GOD AND ENTROPY—THE LATEST PHASE

THE problem of the origin of the Universe has enthralled the minds of thinking men for thousands of years. Some said an intelligent Designer was necessary in order to explain the world order. Others replied that for all they could see things might just as well have come into being by chance or, alternatively, they asserted that the question was too difficult for men to answer and so ought to be left alone.

I

Discussions of this character have raged right up to the present day. Some of the phases of the controversy may be briefly summarized as follows. A long time ago it was believed by most people that the universe had been designed. The growth of the science of astronomy, however, had a profound influence upon such theological views. As a result opinions as to what precisely required creating or designing underwent much modification, now in one direction, now in another. When astronomers found, for instance, that the appearance of comets followed definite laws it was hard to believe any longer that they consisted of " the thick smoke of human sins, rising every day, every hour, every moment, full of stench and horror, before the face of God, and becoming gradually so thick as to form a comet, with curled and plaited tresses, which at last is kindled by the hot and fiery anger of the Supreme Heavenly Judge " (Celichius, *Theological Reminder of the New Comet*, 1578). But in the course of time the opening vista of the vast universe suggested a law and order undreamed of by former generations. It seemed that nothing short of the hand of God could have arranged the movements of stars so that they should not hit one another, or designed man's cosmic abode with such consummate care.

Thus each time astronomers decided that the universe was larger than they had previously supposed, God was apparently glorified the more. But when this had gone on for some time the position apparently became reversed. The world had become relatively so small that people began to suspect that human beings might not matter much after all. The investigation of

the nebulae made this feeling all the more intense until it was discovered that our nebula was the largest known and that the solar system was near its centre. And now, to bring history right up to date, it has been found that these two last "discoveries" were probably mistaken after all!

In no other science have new advances seemed now to support, now to contradict, received opinions more than has been the case with astronomy. This constant fluctuation has at last led many moderns to see the danger of linking religion to the star of current speculative science. But despite this danger, it does not follow that all science is equally uncertain. There are well-established laws in science which have stood the test of time as well as new fashions of thinking which may or may not have come to stay; if religion and science are to become connected, it must be on the basis of the former, not of the latter.

II

About the middle of the nineteenth century a law was discovered which was destined to have profound theological significance. It was known as the law of entropy or the second law of thermodynamics and it concerned itself with the amount of heat which steam engines could turn into useful work. Not until much later was its significance understood, and then at last it was realized that it involved a long known principle—the principle that when things are left to themselves they become more and more disorganized. Here for the first time in history this common sense fact had been given a mathematical formulation which was, however, extremely limited, since it only concerned itself with the arrangements of atoms and molecules. But the possibility of measurement opened a new realm of experiment. The law could be tested in all kinds of out-of-the-way places which had never been envisaged before. And whenever experiments were tried it was found to be true, a state of affairs which remains the same to-day despite all the changes of modern science.

This principle underlying the law of entropy is of such importance that it is convenient to give it a name, and it will, in future, be referred to as the *law of morpholysis* (*morphe*=form, *luo*=to loose). Its truth has been confirmed, not only in the special case of the entropy law, but in hundreds of other instances

as well. For instance, Raleigh's law of fluorescence follows directly from it, but has no direct relation to the second law of thermodynamics. Apparently, also, the expansion of the universe is a direct consequence of the same law. Moreover, many hundreds of phenomena which, some years ago, appeared as though they might be exceptions to the law of morpholysis, have recently been shown to make its truth all the more certain. Such, for example, are the formation of crystals, the growth of embryos and the ways clouds arrange themselves. As a result it would be true to say that of all the laws of science there are none known with greater certainty than the law of morpholysis.

This truly astonishing fact of nature soon tempted people to enquire whether there was no way by which the law of morpholysis might be avoided. All kinds of ingenious suggestions were made. If the law ever proved untrue, perpetual motion should be possible, and many were the people who set to work to achieve this longed-for result. In 1861 Henry Dircks wrote a whole book describing scores of marvellous perpetual motion machines, none of which ever worked. As the result of long thought and endless discussion one fact emerged—the fact that (so far as present knowledge goes) mind alone can circumvent the law of morpholysis. This was first pointed out by Clerk Maxwell in an elementary text-book, and it has never been successfully challenged. In fact at least one branch of modern psychology (the *gestalt* psychology) assumes this to be a fundamental property of mind. There is a great deal of experimental work—apart altogether from common sense observation—which confirms the view that mind actually possesses this property.

