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## PHILOSOPHICAL PRINCIPLES IN THE TEACHING OF SCIENCE AND RELIGION

By

GORDON E. BARNES, M.A.

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# PHILOSOPHICAL PRINCIPLES IN THE TEACHING OF SCIENCE AND RELIGION

BY GORDON E. BARNES, M.A.

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### A. INTRODUCTION

SCIENCE, as we know it to-day, is the offspring of a religious faith. It was born necessarily in an environment permeated by the conviction that the universe is intelligible, and, as A. N. Whitehead tells us, this conviction arose out of the "mediaeval insistence on the rationality of God, conceived as with the personal energy of Jehovah and with the rationality of a Greek philosopher".<sup>1</sup> Further, because this God had made man in His own image and had chosen to reveal, in the Bible, some of His thoughts in language which appealed to human reason, then human reason itself must be a reflection (although a very imperfect one) of divine reason. Man should thus be capable of "thinking God's thoughts after Him",

as Kepler put it, and of discerning in nature something of the order which God had ordained.

But as science progressed it slowly forgot its religious foundation, and, by the very nature of its method, came to interest itself in different aspects of the universe from those which had been the concern of its parent faith. New descriptions of the material world were given, using new concepts, and framed in language that had neither scriptural authority nor the warrant of ancient tradition; and many facts were brought to light which undermined centuries-old interpretations of the Bible. Thus there developed between science and religion an apparent antagonism which split thinking Christendom into two warring camps. At times it appeared as if the extinction of Christianity were imminent, and the victory of science assured; or if Christianity were to survive at all, it would do so by degrading itself into a form of humanism that bore little resemblance to the theocentric faith that Christ taught. Christianity has, however, survived, and it is slowly recovering from its humanism which has proved bankrupt. It has survived, not because it has defeated science, nor because it has come to terms with it, but because an uneasy truce has come about. There has so far been little sign of wholehearted reconciliation, or of that harmony which should characterize two disciplines which have the same aim, the exploration of truth.

Ramm<sup>2</sup> lists seven factors which he suggests underlay the past antagonism between science and religion and led to the almost total eclipse of conservative Christianity by materialism and scientific humanism. They are (1) the general secular revolt against religion and mediaeval authoritarianism, (2) the premium put upon scepticism by the success of critical methods in the philosophy of Descartes, Locke, Hume, and Kant, (3) the great success of the scientific method in both theoretical advance and practical application, (4) the impediment of the many divisions of the visible church into denominations and schools of thought, (5) the futile strategy of the orthodox protagonists who often used the weapons of sarcasm, vilification, or denunciation, (6) the fact that, after its initial development, science became very largely the pursuit of agnostic or anti-Christian thinkers who put a materialistic interpretation upon their discoveries, and (7) the lack amongst Christians of a well-developed philosophy of science, so that they often dissipated their energies on small details of fact and failed to appreciate the relevance of the whole scientific approach to the understanding of the universe. They failed to develop a Christian "world-view" which would incorporate in one harmonious whole the knowledge gained from the two-fold, scientific and Christian, attitude to reality.

To my mind the last is the most important factor of all. As influential as the other factors may be, it is difficult to believe that they alone could have led to the almost complete abandonment of conservative Christianity in intellectual and academic circles if Christians had been

able to adopt a philosophy which welcomed and incorporated the results of scientific research.

To-day the need for such a world-view is as great as ever. The practical applications of scientific knowledge have made it imperative that man should have not only a satisfactory ethical code but also the power to implement it if he is not to destroy himself. Man needs a religious faith in addition to his scientific attitude, and if Christianity is to meet the need in this scientific age it must come to terms with science. Furthermore, this is a problem which we cannot afford to leave to the academic theologians, scientists, and philosophers, for the majority of citizens neither hear their lectures nor read their books. Rather this is a matter that concerns all who play any part in education—parents, teachers, ministers, Sunday School teachers, and university lecturers. To teach either science or religion in such a way as to make it difficult for a person to accept *both* is highly culpable. And yet it is continually happening. Science is being taught in a manner which inculcates a deistic or atheistic view of the universe and a materialistic view of man, while teachers of religion often give their pupils the impression that science (or certain branches of it) is a sphere of activity in which the devil reigns supreme. A tension is thus being imposed upon the minds of many young people to-day; and if this is to be avoided in future it seems essential that all who teach the young should be familiar with the philosophical principles which relate science and religion.

The object of this paper is to discuss the relevant aspects of the methods of science and theology, in the hope that it will help the teacher in his task. It presents little original thought, but merely brings together into small compass information which is to be found scattered through a wide range of philosophical works.

