannot apply any scheme of correlation which has been evolved by science. On the other hand, it is unsatisfying to leave what I shall call my moral experiences uncoordinated, especially as some-

times I find peculiar cases arising. For example, what am I to do if I cannot tell the truth to someone without making him miserable? Or, it may be that if I tell the truth to one man I may be breaking a promise to another. Thus it becomes necessary that I should evolve some scheme by which I can myself correlate those aspects of my experience that are called ethical. But such a scheme must never be held to apply to the experience of other people, and the attempt to apply it can lead only to failure, for by hypothesis the experience for which it is framed is personal, not public. Thus ethical education must be treated in a manner radically different from scientific education. In a sense, of course, it is much less important than scientific education, as the latter deals with our common world, but it may be of great importance for those individuals whose happiness depends on the success with which they can deal with their moral experiences.

The failure to realize how completely different scientific and ethical education must be lies at the root, I think, of the failure of orthodox Christian education in England. The Christian Churches have conceived their duty in education to consist of instilling belief in a set of propositions which are supposed to be universally true. Unfortunately these propositions are demonstrably unscientific and are often not much less crude than superstitions. Yet the whole structure of orthodox Christianity exerts such an influence on the minds of many people to-day that they try, to some extent successfully, to ignore modern knowledge and to live their lives in a system of thought which is almost entirely medieval. For the great Scholastic philosophers of the thirteenth century did such a magnificent job of work that all the problems of life appeared to be solved, and although a number of domestic changes took place at the Reformation, many of the ideas remained unquestioned, and were even set forth as dogmatically as ever by Calvin. The

work of Copernicus, Newton, and Darwin successively undermined the view of the universe which had been created, and scientific method applied in the field of Biblical criticism destroyed anything that remained, yet the Churches to-day require members, and still more those who accept office, to accept formulæ which are quite irreconcilable with modern knowledge. It is hardly surprising that signs of disintegration are appearing in many places, when man has been forced by education to live in one world six days a week and in another world on the seventh.

It may be urged that there is no necessary connection between the ethical aspects of Christianity and the set of propositions which appear in the creeds of the different Churches. And this, I believe, is the case. But if people are educated by a method in which ethics and propositions about the universe are inextricably mixed up, it becomes very difficult for them to disentangle them in later life, and when they come to realize that the propositions about the universe have to be rejected or can be explained only by being explained away, it is almost inevitable that the ethical exhortations should suffer the same fate. Thus arises a widespread rejection of everything associated with Christian education, and the way is opened up for the disastrous moral collapse which Europe has witnessed in the present century.

It is not for me to say what the Churches should or should not do. It may be that they will find themselves unable to give up the set of propositions to which they have been wedded for so many centuries. If so, they can look for little sympathy to comfort them in their declining years. If, on the other hand, they do give them up, it seems to me that the Churches might once again come to occupy an influential position in education, and (although I do not expect this would weigh heavily with them) they would forever be immune from these recurring conflicts with scientific thought which have brought them into so

much discredit in the past. Moreover, although I am not at all competent to express an opinion on this, it seems to me that the Church would be adopting an attitude reasonably consistent with the teaching of the Gospels. For that teaching is surely that Christianity is above all else a way of life which, by its example, seeks to change the behaviour of men. In other words, it puts into practice the view that ethical judgments are not of the same nature as scientific judgments, but are rather ways by which we attempt to persuade people to alter their behaviour. Whether the practice it advocates will always be successful is, of course, another matter. It seems to be, for example, a matter of considerable difficulty even to those who call themselves Christian how far national aggression could be stopped by the practice of non-resistance. But, however that may be, there is little doubt that what may be called the Christian way of life has had tremendous influence throughout the world by persuading people to change their behaviour in certain ways. It is tragic that this influence has been so often negatived because it has been held to be dependent on propositions which are scientifically absurd.

The Churches, however, are not the only people who have adopted the disastrous policy of treating ethical and scientific education in the same way. Most educationists, in fact, have acquiesced in it. A very notable exception is Dr. F. H. Hayward, who, by developing what he has called "the Celebration Movement," has made, it seems to me, a most important contribution to the methods of ethical education.