As a result of these facts—the fact that the universe has form (e.g. as concentrated heat energy) and that form only arises where mind operates—it seems very likely that theologians have been right in saying that the world was created. Such a conclusion is based, as all sound reasoning should be based, upon the available facts of experience. It is, of course, conceivable that these experiences are not typical of what takes place throughout the universe, but no conclusions can be based on such useless speculations. The fact remains that *if* we attempt to construct a theory of the origin of the universe on the basis of the most trustworthy knowledge available, we shall be led to postulate a creator God.

III

The force of this argument has made itself felt increasingly in recent years, and many and ingenious have been the attempts to circumvent it. In the publications of the Rationalist Press Association, which pours out book after book of agnostic apologetics, many of these attempts are to be found. Thus Haeckels, in his *Riddle of the Universe* which is still circulated to-day, asserts that the entropy law is inconsistent with the law of the conservation of matter " and so must be rejected ", which proves no more than that Haeckel did not know very much about physics. A more modern writer is Mr. Joseph McCabe, who for a long time now has been asserting that " Nature *may have* myriads of laboratories for the reconversion of energy, for all we know " (*Existence of God*, 1913 edn., p. 124, *m.i.*). More recently (*The Riddle of the Universe To-day*, London, 1934, p. 202) he has expressed this sentiment with renewed vigour : " To deny that there is in the obscure depths of space a compensating or restoring mechanism is an unscientific and illogical piece of dogmatism. It is no use appealing to thermodynamic laws. They express our experience, not what lies beyond our experience." But it is interesting to note that Bertrand Russell, of whose writings Mr. McCabe doubtless approves heartily, has repudiated this very argument in another connection. It is preposterous, he says, to hold that the universe is good, for if one had a crate of oranges and found that all those at the top were bad, one would not think of arguing that " the underneath ones must be good, so as to redress the balance " (*Why I am not a Christian*, 1927, p. 18).

An attempt has also been made to revive the age-old chance argument. J. B. S. Haldane has calculated that the universe might " wind " itself up of its own accord once in $10^{10^{80}}$ to $10^{10^{100}}$ years (*Nature*, 1928, cxxii, 808) and in a popular book (*Fact and Faith*, 1934, pp. 50-65) he pictures himself resurrecting by chance an infinite number of times in past and future ages. But Eddington has shown (*New Pathways in Science*, 1935, pp. 62 ff.) that such evasions cannot fairly be employed. If it is really arguable that the present state of the universe is due to a chance " winding up " we might just as well argue " that the apparent uniformity of Nature observed up till now is merely a coincidence "—so that the very basis of all our knowledge of

probability as well as of everything else would disappear. The chance argument thus destroys the very ground on which it rests.

To turn to other objections, it is clear that the strength of any theory rests upon its ability to withstand criticism. The law of the conservation of mass, for instance, was firmly rooted in scientific thought at the beginning of this century, but that did not stop Landolt from doing his very utmost to disprove it. In the same way it is right that astronomers and physicists should occasionally speculate on the possible falsity of the entropy law and this, in fact, a few of them have done.

In recent years speculations of this kind appear to have been started in a private conversation by Niels Bohr, who, some years later, made the idea public in a lecture to the Chemical Society (*Jour. Chem. Soc.*, 1932, 383). The mathematical consequences of the idea were quickly developed by R. C. Tolman in America (*Nat. Acad. Sci. Proc.*, 1934, xx, 379) and by Bronstein and Landau (*Physik. Zeit. der Sowjet-union*, 1933, iii, 73) in Russia.

IV

The basis of these speculations may be briefly stated as follows. When atoms of radioactive substances break up they are observed to do so irreversibly. But in the interior of the stars it is possible that an equilibrium is set up between the original elements and their decomposition products. If so, it is conceivable either that a kind of perpetual motion machine comes into being, or else that energy disappears mysteriously. Whether either of these things happens or not depends on whether the energy given out when an atom explodes is equal to the energy absorbed when it is built up. There is no evidence whatever that this is not the case and, judging from all past experiments, it probably is. But it is only natural that mathematicians should speculate on what would happen if energy were not conserved in such a process.

Now it is a very interesting sign of the times that speculations of this character have entered into purely popular works. In Landolt's time no philosopher ventured to throw doubt on the law of the conservation of mass on the ground that further experiments were in progress. Even after the war, when relativity became generally accepted, it was plain to some minds that it *might* give rise to a way of circumventing the entropy law,

since faster moving molecules had greater mass and could perhaps be separated from others by gravitation. (This possibility was disposed of by Berthoud, *Jour. de Chim. Phys.*, 1919, xvii, 616.) But popular writers did not at once hail the faint possibility that the newly devised perpetual motion machine *might* work as a ground for overthrowing belief in thermodynamics! The mathematical investigation of such speculative possibilities was confined to scientific journals.