## B. THE LOGICAL BASIS OF SCIENTIFIC KNOWLEDGE

The starting-point of scientific investigation is always observation of objects or events.\* They are, of course, observed never in isolation but always against the background of their environment, so that any actual observation is always exceedingly complex, so complex in fact as to be quite unmanageable. From this total observation then the investigator has to abstract those features which he considers relevant to his particular aims. By completely ignoring the numerous other features, he reduces his observation to a set of observational data sufficiently few and simple to be compared or contrasted with corresponding data abstracted from other total observations. This process of abstraction is such a commonplace in everyday experience that when it is performed in the school laboratory it is rarely, if ever, discussed, despite its fundamental impor-

\* Strictly, the starting-point is subjective awareness of what we regard as sense data. But throughout this paper the discussion is at the "commonsense" philosophical level at which teaching of science and religion is carried on.

tance in the method of science and its relevance to philosophical problems arising from science. The schoolboy carrying out a gravitational experiment records in his notebook the weights of a number of different objects released, the heights from which they were released, the time taken for them to fall, and possibly a few other data. But he is not told to record the colour and shape of the objects, the atmospheric temperature and relative humidity, the latitude and longitude of his school laboratory, whether the objects landed on his foot or on the floor boards, or whether he was amused or bored by the experiment; neither usually is he told why these data are ignored. Actually they are ignored for different reasons. The factor of the boy's amusement or boredom is disregarded for the reason that it was observed not by the use of the senses but by introspection; and it is a convention of science to handle only those features of the universe which are recognized by means of our sense organs and which are therefore "public property". This has the great advantage that the data can in principle be checked by other investigators, but, at the same time, the serious limitation that whole fields of human experience are beyond the scope of scientific enquiry. The other features mentioned all come within the scope of the scientific method, but they are ignored because the science master on the basis of past experience deems them irrelevant (e.g., the colour, and place of landing) or insignificant in view of the experimental inaccuracies (e.g., temperature, and longitude). Having made the necessary abstractions, the schoolboy now has a manageable number of data which he can compare or contrast, and he discovers that the acceleration of the falling bodies is constant despite differences in weight.

This illustration indicates both the value and the weakness of abstraction. Its value is that it simplifies observations and makes them manageable—without this there could be no science. Its weakness is that any conclusions reached by the investigator cannot logically apply to the whole of reality but only within the limited field of his abstractions. The schoolboy's conclusion, "The acceleration of the falling bodies is constant despite differences in weight," is true only if it is understood to apply to a particular place, constant air conditions, constant wind resistance, and/or rather crude measuring apparatus.

Every object and event in the universe is unique (if only for the reason that it is separated from all others in time or space), but abstraction enables the investigator to classify objects and events on the basis of those features which they share. The classification of things observed is as far as one can go by the use of syllogistic logic, and it therefore marks the final stage in the science of Aristotle. But modern science is not merely interested in classifying past observations; it wants to predict future observations. Therefore, as Stebbing says, "the scientist wants to make assertions about what *always* happens, not about what *sometimes* happens".<sup>3</sup>

In order to do this, he has to generalize from his particular classified abstractions, and he does so by the logical process of induction (simple enumeration). This is a process which everybody uses repeatedly in everyday affairs, but it was not until the seventeenth century that Francis Bacon systematized it and emphasized its value and importance in scientific research. As a simple example of induction one might consider the following: "All the cats I have seen have tails; therefore it is reasonable to believe that all cats have tails." Now we have only to show one Manx cat to the person who makes this induction for him to realize that his inference is false. Inductive inferences then are always tentative and uncertain, and subject to the possibility of future refutation by subsequent observations. Furthermore, the degree of uncertainty (or the probability of their being incorrect) cannot be determined unless one knows what fraction of the total number of similar objects or events the observed ones constitute. In the vast majority of scientific observations this fraction is unknown. So one can seldom estimate the value of one's generalizations. But there is a further problem. The validity of the method of induction has so far been assumed in this discussion. Hume,<sup>4</sup> however, in the eighteenth century challenged this, not by denying that it could lead to a true generalization, but by asking what logical justification there was for believing that it could. As far as I know, no completely satisfactory answer has been given to his question. Induction, then, which appears to be a very unsatisfactory process from the point of view of the logician, is nevertheless an indispensable piece of equipment of the modern scientist.

This Baconian use of induction is a great advance on Aristotelian science since it not only leads to generalizations of theoretical importance but also facilitates prediction of future events, and thus makes possible the practical application of scientific discoveries. But a yet greater advance came with the work of Newton, who pre-eminently developed the hypothetico-deductive method which more than anything else produced the great scientific achievements of the last three centuries.

The essence of the Newtonian method is the postulation of hypotheses which could explain the scientist's generalizations, and which could at the same time be tested empirically. Of course, thinking men had always formulated theories to account for natural events, but before the seventeenth century the theories had usually been teleological and often moral. For example, the regular succession of day and night and the rhythm of the seasons had been explained as necessary for providing man with his required sleep and food, while adverse environmental factors such as storms and famines were to teach him moral lessons. Such theories could obviously not be verified by reference to observations; they had merely the endorsement of ancient authority. But the seventeenth century witnessed a rebellion against the authority of classical rationalism, and a new authority, empiricism, was substituted. This requires a different