Hayward has been greatly impressed by the complete failure of moral education by means of religious teaching in the schools of England. The failure, he maintains, has come about largely because of lack of vision. "Moral education is impossible without the habitual vision of Greatness," wrote Whitehead, and Hayward set himself the task of devising a method

whereby those in the schools and colleges of England should be provided with the opportunities for seeing such a vision:—

> "By means of Celebrations of the sciences, arts, institutions, etc., great *impressions* may be produced and great bird's-eye views given, which will correct and supplement the narrow studies and the crude morals current in many secondary schools."[1]
>
> "Broadly, successful Celebrations would bring illumination and inspiration to pupils, to teachers, and to such parents and visitors as could be present, and would bring a renewal of old and lost ideals to the last three groups. The Celebration is *an attempt to organize Inspiration*, which otherwise is entirely dependent upon the spiritual life of individual teachers and may often be absent."[2]

Roughly we may say that moral education may be accomplished by Celebrations of all Great Themes. Hayward rightly thinks that Celebrations will also convey knowledge, but moral education is to be their chief function, and it is the latter only which I have stressed here. What I wish above all to make clear is that a method does exist whereby people can be influenced in regard to that private part of their experience which we call moral.

I have already indicated that recent tendencies in education in England are such as to make me very pessimistic about the future. It seems to me quite clear that the people responsible for education in this country have completely failed. We are told complacently that the present disastrous state of affairs is due to Adolf Hitler, to the evils of capitalism, to the vindictiveness (sometimes, the tenderness) of those

[1] F. H. Hayward, *A Summary Statement of the Celebration Case* (Herbert Russell, 1932), p. 3.

[2] *Op. cit.*, p. 1.

who made the Versailles Treaty, or to this, that, and the next thing. There is, indeed, some truth in all that, but we are never told that the main trouble is the inability of the average person to understand the world in which he lives and to make sense of his own moral experience. Moreover the remedy for that is in our own hands. By reforming education so that scientific thought occupies its rightful place and so that moral education is divorced from its medieval supernatural background, we have the means whereby we can shape a society in which everyone is able to appreciate the fullness and richness of life.

APPENDIX I

THE IDEA OF DEDUCTION

It is probable that from the earliest times some uneasiness was felt about the possibility of deducing facts about the world by purely a priori methods. Euclid's starting point consisted of a number of definitions which were supposed to say nothing as to the existence of the things defined, and required only to be understood, together with five axioms and five postulates. The five axioms, or "common notions," were held to be self-evident principles common to all the sciences. They were:—

(*a*) Things which are equal to the same thing are also equal to one another.

(*b*) If equals be added to equals, the wholes are equal.

(*c*) If equals be subtracted from equals, the remainders are equal.

(*d*) Things which coincide with one another are equal to one another.

(*e*) The whole is greater than the part.

These axioms do not raise any serious difficulties, for clearly they are all analytic statements in Kant's sense, and therefore the fact that we know them a priori need not surprise us. The five postulates, on the other hand, were held to be self-evident principles which applied only to geometry. They were:—

(*a*) It is possible to draw a straight line from any point to any point.

(*b*) It is possible to produce a finite straight line continuously in a straight line.

(*c*) It is possible to describe a circle with any centre and radius.

(*d*) All right angles are equal to one another.

(*e*) If a straight line falling on two straight lines makes the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, will meet on that side on which are the angles less than two right angles.

Now it has been generally admitted, except by Oxford logicians such as Cook Wilson, that the last of these postulates is by no means self-evident, and throughout history many attempts were made either to prove it from the other postulates, or to prove it from the others in conjunction with some postulate which was at the same time simpler and more self-evident. These attempts achieved no real success, and in the nineteenth century it was at last established that the denial of the postulate was consistent with the other postulates, and that a so-called "non-Euclidean" geometry could be developed.

The further development of postulational technique referred to in Chapter IV can perhaps be most easily explained by means of a simple example. Let K symbolize a class, and let a, b, c . . . symbolize individual objects. Let $a \times b$ denote the result of a dyadic operation on a and b, and let a' denote the result of a unary operation on a. Consider now the following postulates:—

If a, b, c are in K, then—

(1) $a \times b$ is in K

(2) a' is in K

(3) $a \times b = b \times a$

(4) $(a \times b) \times c = a \times (b \times c)$

(5) $(a' \times b')' \times (a' \times b)' = a$

Suppose that K is interpreted as the class of all propositions, $a \times b$ as the proposition a and b, a' as the proposition not-a. Then it is easily verified that

(1)—(5) are all true propositions, and they are said to constitute a set of postulates (or a set of axioms) [1] for the theory of propositions. By this is meant that when a propositional interpretation is given to the variables occurring in the propositional functions (1)—(5), these all give true propositions. There are, of course, many other interpretations which can be given to them. One, for example, which is due to Professor Sheffer, is as follows. Let K be the class of eight numbers 1, 2, 3, 5, 6, 10, 15, 30. Let $a \times b$ be the highest common factor of a and b, and let $a' = 30/a$. Then (1)—(5), so interpreted, are all true propositions. From them it is possible to deduce, by the ordinary rules of inference, many consequences which will all lead to true propositions when given any of the possible interpretations. (1)—(5) are, in fact, a set of postulates for Boolean algebra.