But in the case of exactly similar speculations arising in our own day an entirely different thing has happened. On every hand such speculations are being seized upon and put forward as rebuttals of anyone who may chance to argue that there is a God. The scientists themselves join in this extraordinary procedure. In 1935, W. F. G. Swann gave a long and amusing lecture to the American Philosophical Society entitled "Is the Universe Running Down?" (*Proc. Amer. Philos. Soc.*, 1935, lxxv, 217-49). In this he laughingly made out that he had not the slightest idea as to whether the entropy of the universe was increasing or not. In the same spirit J. B. S. Haldane has put forward these speculations in a purely popular book (*Fact and Faith*, 1934, p. 55) and later on again in his controversy with Arnold Lunn (Lunn and Haldane, *Science and the Supernatural*, 1935, p. 176). Even P. W. Bridgman (*Science*, 1932, lxxv, 419) in a more serious memoir has popularized similar speculations, while E. A. Milne (*Mem. Manchester Lit. and Philos. Soc.*, 1933-4, lxxix, 9) has pointed out in a very entertaining lecture that *perhaps* the congregation of stars on the outside of the expanding universe (as required by his theory which has not yet been adequately developed) may function like a "Maxwellian demon" and so avoid the second law.

V

This situation, which has developed during the past few years, is so astonishing that it calls for some explanation. And that explanation is not difficult to discover. The popular works of Jeans have shown how very convincing an argument for the existence of God may be when it is based on the law of morpholysis. Even Bertrand Russell (*The Scientific Outlook*, p. 122) admits that the evidence about the running down of the universe is as good as it could well be under the circumstances. It can hardly be doubted, then, that the force of the argument is

beginning to be felt in the modern world. The majority of people have the strongest emotional antipathy to conclusions reached in such a manner, and they are now attempting to avoid them by clutching at a straw—by invoking the possibility that *perhaps* we do not know all there is to know. Yet if anyone were to argue that we cannot be certain that there are such things as atoms because science *might* one day discover something which altered our views on the subject, every intellectual person would at once stigmatize such an unintelligent attitude as a departure from knowledge in favour of ignorance. Thus the mere fact that an appeal to ignorance has been made so repeatedly in recent years in order to avoid the force of the creation argument, shows how cogent that argument has become.

Lest anyone should gain the impression that a majority of scientific papers on the subject of the entropy law deal with its possible failure, it must be pointed out at once that this is very far from being the case. A succession of recent mathematical researches have shown that the law is in accord with many of our newest conceptions of the world. In addition, some long-known and well-established laws which previously appeared unrelated have recently been shown to follow directly from the same principle. In fact, it would be true to say that no truth becomes daily more certain than the law of morpholysis.

Moreover, the speculation that the second law, and with it the law of morpholysis, may not be true for the whole of reality, is far less plausible to-day than it might have seemed a few decades ago. Such an extension of the law seems justified by the theory of the expansion of the universe and by the acknowledged fact that stars " get old "—which would hardly be the case if energy were being regenerated continuously in their interiors. In addition, the past history of science has shown again and again that this world is not an unreliable sample of the universe. People used to wonder whether matter in the heavens might not be something wholly different from matter on earth, but the spectroscope soon settled the point. And we now know that even at the farthest confines of space to which the present telescopes can penetrate, just the same common elements occur as we find around us. Moreover, gravitation, magnetic and electric fields and many other physical forces appear to function in the skies just as they do on earth. It is conceivable, as some scientists have suggested, that the light of the stars may build

itself up into other stars in remote parts of space, but even if this were so it would only serve to increase our estimates of the age of universe, without affecting the creation argument.

From all this and much more evidence, which cannot be discussed here, it looks very much as though a belief in God as Creator is the inevitable consequence of modern knowledge. The old Cartesian dualism—now being assailed by writers on all sides—may soon take on a new phase of life. For, if once the idea that mind existed apart from matter before the world came into being takes root again, there can be no point in maintaining that minds as we find them in nature are only " epiphenomena " of brains.

It is true there are difficulties to such a return in thought. But the clarification of ideas which has come about in recent years has gone to show that many of these are founded on misconceptions. Such, for example, is the very sensible claim that science can never return to vitalism in any of its forms. But while this may readily be granted, it is becoming more and more widely recognized that if science is unable to deal with souls it does not necessarily follow that souls are non-existent. Again, the old objection that to postulate a God was to throw the difficulty back without solving it, has lost its force since people have recognized that much scientific explanation itself is of this character. But these and many other problems such as the *kind* of God involved, cannot be discussed within the limits of a short article. Suffice it to say that there are an increasing number who believe that science and a large element of traditional religious ideas are in much closer accord than rationalist writers appear to suppose.

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