type of hypothesis, one which answers the question "How?" and not the question "Why?" The Newtonian type of hypothesis is causal and not teleological. As is well known, Newton explained the alternation of day and night by formulating the hypothesis that a force exists between bodies separated in space, and that the magnitude of the force bears a definite relation to the masses of those bodies. Such a hypothesis can be tested empirically by making deductions about special cases and setting up experiments to ascertain if the deductions are true. If the experiments do not yield the predicted results the hypothesis is ruled out as untenable. But if they do, this does not prove that the hypothesis is correct, because it may be possible to construct other hypotheses which would predict the same results. A hypothesis can never be proved correct; it is merely tenable until such time as it is proved wrong. When several hypotheses are capable of explaining the same facts, the simplest one is conventionally chosen as the most valuable or fitting. Sometimes, however, two or more different causal hypotheses may be formulated which cannot be compared for simplicity, because they belong to different logical categories, and therefore different intellectual disciplines. Thus the movement of a human arm may be explained by a physiologist as the effect of a series of nerve impulses, but by a psychologist as the effect of a mental decision. Both hypotheses are valuable, but it should be noticed that the psychological one represents a jump out of the logical category of empirical facts (movement of arm) into a new category of introspective inferences (decision), and if the hypothesis is to be tested empirically the reverse jump has to be taken. In this respect psychology (and certain other disciplines, e.g., social anthropology) differs from the purely empirical sciences (e.g., chemistry, physics, geology, astronomy, anatomy, and physiology), and is more nearly akin to the Arts disciplines, with which it is often classified.

The whole of the foregoing logical apparatus is used, with various practical applications, in all the scientific disciplines, and always with the same ultimate end in view, to explain objects and events by giving an analytical description of them. Matter is explained as being built up of molecules, molecules of atoms, and atoms of electrons, neutrons, and positrons. Even the most complex structures are dealt with in the same way, e.g., a biological community may be analysed into its individual organisms, the individual organisms into organs, organs into tissues, tissues into cells, cells into organelles, organelles into molecules, and so on. If structures are analysed into their constituent structures, so also processes are analysed into their constituent processes, so that the most complex events can all, in principle, be explained as being made up of relatively simple events such as the passage of electrons, or quantum jumps in the atom.

As a result of this analysis it is often found that objects or events which appear very different have in fact common features, and this makes



new generalizations possible. So the further the analysis proceeds the greater the number of objects or events which can be described in terms of more and more fundamental generalizations. Now "natural laws", which have often been mistaken (by both scientists and laymen) for items of divine legislation binding upon every atom and molecule of the universe, are actually nothing more than such fundamental generalizations.

So the scientist's task may be summarized as the attempt to describe individual objective phenomena in terms of fundamental generalizations based upon observed correlations. His logical equipment for the task consists of the processes of abstraction, induction, hypothesis-formation, and deduction.

### C. THE BASIS OF RELIGIOUS KNOWLEDGE

The word "religion" has been used to cover such a wide range of human belief and conduct that the concept must be very considerably narrowed if it is to be dealt with even superficially in the space of one paper. I shall therefore use the term synonymously with "the Christian faith" in both senses of the phrase: (a) a humble and dependent attitude toward God revealed in Jesus Christ, and (b) the body of Christian doctrine. Hence "religious knowledge" in this paper means both the personal knowledge of (i.e., acquaintance with) God and the knowledge (i.e., intellectual acceptance) of facts about God. But even the Christian faith is regarded by different people as resting upon different bases, so it ought to be said that this paper is written from a conservative viewpoint.

In the previous section dealing with the basis of scientific knowledge, it was found not necessary to enquire into the causes of, or reasons for, a person's becoming a scientist, but necessary merely to discuss the method he uses once he has become one. The validity of scientific knowledge depends solely on the validity of the scientist's method, whether he understands his method or not. In fact, probably the majority of practising scientists have just grown up into the method without ever pausing to consider its logic. The same principle applies to professing and practising Christians. The reasons why people become Christians are probably as numerous and varied as the reasons why they become scientists. Furthermore, many Christians have never made the effort to consider the basis of their faith, and would be quite unable to "give a rational account of the hope that is in" them. But this does not mean that their knowledge is invalid. The important thing is, not why they became Christians, nor whether they understood the basis of their faith, but whether their knowledge is based upon a firm foundation. The following remarks describe the rational basis of the Christian religion

without implying that people become Christians because they are conscious of this rational basis.

Much Christian apologetic, and probably even more agnostic opposition, have been based upon the assumption that, if religion is to be validated rationally at all, it must be substantiated by a process of ratiocination starting from self-evident truths and empirical facts. Arguments along these lines include the classical "proofs" of the existence of God and the attempts of recent years to demonstrate that the Bible is confirmed by science or archaeology. That the classical "proofs" of Natural Theology are not proofs at all is well known. They do not compel assent to-day, and probably never did. At the most, they are a series of arguments which all point to the need for a hypothesis of a Supreme Being, a First Cause, a Designer, etc., a concept far poorer than that of the God revealed in Christ. The alleged confirmations of Scripture are of no greater value. At best, they merely adduce independent evidence for the truth of historical events mentioned in the Bible, but they can never confirm the spiritual aspects of those events. The prime function of the Bible is not to teach history but to reveal the spiritual causes and implications of history. Such arguments, then, fall an easy prey to the opponents of religion, who retort quite rightly that if they constitute the best rational case for the truth of religion then thinking people have good reasons for being agnostics.