This brief account of the postulational method can be summed up by the following passage written by Huntington:—

> "The development of any abstract mathematical theory may be described, in the last analysis, as a process of writing down, one after another, a series of expressions—this process involving the motor activity of some human agent. The human agent, in actually working out the development of the theory, constantly passes judgment upon a variety of expressions, deciding (on the basis of previously agreed upon rules of procedure) which expressions are to be written down as 'accepted' expressions in the theory and which are to be rejected. . . . In order to start such a theory going at all, one must have at least one expression which is agreed upon as an 'accepted' expression. In any particular theory, the expressions which are accepted as the

[1] No distinction is made now between the terms "axiom" and "postulate."

starting point of that theory are (or should be) listed in advance and may be called 'a set of formal postulates' for the system in question."[1]

For example, in the system of Boolean algebra (1)—(5) were the expressions which started the theory "going," and "the previously agreed upon rules of procedure" were the ordinary laws of inference. In more complicated systems, as for example the deductive systems known as the kinetic theory of gases, the classical theory of elasticity, quantum mechanics, the rules of procedure will also include many of the rules of mathematics.

[1] E. V. Huntington, *The Mathematical Structure of Lewis's Theory of Strict Implication.* Fund. Math. T. XXV., p. 147.

APPENDIX II

THE PROBLEM OF INDUCTION

THE term " induction " has, from the earliest times, been used in two different senses. Aristotle by ἐπαγωγή sometimes meant the process by which, from observation of a particular instance, we come to form a general idea. But he also used the term in the sense of generalization after complete enumeration. For example, after verifying that each individual ball in a given urn is red, I could by induction conclude that all balls in that urn are red.

It was natural then to extend this second meaning to cases where there had not been complete enumeration, so that the generalization might be asserted even although only a few instances had been examined. In comparatively recent times it has become the practice to extend the use of the term still farther, so as to cover cases where only a limited generalization has been put forward. For example, if I examined ten balls in the urn and found that two were red, I might put forward the rather limited generalization that twenty per cent of the balls in that urn were red. This is what is often called a statistical generalization, and plays a considerable part in science. There has also been a tendency to use the term " induction " even in cases where no generalization at all is put forward, but where an assertion is made about the result of some particular future experiment. It is better, however, to use W. E. Johnson's word " eduction " for such cases, and to use " induction " either for the process of forming a general idea after observation of a particular instance, or for the process

of generalization, universal or statistical, after complete or incomplete enumeration. In what follows I shall ignore the problem of statistical generalization, as that of universal generalization must be solved first. The reason for this is that statistical generalizations, for example, " the mortality rate from influenza is 0·5 per cent," involve concepts, such as mortality and influenza, which depend on universal generalizations.

We saw in Chapter XII that the problem of induction in its modern form was raised explicitly by Hume. (On what grounds do we, from a hundred instances, draw a conclusion different from the conclusion which we draw from one instance?) As science advanced more and more during the eighteenth and nineteenth centuries, the separation between philosophy and science became increasingly great, with the result that some scientists have not even been aware of the logical difficulties which philosophers found in the technique which has unravelled the mysteries of the universe with such success. Believing firmly in the doctrine that nothing succeeds like success, they have gone on their way quite unmoved by the awful possibility that some of their generalizations might have a probability not significantly different from zero. Indeed, a philosophy of science has been developed, mainly in America, which explicitly takes the criterion of success as the justification for the methods of science. Less heroic attempts at solving the difficulty, however, have been made from time to time, and we must briefly consider the most important of these, as it has sometimes been held that the problem can only be solved if we know a priori some general proposition about the universe.