The empirical-ratiocinative method, however, is not the only path to knowledge. If it were, our knowledge of other human beings would be restricted to an anatomical, physiological, or biochemical analysis, and social intercourse and human friendship, as we know them, would not exist. But in our everyday dealings with other people we normally adopt an entirely different approach which leads us primarily to a knowledge of them as persons, and, secondarily, to a knowledge of certain facts about them. It informs us of all those personal qualities which we should value in a friend; it enables us to appreciate the thoughts and emotions of others, their hopes and aspirations, their moral standards, in fact all that goes to make up character. It is therefore of the greatest significance to us as human beings.

The basis of this method is that we adopt a different attitude towards other persons than that which we adopt towards things. We approach them, not as objects to be investigated empirically and critically, but as fellow subjects to be accepted sympathetically. In other words, we enter, not an I-it relation, but an I-Thou relation, which establishes a personal acquaintance. The latter cannot be analysed because it is a direct awareness (to call it sympathetic intuition does not help), but at least one can see the conditions necessary if it is to develop into a fruitful knowledge of a person. Firstly, the person to be known must be prepared to act openly, freely, unreservedly, in our presence, that is, he must reveal himself, not necessarily as a result of any conscious effort to do so, but

just by "being himself". Then secondly, we must be prepared to accept the revelation that he gives. This involves, not only treating him as another subject, but also trusting him. If we do not trust him, but regard all his actions and comments with the critical mind of the scientist, we shall find that we cannot get to know him. In actual fact, in our everyday dealings with other people we do spontaneously trust them until we discover in them some inconsistency which destroys or mars our confidence. If we wait until a person is proved trustworthy before we trust him, then we shall wait until the end of our days.

Having become acquainted with a person in this way, we have a new world of knowledge opened up to us, the world of his own subjective and objective experiences, which he can relate to us. His objective experiences we could in principle confirm by our own use of empirical methods (although we seldom bother to do so—nearly all our scientific knowledge is based upon the testimony of others), but his subjective experiences we could never know apart from his revealing them to us.

Now the religious knowledge of the Christian is based upon the self-same I-Thou relation.\* Jesus of Nazareth has revealed Himself to mankind by living and working openly and unreservedly amongst men and women. The Christian is one who has accepted this revelation by faith. (The fact that men cannot encounter Him physically to-day is no hindrance—men and women who have never met have been known to fall in love by correspondence.) Furthermore, as he accepts the Self-revelation of Jesus, he discovers that the Self which Jesus revealed is not merely a good human character, not merely a perfect human character, but no one less than the God of the universe. Jesus was obviously a man, yet He claimed to be God manifest in the flesh: the amazing thing is that everything about Him authenticates<sup>6</sup> His claim. The Christian then finds that he has not only come to know a man called Jesus, but also come to know God Himself in the Lord Jesus Christ.

This makes it possible for the Christian to be let into the secret of God's own "subjective and objective experiences" if God chooses to reveal them. The writers of the Bible often claim that they are, in fact, conveying such a revelation, and the criterion by which this claim is to be tested is, not whether the Bible can be confirmed empirically, but whether the alleged revelation is consistent with the character of the God revealed in Christ. The Bible passes this test. The truth of the Bible, then, follows from the truth of Christ.

The source of the Christian's religious knowledge is thus the Bible, which he accepts as true because he has become personally acquainted with its Author and knows Him to be a God whom he can wholeheartedly trust.

\* Some writers differentiate between the I-Thou relation and the I-Absolute relation, which is the relation of creature to Creator. But the difference appears to be one of attitude rather than logic, which is the concern of this paper.

## D. THE RELATION BETWEEN SCIENCE AND RELIGIOUS KNOWLEDGE

Man, then, has two distinct ways of gaining knowledge about things outside himself: the method of empiricism, and the method of faith. Empiricism, as used in developed science, gives us an understanding of the mechanism of the universe. Faith, when placed in Jesus Christ, leads to an insight into the mind of God.

One might at first suspect, therefore, that science and religion are concerned with such different categories of facts that they have no common ground. For the most part this is true. Religion is concerned with the knowledge of, and about, God, and, consequently, man's spiritual relation to God: science, on the other hand, is concerned with the material universe and therefore those physical aspects of man's being which enable him to occupy a place within it. Nevertheless, because God is not only transcendent but also immanent in the universe, there are a few "contact-points", as Malcolm Dixon<sup>7</sup> has called them, between science and religion. These are "subjects where there is an overlapping of territory between the field of science and the field of religion and in which both religion and science may claim to speak". Dixon lists three such contact-points, but I should like to add a fourth:

- (a) The day-to-day control of the universe,
- (b) The origin of the physical and biological worlds,
- (c) The possibility or impossibility of miracles, and
- (d) The personality of man.

On all these points science and religion have very different stories to tell, and it is this which has given rise to the allegation that science and religion are in conflict. The thesis of this paper, however, is that, far from being an obstacle to the happy relation of science and religion, the different stories are just what one might expect if the scientific and the religious approach to the universe are *both* valid.

The description that a scientist, as such, would give of an oil painting is very different from that which would be given by the artist. The scientist would describe it in terms of chemical formulae, wavelengths of light, etc.; the artist would probably talk about beauty, design, significance, and purpose. Both descriptions could be accurate, but it would be impossible to argue from one to the other because they deal with totally different aspects of the painting. Both descriptions have their peculiar terminologies which properly relate to different logical categories. They are not incompatible or mutually exclusive, but complementary.

The same principles apply to the scientific and religious accounts of the universe, which are similarly complementary. The religious account is derived from the Bible which contains the Artist's revelation concerning His creation, and, like the artist's account of the oil painting, deals with

the design, the significance, and the purpose of the creation. The scientific account, on the other hand, is merely an analysis in the terms of empiricism of what the Artist has created.

The relation between the two accounts is well illustrated by the first of the above contact-points, the day-to-day control of the universe. The biblical view is that God "upholds *all things* by the word of His power",<sup>8</sup> and that "by Him *all things* hold together";<sup>9</sup> that He is Sovereign, and free to "work *all things* after the counsel of His own will";<sup>10</sup> and that because He has planned them, "*all things* work together"<sup>11</sup> to serve His moral purposes. In fact, "of Him, and through Him, and to Him, are *all things*".<sup>12</sup> Every event is thus of unique significance, and it is this uniqueness which to faith is the feature of greatest importance. But to emphasize the uniqueness of an event is not to deny that it shares features with others. Now, as we have seen, science ignores the unique features, and abstracts the common features, upon which it bases its causal explanation in terms of natural laws. We are thus provided with two accounts of the universe, one which regards it as being controlled by an omniscient, omnipotent, righteous, loving, personal God, and the other which describes it as being controlled by impersonal natural laws; and *both* are true. Needless to say, the word "control" is here used in two different senses.

The second contact-point, the origin of matter, life, and species, again illustrates the same relation between science and religion. "Through faith we understand that the worlds were framed (or "the ages were planned") by the word of God, so that things which are seen were not made of things which do appear."<sup>13</sup> God has revealed the fact of creation and faith accepts it, but this does not prohibit the scientist from investigating God's creation as it exists to-day to ascertain what he can about the mechanism whereby it came into existence. When he does so he is led to propound theories which postulate the lapse of vast periods of time, during which processes continuous with present-day ones have occurred. He thus speaks of cosmic and organic evolution. If Theism and Natural Law are complementary accounts of the present-day control of the universe, then Creation and Evolution are merely extrapolations into the distant past of the same two complementary accounts. The doctrine of creation implies that God planned the universe for His own purpose, that His will ordained its being, and that His power effected it, but it does not necessarily imply any particular timescale or mechanism. The theory of evolution is the scientist's attempt to describe in the language of empiricism what an imaginary observer might have witnessed of this mechanism had he been present during the process.<sup>14</sup>

The third contact-point concerns the fact of miracles, which Christians are bound to accept (because their very faith rests upon certain miraculous historic events), but which science does not recognize. But once again it can be shown that the apparent conflict is logically involved in the methods of science and religion, and is not to be taken as evidence that

one view is true and the other false. It is, in fact, a "phantom problem",<sup>15</sup> to use Max Planck's phrase.

In discussing the problem it is first of all necessary to enquire what the biblical concept of miracle involves. Traditionally a miracle has been regarded as a divine intervention interrupting the normal outworking of natural laws. Aquinas, for example, viewed nature as being controlled by "secondary causes" which were created by God, the First Cause, but which worked "automatically". But from time to time God intervened by a three-fold process, firstly interrupting the causal sequence by a *miraculum suspensionis*, then making the necessary adjustment to the machinery, and finally recommencing the causal sequence by a *miraculum restitutionis*. Although all who adopt the intervention idea of miracle would not feel obliged to accept the Thomist analysis of it, the concept of a miracle as a divine intervention in a "natural" causal chain has become almost universally adopted by the religious mind. It seems to me, however, that for two reasons this view does not do justice to the biblical teaching. Firstly, the Bible teaches that God is in continuous control of all natural events, and that the universe continues to exist only for this reason. If this is so, then it is nonsense to speak of God as intervening, when He is active all the time. Secondly, the recorded details of many miracles (both biblical and post-biblical) include nothing to suggest that any interruption of the normal causal sequence occurred. For example, the details given in Joshua 3: 14-17 of the damming up of the Jordan to allow the Israelites to pass suggest that the event was similar to at least three others which have occurred since, and which are known to be the result of landslides.<sup>16</sup> In some biblical accounts of miracles a normal "natural" cause is mentioned, e.g., winds in Exodus 14: 21 and Numbers 11: 31. So, although many miracles are interruptions of the normal course of nature, this fact cannot be used as the basis of a definition of, or test for, a miracle.