Whewell, Master of Trinity College, Cambridge, was by inclination more sympathetic to experimental science than most philosophers, and he made a valuable contribution by re-emphasizing the importance of induction in Aristotle's first sense—that is,

the sense in which we form general ideas from contemplation of a number of instances. When we reflect on the scientific advances made possible by the formation of such ideas as atoms in chemistry, genes in biology, energy in physics, we begin to realize the tremendous value of good " inductions," in this sense of the term. Most logicians, on the other hand, who have considered induction at all have concentrated on the problem of generalization, and it is, I think, partly for this reason that so few scientists have felt that their work was valuable. For a complete account of deduction and of inductive generalization would not exhaust the resources of scientific thought, but would leave out of account precisely what some scientists consider of most value—namely, this other sense of induction. It is this which scientists have in mind when they say, as some of them do, that there is no such thing as scientific method. They mean that there is no method by pursuing which anyone could make important scientific discoveries. This, I think, is perfectly true just because this sense of induction is not amenable to rules and regulations. Thus even when it has become possible to give an adequate account of deduction and inductive generalization there is no possibility of scientific thought becoming easy. The history of science tells us that nearly two thousand years elapsed before Galileo and Newton, by forming the concepts of space and time as measurable extensions, solved the problem of gravitation which had been considered by Aristotle. It is inductive thinking in this sense which calls for the highest powers of insight and creative thought, and it was this which Whewell wisely emphasized.

The name of Jevons is usually associated with a particular aspect of inductive generalization. When a generalization has been made after incomplete enumeration, it is customary to deduce consequences from it and to find by observation or experiment whether it is thus refuted or confirmed. Indeed, it is

this characteristic which distinguishes some text-books on mathematical physics from text-books on pure mathematics. For example, a text-book such as *Electricity and Magnetism* by the late Sir J. H. Jeans takes certain laws which have been found to be true in a limited number of cases—Coulomb's law, Ohm's law, and so on—proceeds to generalize these as far as possible, and to deduce by pure mathematics consequences which lead to experimental verification. The only way in which it differs from a treatise on pure mathematics is in its starting point, and in the fact that it tends to concentrate on only those consequences which are experimentally verifiable. It was this aspect of induction which led Jevons to describe it as the inverse of deduction. By this he meant that in deduction, the direct process, we obtain the truth or falsity of a conclusion from our knowledge of the premises, while in induction, the inverse process, we try to obtain the truth or falsity of the premises from our knowledge of the conclusion. But it is clear that the use of deduction in such a process in no way provides a justification for the generalization. It may show that the generalization is consistent with all the instances that have been observed, but there may be many other generalizations which would also be consistent. Hume's question is still unanswered.

Probably few logicians have produced a work which has been so severely criticized and which, at the same time, has had so much influence as the *System of Logic* of John Stuart Mill. The reason for this is that Mill has always something interesting and suggestive to say no matter what problem he is discussing, but his treatment often contains the most elementary mistakes. Thus the criticism of Mill has for many years been a favourite sport for those who examine undergraduates, while his important ideas have often been ignored. It should be remembered, however, that, with the exception of Whewell, Mill was much more empirically minded than any of his

philosophical predecessors, and bears indeed a close relationship to the Logical Empiricists of the present day. Consequently it is often alleged that he does not appreciate the difficulty of the problem raised by Hume. But it would be more correct, I think, to say that Mill, like the pragmatists a generation or so after him, does not consider that the methods employed in scientific thought need justification. There is really very little evidence indeed for the common view that Mill believed he could teach the scientist how to do his job. In fact it seems to me that the reverse is true. Mill was eager to see some sort of order brought into social investigations, and he believed that social sciences could be developed if only the methods which had been so successful in the natural sciences could be applied to the study of man in society. Consequently he set himself to discover what these methods were, and summed up his results in the famous chapter entitled "Four Methods of Experimental Inquiry." There is little doubt that Mill believed knowledge of general propositions could be derived with certainty from knowledge of particular instances provided that it was derived in accordance with the methods he expounds, but in believing this he is no more to be censured than many scientists who believe that scientific knowledge is certain and not just probable. Indeed, most of us in the course of our ordinary day-to-day lives accept such a standpoint. It is perhaps true that Mill should have realized the inadequacy of the methods which he gives to cover the whole range of scientific thought. But this criticism is very different from the one which says that he does not understand the problem raised by Hume. To Mill, as to many modern scientists, it was difficult to believe that science needed any justification, and the real problem was, What is the correct analysis of the methods employed by scientists?