A glance at the scriptural Hebrew and Greek words used for miracles indicates that to the biblical writers the important feature of a miracle was not its peculiar mechanism but its peculiar significance. It was an unusual event which evoked wonder in the observers (Heb. *Mopheth*: Gr. *Teras*), or functioned as a sign (Heb. *'Oth*: Gr. *Semeion*), or betokened supernatural power (Gr. *Dunamis*). A miracle then is to be recognized by its impact upon the whole personality of man; it is to be identified by its subjective effect and not by any objective characteristics. A miracle, as such, is therefore beyond the scope of scientific investigation.

Of course, the objective features of the event may well be investigated empirically, and they may or may not be found to conform to the generally accepted laws of nature. If they do not, science, to be logical, would have to amend its natural laws to cover the new observations. Science must bow to the authority of events, and not events to the authority of science. But it may be objected that we are here dealing with the hypothetical

case of something that could never happen, for is not the uniformity of nature a fundamental principle of science? Yes it is, but not because it has been proved, but because it has been assumed.

A miracle, then, is an unusual event of which the significance is all-important and the mechanism irrelevant. It is not surprising then that religion makes much of miracles while science ignores them.

The problems presented by the last contact-point, the nature of man, have taken many forms, but it seems to me that they can all be resolved into one basic problem, how to reconcile the religious view of man as a being created in God's image with the scientific description of man as a "glorified animal" and complicated machine.

To the scientist, *Homo sapiens* is just one species amongst many. It has the same fundamental, anatomical, physiological, and probably psychological, make-up as have other species of Primates. The scientific differences between man and animals are only differences of degree, the most important being the differences in relative size and complexity of the brain which have made possible the highly complex behaviour which man exhibits. Science recognizes no differences in quality or value between man and animals, and this has been taken by some to imply that man is of no greater significance than an animal. If this were a valid deduction from the scientific facts science would obviously be in conflict with a religion which insists that man is of vastly greater worth than any animal. But the inference is not valid because it fails to take into account the fact that science is once more dealing with an abstraction. Science deliberately ignores those subjective aspects of man's personality which immediately give the lie to this deduction. Even the writing of the poet, the painting of the artist, the experimentation of the scientist, and the prayer of the devoted Christian, are to science just complex behaviour. It is only the realization that these are all the expressions of the interests, aspirations, or faith of thinking, feeling, willing, trusting, subjects which gives them a significance which raises man to his proper status of a creature bearing the divine image.

Another aspect of the problem of human nature is the apparent incompatibility between the scientific view of man as a mechanism whose behaviour is controlled by natural laws (whether physiological or psychological) and the religious view of man as a responsible being whose behaviour is governed partly by free choice. Now "free choice" does not mean "random choice" (if this is not a contradiction in terms); in fact Christianity insists that our choices should be made in the light of our knowledge of the consequences, and that knowledge in turn depends upon our past experience (instruction by parents, teachers, ministers of religion, as well as first-hand observations). Indeed all men, whether Christians or not, do choose in the light of past experience. So one should expect a correlation between behaviour and past experience, and, furthermore, expect science to be able, in principle, to summarize this correlation

in terms of natural laws. That human behaviour appears to conform to empirical laws is, therefore, not an obstacle to, but a logical concomitant of, the religious view of man as a being responsible for his choices. It would be a much greater obstacle if human behaviour were found to be completely random.

In this rapid survey of the contact-points between science and religion it is apparent that the same relation between the two always holds. Where science and religion investigate common territory they do so from totally different standpoints. Religion is concerned with significance and purpose, while science is concerned with structure and mechanism. They therefore give different accounts which are not mutually exclusive but complementary, and which, taken together, give a more nearly complete picture of the truth than either alone.

### E. THE TEACHING OF SCIENCE AND RELIGION

The features of science and religion which have been discussed in the foregoing sections are all relevant to the problem of teaching these two disciplines in a satisfactory manner. Very few teachers will be required to teach both subjects, but to teach one of them adequately demands a thorough appreciation of the method, aims, and limitations of that subject, and an understanding of the complementary viewpoint of the other. For only when the teacher has equipped himself with this understanding will his teaching go beyond the mere feeding of information or techniques into separate mental pigeon-holes, and begin to build that intellectual integration which is a *sine qua non* of education. It is not suggested, of course, that the science specialist should attempt to teach religion, or that the divinity specialist or Sunday school teacher should try to teach science, but it is suggested that if one teaches his own subject in such a way as to make it more difficult for his colleague to teach the other then he is not teaching his own subject properly, and is failing in his duty towards his pupils.

The practical applications of the foregoing philosophical principles in the work of teaching science and religion are many and various, but the following are some suggestions of the use to which they might be put (a) in the teaching of science, and (b) in the teaching of religion:

#### (a) SCIENCE

a. 1. *Limitation of observation.* The importance of using the right instrument for an investigation can easily be impressed upon a child by getting him to try to detect a magnetic field by means of first a thermometer and then a compass. The thermometer, being the wrong instrument, fails to demonstrate the existence of the field, but it would be quite illogical on that account to deny the field's existence. The information which the thermometer gives is quite irrelevant to the investigation, and a compass or some other appropriate tool is necessary for the job. Science itself, like the thermometer, has limitations: there



are fields in which its information is irrelevant. Since its basis is observation by the senses it is powerless to detect any non-material reality, so that it cannot deal with spiritual truths, and can neither prove nor deny the existence of God. To emphasize the fundamentality of sensory observation in scientific work one has only to ask the child to refer to the records of his laboratory experiments or request him to inspect all the apparatus in the laboratory, and he will soon appreciate that even when he uses apparatus to enhance the accuracy of his work he is still dependent ultimately upon his own senses. But if the child grasps the simple fact that sensory observation imposes a severe limitation upon the scope of scientific conclusions, he will have learned something that many of his elders fail to appreciate.

a. 2. *Limitation of abstraction.* The fact of abstraction in scientific work is exemplified by every record that the pupil makes in his practical notebook; and this fact should be emphasized. The philosophical importance of abstraction is perhaps best made clear by the use of some such analogy as that of the scientific description of an oil painting (see section D). The relevance of abstraction to the education of the child is a matter the teacher must continually bear in mind if he is to avoid inculcating unwittingly a materialistic philosophy. To explain the universe by reference to natural laws, to talk about an animal as a machine, or to describe a human being as a complex animal, may all be good science, but they are not good education, unless it is made clear at the same time that they are abstractions which do not exclude other types of description. The scientific materialism which is so prevalent a philosophy amongst those who leave school from the science sixth form is not usually, I suggest, due to the wrong presentation of scientific facts, but is more often the result of a failure to demonstrate to the pupils the bias of science.

These considerations are very relevant to sex education, which is often handled inadequately. Some teachers appear to think that they have discharged their responsibilities to their adolescent pupils when they have given them an account, straight from the biology textbook, of reproduction in the rabbit. That an objective account of reproduction is very valuable no one nowadays would deny, but if it is given alone without the complementary account of mental, moral, and spiritual factors, we cannot blame the pupil if all that he gains from the sex instruction is the desirability of using contraceptives to avoid "getting into trouble".

a. 3. *The uncertainty of induction.* The majority of statements in textbooks of science are generalizations: they are statements about, not one particular bar magnet, or one particular crystal of copper sulphate, or one particular rabbit, but bar magnets, copper sulphate crystals, or rabbits in general. This provides the teacher with a basis for discussing the importance of induction. The facts that the teacher can predict the outcome of properly-conducted experiments, and that engineers can design machines to do particular jobs, in fact, the very existence of an

industrial civilization, are all further evidence of its value and reliability in everyday affairs. Nevertheless, the teacher has a responsibility to point out the uncertainty of scientific induction, and he can use the examples of Manx cats, black swans, the coefficient of expansion of water below 4°C., the modern overthrow of Newtonian physics, or a host of others, to illustrate the point.

Mention might be made here of the objectionable phrase "science proves", which one meets from time to time. Science, of course, proves nothing. The assertions of facts (as distinct from theories) which science makes are either statements about observations of objects or events, or else generalizations from such observations. The observations themselves do not require proof (they are data), and the generalizations are not capable of proof.

Since natural laws are generalizations, it follows that they also are not absolutely certain. I suggest therefore that they should be taught as statements about the *normal* course of events as so far observed, rather than as legislation comparable with that of the Medes and Persians.

a. 4. *The nature of hypothesis.* Hypotheses formulated to explain empirical facts are of two types: those which in principle can be tested empirically, and those which in principle cannot. The former are scientific, the latter philosophical. Now it has already been pointed out that science can neither prove nor disprove the truth of Christianity; the same applies with respect to any other religion or philosophy. Scientific hypotheses, then, are philosophically neutral; they do not necessarily imply any particular philosophy. Metaphysical or moral theories, on the other hand, are necessarily part of a philosophical world-view. The two types of theory must therefore be clearly distinguished in the teaching of science, or there will be a danger of giving the impression that science implies the particular philosophy which the teacher adopts. The science teacher is not normally concerned with philosophical theories in his formal teaching, but he may often be asked philosophical questions concerning the universe. If he is, he will obviously have to give a philosophical answer, but I suggest he should hasten to add that the answer he has given is not implied by his science but is derived from his philosophical faith, and that other people might well give a fundamentally different answer. Perhaps even more often he may be asked a question which is ambiguous in that it permits of both scientific and philosophical replies. This gives the teacher an excellent opportunity of pointing out the differences between, and complementarity of, the two explanations. Such a question is "Why is so-and-so thus?", which may mean "For what purpose is it thus?" or "By what mechanism has it come about that it is thus?"

One other feature of scientific hypotheses that I think is worth stressing is their tentative nature. One has only to touch upon the history of science to emphasize that its concepts are ever changing. We are often inclined to smile at the strange theories of the past and wonder how the scientists

of those days could hold such false notions, and yet we seldom consider that our present theories will probably look just as ludicrous to the scientists of fifty years hence. It is so easy for the science student, with his often inadequate historical perspective, to embrace the latest scientific theory as necessarily the final truth.