Recent work on induction has rejected this claim that some generalizations may be known with cer-

tainty, and has attempted instead to base induction on probability. The most detailed accounts from this point of view have been given by Broad, Jeffreys, and Keynes. The fundamental assumption is that probability is a logical relation existing between propositions, and that, corresponding to different logical relations, there are different degrees of rational belief. Thus to say "I have degree of rational belief x in proposition p given proposition q" is the same as to say "The probability of p, given q, is x." When the logical relation between p and q is such that q implies p, then the degree of rational belief becomes certainty; that is, given q, I am certain p is true. When the logical relation is such that q implies not-p, then the corresponding degree of belief is complete disbelief; that is, given q, I am certain p is false. With a suitable interpretation of certain postulates of probability theory which are assumed to govern the ordering of the logical relations, it is easy to introduce a numerical system for the measurement of probabilities, so that 1 corresponds to logical implication and 0 to logical incompatibility. There are, however, two serious difficulties in this view. In the first place, many people would deny that between every two propositions there exists a logical relation. For example, it is at least arguable that the relation between "Washington is the capital of the United States" and "Mr. Churchill likes cigars" is somewhat obscure. Supporters of this point of view, however, are in the strong position of being able to reply that the relation exists, and if some people are unable to see it, it is just too bad. It should not be held that colours do not exist because some people are blind.

The second difficulty, nevertheless, cannot be evaded so easily. It concerns the logical status of the interpreted postulates which assign an order to these logical relations. Jeffreys says, "It is important to note that they cannot be proved by deductive logic.

If they could induction would be reduced to deduction, which is impossible. Equally they are not empirical generalizations; for induction would be needed to make them and the argument would be circular."[1] Jeffreys attempts to hold that they have the same sort of status as the primitive propositions of *Principia Mathematica*, but as the latter have the characteristic called by Wittgenstein [2] " tautology," this attempt is clearly hopeless. The fact that they are neither empirical generalizations nor tautologies exposes them to the kind of criticism with which it is now fashionable to discredit metaphysical propositions. It is perhaps possible to hold that such criticism is invalid and that meaningful propositions exist which are neither empirical generalizations nor tautologies, but it is certainly unfortunate that a theory of induction should depend on such a view.

In the subsequent development of this account of induction another difficulty, similar to the last one, has to be faced. Before any generalization can come, as a result of successive verifications, to have a high probability, it is necessary, on this view, for it to have a finite probability prior to the verifications. Keynes introduces a principle which limits the amount of " Independent Variety " in the universe, while Jeffreys introduces a Simplicity Postulate, but the logical status of such a principle or postulate is exceedingly doubtful. For it again is neither a tautologous nor an empirical proposition. Supporters of this position, therefore, seem committed to what is to me the unplausible view that the justification of scientific generalizations depends on the truth of some a priori synthetic proposition.

Because of these difficulties I think this whole approach to the problem ought to be abandoned. The

[1] H. Jeffreys, *Theory of Probability* (Oxford University Press, 1939), pp. 7–8.

[2] L. Wittgenstein, *Tractatus Logico-philosophicus* (Kegan Paul, 1922), p. 97.

Logical Positivists, however, have made an ingenious attempt to keep the advantages of this approach while escaping the difficulties. They have suggested that the Simplicity Postulate, for example, should be regarded merely as a rule of behaviour which we can adopt or reject as we wish. If we adopt it, then there is a chance that we shall be successful scientists; if we reject it, then we have no chance at all. A man who did not accept it as a rule of behaviour we ought to call unfortunate, rather than foolish, because he lacked what would have been a very useful habit. Unfortunately, I do not think that this attempt to avoid the difficulty is successful, for it confuses two aspects of induction—the habitual aspect and the belief aspect. Consider any generalization, such as, *P* is always followed by *Q*. We may have been conditioned to expect *Q* whenever we experience *P*, and if so, we will, when confronted with *P*, always behave as if we believed that *P* is always followed by *Q*. But clearly we may have no such belief at all. Indeed, this habitual aspect of induction is all that is meant when it is said that dogs, for example, guide their behaviour by induction. After a few experiences of *P* being followed by *Q* (assuming that *P* and *Q* are of considerable interest to dogs) the dog comes to expect *Q* when confronted with *P*, but it is ridiculous to suppose that there is anything in the dog's mind that could be said to be a belief in the general proposition *P* is always followed by *Q*. On the other hand, when we do have a belief in a general proposition, it does not necessarily affect our habits at all. I may, for example, believe that all nebulæ are receding from each other, without that belief having the slightest effect on my behaviour. Now it is the belief aspect of induction with which we are concerned. The habitual aspect is adequately accounted for by the psychological process of conditioning. Consequently the attempt to treat the Simplicity Postulate, or, what is even sometimes suggested, the attempt to treat

every generalization as a rule of behaviour does not solve the real difficulty.