In the foregoing remarks on the teaching of science, simple elementary illustrations of the limitations of science have been mentioned to show that these important principles can be introduced one by one at an early stage in the teaching of any science syllabus. The teacher does not need to wait until his pupils can appreciate the abstractions of the philosopher, neither does he need to give special lessons or lectures on the method and limitations of science. In fact, if he mentions these principles whenever he is dealing with concrete examples which illustrate them, the pupil, I think, is more likely to develop that healthy critical attitude to scientific conclusions which characterizes the competent research worker.

(b) RELIGION

b. 1. *The basis of religion.* In the teaching of Christian apologetics it is very easy to give the impression that our beliefs rest upon some sort of logical argument, whether the ontological, teleological, cosmological, or other "proofs" of Natural Theology, or the historical, scientific, or archaeological vindication of Holy Writ. Although the combined weight of all these arguments may make an indelible impression upon the minds of some people who tend to respond "intuitively", it is doubtful whether they will convince a person who, by reason of a scientific training, has become very critical in his thinking. This is not to say that the subject of apologetics is of no value in the teaching of religion: on the contrary, it often serves to remove intellectual impediments to faith, or to strengthen the faith of those who already believe. But I do suggest that in the teaching of Christian evidences one should avoid treating them as the basis of religious faith. In fact, I believe the best apologetic of all is to contrast the relative weakness of the arguments of Natural Theology with the compelling power of the self-authenticating Christ.

b. 2. *The witness of nature.* But if Natural Theology is not the basis of Christian faith, there is a true natural religion that follows from that faith. For, although the heavens cannot declare the existence of God or their creation by God, they do "declare the glory of God" to those who "through faith understand that the worlds were framed by the word of God". There are other biblical passages which deal with the testimony of nature to God (e.g., Acts 14: 17; Rom. 1: 19-20), but they are all evidential of His attributes (His goodness, His power and supremacy), and not of His existence. It is then quite right in religious teaching to point out the witness of the universe, but the argument should take the form, not of "Look around, and learn that there is a God", but rather of "Because we believe that God has created this universe, let us look around and discover how wonderful He is".

b. 3. *Limits of revelation.* Just as science is limited, so also is revelation, but for different reasons. Science is limited by the restrictions imposed by its method; revelation is limited by God's choice. Science has limitations, revelation limits. God could have revealed anything, but He has chosen to reveal only certain of His own thoughts, and sufficient empirical facts to enable man to appreciate those thoughts. When the Bible deals with historical events, it recounts their spiritual significance, and not their mechanism which is irrelevant. The Bible, therefore, does not teach science, and it is illogical to attempt to deduce the scientific description of an event from what the Bible says about the same event. That men have failed to appreciate this point lies at the root of nearly all the science-religion controversies of the past, and, if further antagonism is to be avoided, the limits of revelation must be made clear in the teaching of religion.

b. 4. *Interpretation of revelation.* In teaching, one would be quite justified in treating science and religion as unrelated disciplines, since a knowledge of one of them does not facilitate the understanding of the other. But the result would be that at each of the contact-points the pupil would be given two distinct mental pictures of the same event. Now the human mind is such that it is not very happy with two distinct pictures, and it strives to unite them in a larger picture which incorporates both. There is little to be gained in doing this in this instance, except the satisfaction of having solved an intellectual puzzle; it is of no practical value to science nor spiritual value to religion. But the teacher of religion will often find himself called upon by his scientifically- or philosophically-minded pupils to provide such a picture; and, if the picture is not forthcoming, that pupil may have difficulty in accepting his teacher's religious instruction. The teacher, then, will usually desire, for the satisfaction of both himself and his pupils, to develop a Christian world-view which embraces both his science and his religion.

Now, in order to do this, he will have to go beyond the scriptural revelation to an interpretation of it. The revelation has been given in the thought-forms of bygone ages, and of cultures that are foreign to the majority of Christians; and it has to be translated into the language and concepts of the twentieth-century West. This interpretation is bound to be tentative; it will be continually modified in the light of research into the language and literature of the ancient cultures, and it will change with the changing theories of science. When such interpretations are used in teaching, then, they must be clearly distinguished from the revelation as being, not what God has revealed, but what the teacher thinks, and therefore subject to revision. They are furthermore not an essential ingredient of Christian theology, and the teacher must at all costs avoid being dogmatic. As far as I can see, all the science-religion controversies of the past have been disputes between, not science and the Bible, but science and particular interpretations of the Bible.

## F. CONCLUSION

The thesis of this paper, then, is simply this: Science and religion are for the most part unrelated disciplines, having different bases, different aims, and different languages. They are concerned with different fields, which, however, overlap in four areas. Of the regions where they overlap they give different descriptions, which are the peculiar products of their respective methods, and which are therefore complementary and not contradictory. If science and religion are to be taught in the future in such a way as to obviate conflicts similar to those of the past, the teacher must not only teach the aims, method, and limitations of his own subject, but also appreciate its relation to the other in those four areas in which both are interested.

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