I think, therefore, that the view which would base induction on probability should be abandoned. Moreover it is surely extravagant to claim that, given present-day scientific knowledge, we can assign probabilities to such generalizations as "copper reacts with sulphuric acid," "metals expand when heated." If anyone can do so, then let him say what the probabilities are. Actually it seems to me to be very doubtful if such generalizations can be ordered as regards probability. I do not believe that anyone would be willing to assert that "copper reacts with sulphuric acid" is more or less probable than "metals expand when heated." If, however, generalizations cannot be said to have such and such a probability, must we say that they may be certainly true? If so, it would appear that we had returned to the answer given by Mill.

At this point I think it is important to remember a characteristic of general propositions often stressed in books on formal logic but strangely ignored by writers on induction, for it explains why we feel we cannot be certain of generalizations such as "copper reacts with sulphuric acid." The reason is that, no matter what experience we have had, we can always imagine some future experience conflicting with it. In other words, the form of the proposition is such that it is impossible for us ever to assert its truth. On the other hand, we could assert its falsehood if we had experience of one occasion on which it was false. Thus universal general propositions are unlike other propositions, for which we can determine, at least theoretically, their truth or falsehood, but are such that we can determine only their falsehood. This has led some logicians to recommend that the term "proposition" should no longer be used to describe them, and that some such term as "hypothesis" be used instead. There would be some advantage in

this, but the term " proposition " has been so strongly entrenched in the literature of the subject from the time of Aristotle onwards that on the whole it is probably best to retain it. No confusion need arise provided it is remembered that no universal general proposition of this type can be shown to be true, and that this is due not to our deficiency as human beings in the sense that we are not clever enough to show its truth, but that the verbal form which expresses it necessarily rules out such a possibility.

The result is that, in pursuing the inductive method either in ordinary life or in scientific investigations, we continually try to prove such generalizations false. In the attempt to organize our experience we form concepts, or inductions in Aristotle's first sense, and try to generalize as many relations between concepts as possible. Thus, having formed the concepts of copper and sulphuric acid—concepts which, by themselves, correlate large portions of experience—we naturally go on to see how they are related. One of the first relations to try is that of chemical reaction, and what we call the proposition " copper reacts with sulphuric acid " is a confession that, although we have tried, we have not been able to prove this false, and can hence use it as a tool to order more of our experience until it is proved false, if ever.

There is one obvious criticism that may be urged against this point of view. It may be true, it will be argued, that all universal general propositions cannot be compared as regards probability, but there is no doubt that some are more probable than others, in the sense that we have a stronger belief in them. For example, on the basis of existing scientific knowledge, it is more probable that copper reacts with sulphuric acid than that vitamin K affords protection against hæmorrhage. If, however, the assertion of such a proposition means merely that we are unable to prove it false, then all such propositions which we have been unable to prove false should have the same

probability. But this criticism is by no means fatal. For although we have been unable to prove either proposition false, there has been very much more opportunity for proving the first one false than for proving the second false. Thus we should believe the second to the same extent as the first only when there has been adequate investigation into the relationship between hæmorrhages and vitamin-K deficiency, the investigation being an attempt to find an instance in which vitamin K did not afford protection.

The problem of induction is thus, on my view, not to justify the probabilities of generalizations, but to find a set of concepts and generalizations with which we can reduce our experience to something approaching order. We try all sorts of concepts and generalizations, eliminating and altering some of them as our experience grows. When any new event cannot be correlated with our existing scheme we have always several alternatives. We may, by a slight modification of the existing structure, be able to account for both the new event and also our previous experience; or we may form some new concepts and keep our old ones unchanged; or, as a final alternative, we may say that the event is due to chance. Thus, on my view, not only is it wrong to base induction on probability, but experience into which probability enters is precisely what we cannot account for solely by inductive thought. It is here that the processes of statistical induction come in, our knowledge of which has been greatly extended in recent years by the work of R. A. Fisher and his confidants.

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