CHAPTER 8
The Mind of the Universe[1]

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During the last century it became possible to study the universe as a whole, spread out in space and time. We now have a firm framework of knowledge and understanding from the primeval explosion about fifteen billion years ago to the present time. Combining our knowledge of nuclear and elementary particle physics it is possible to describe the evolution of the universe from the formation of the nucleons and simple nuclei, the synthesis of heavier nuclei in stars, the development of planetary systems to the emergence of life and its evolution into the myriad of forms that surround us today. Some of this story is known quite well, other parts are still obscure, and obviously we know only a small fraction of what is to be known.

If we stand back and think about it all, several questions arise: did all this stupendous development just happen, or is there a reason behind it all? Is the universe the product of a mind, and is it all done for a purpose? If so, what is that purpose, and does the mind behind the universe care for us in a personal way? These are not scientific questions, but they arise with increasing frequency as the result of scientific advances.

Professor Artigas has chosen the title The Mind of the Universe because he believes that "the contemporary scientific world view suggests that the universe is permeated in its innermost being by a rationality whose explanation requires the authorship of a rational mind". His aims are to show "that our present scientific world view provides a most suitable basis for a perspective that includes an end and religious values", but also "to explore the implications of this world view on our ideas about the universe as Gods creation, man as God's collaborator and God as the foundation of being, creativity, and values".

He first shows that science itself rests on certain presuppositions and the values implied by the scientific activity itself, namely "the search for truth, rigour, objectivity, intellectual modesty and cooperation with others". The undoubted fact of scientific progress "retro-justifies, enriches and refines" these presuppositions. "The analysis of each of these presuppositions can provide a clue to the philosophical meaning of scientific progress and therefore to its theological relevance".

The detailed exploration of these arguments is divided into four parts, which Artigas describes as follows. "In the first part, I consider which method should be used to study the philosophical and theological implications of science; then I analyse these implications in the following parts, which deal, respectively, with the ontological implications of scientific progress and the corresponding image

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of divine action, the epistemological implications of scientific progress and the corresponding image of man, and the ethical implications of scientific values. I conclude by examining the results of my study and the plausibility of the naturalistic and theistic positions using criteria similar to those applied to evaluate scientific explanations". Science and religion can be related in three ways: hostility, indifference, and cooperation, as already analysed by Ian Barbour and John Haught. Since the aims, methods, and results of science differ from those of religion, there is a methodological gap between them. Thus "if there is a personal God, and if the human person possesses spiritual dimensions, these spiritual realities will remain forever outside the possibilities of the methods of experimental science". Many scientists such as Monod, Sagan, Crick, E. O. Wilson, and Weinberg hold materialistic beliefs, but these are in no way supported by their scientific work. Empirical science by itself cannot answer religious questions. Scientism, the belief that science will ultimately solve all problems, is a naive faith that receives no support from science. Furthermore, it fails to provide any moral guidance, because there is an unbridgeable gap between statements of fact and statements of value.

The development of science can be described as a progressive; increase in our knowledge of the order of nature. The ancients considered nature as an organism, and in Renaissance times this was replaced by a mechanistic model that treated the natural world as a purposeless machine. Many hoped that all complex structures would eventually be explained in terms of the interactions of simpler structures, but this reductionism eventually failed even in physics. Studies of the chemistry of self-organising systems and much biological research is providing many examples of emerging order, thus showing how matter can behave in a cooperative way to produce new structural patterns. This self-organisation produces many novelties that cannot be understood as just the sum of the components. This immediately raises the question of teleology, namely whether nature acts for a purpose. Is evolution directed toward a particular end? Dawkins denies this, but his argument is completely deceptive. At a deeper level he argues that there is no need to ask for an explanation of the basic features and even the existence of the physical world since its fundamental units could have come from nothing. Artigas remarks that some physicists may say such things, but they are not supported by any valid physical arguments.

The justification of the methods of scientific investigation has been the subject of many philosophical studies. It is rightly pointed out that we can never be sure that a scientific generalisation or theory is true, because it is inevitably based on limited knowledge. Some writers have used this to argue that science, being fallible, can never contradict religion. Artigas, a physicist himself, firmly rejects this devaluation of science, and sets out to place scientific knowledge on a firm footing. He analyses the views of many philosophers, including Mach, Schlick, Feigl, Popper, Neurath, Kuhn, Lakatos, Feyerabend, Laudan, McMullin, Van Fraassen, Leplin, and Putnam. In each case Artigas first gives their views, then a critical analysis accepting what he considers valid and useful, and finally the reasons why he cannot accept some aspects of their work.

Artigas begins his own account by emphasizing that "creativity and inter-

pretation play a central role in scientific progress". Since it is possible that our observations can be explained by different theories, there is a logical asymmetry between verification and falsification. From this Popper concluded that no theory can ever be verified and so all scientific knowledge is conjectural. Artigas argues that nevertheless "we can be pretty sure about the truth of many scientific statements", and that to "explain how empirical science works we must admit that scientists use subtle kinds of reasoning that go beyond pure formal logic". Thus "the rationality of science does not lie in the application of automatic rules or algorithmic procedures, but includes a sophisticated combination of creativity, argument and interpretation". Even the most elementary concepts, such as mass, time, and temperature, cannot be derived from observation and logic alone. Five criteria may be used to assess scientific theories: explanatory power (e.g., DNA, relativity, and quantum mechanics); predictive power (e.g., Neptune, the deflection of starlight by gravitational forces, the discovery of the omega minus, and the W and Z particles); accuracy of explanation (e.g., Kepler's analysis of the orbit of Mars); the convergence of varied and independent proofs, as the Big Bang theory is supported by the cosmic microwave background and by the abundance of the elements; and finally the mutual support of several theories, as the atomic theory is used in chemistry, biology, and astrophysics. These five criteria enable us to understand how, in spite of logical difficulties, we can reach conclusions that are "good candidates for the status of true knowledge". Thus empirical science enables us to reach true knowledge of the natural world, and "this realism is retrojustified, enlarged and refined by the progress of science".

Science has strongly influenced our image of the human being. Naturalism emphasizes the continuity between human beings and the rest of nature, but "some versions of naturalism carry the methods of empirical science too far and leave no room for the spiritual dimensions of the human being". Like scientism, the claim that all can be explained on the basis of materialism relies on the promise of future achievements. Thus Patricia Churchland holds that if we can determine how the brain works we can maximize rationality in human enquiry. Artigas remarks that this would be fine if it were true, but that he "seriously doubts that a better understanding of •how our brain works will enable us to predict which theory of unification we should formulate in microphysics or which new accelerator we should build to test it".

Jaki has emphasized that man is a mysterious union of matter and mind, and that if we ignore his body he becomes a sort of angel and if we ignore his soul he is turned into an ape. The methods of empirical science combine theory and experiment and so require a subject capable of combining them. We are natural beings engaged on empirical studies and in addition we build theories that require us to transcend the natural world. We use scientific arguments to transcend our experiences, thus showing our capacity for objectification and conceptualization. Thus "scientific progress retrojustifies, enriches and refines the epistemological presuppositions of science", and "this is most coherent with the view that man is a co-creator who participates in God's plans". Thus "cultivating science becomes a human task with a divine meaning".

Empirical science is concerned with objective facts and so is often considered to be value-free, thus protecting its autonomy. Pure science is committed to its own goals and its progress is governed by internal criteria, while applied science is governed by extra-scientific values. However the search for truth is itself an ethical value, although not an absolute one, and scientists should be aware of the effects of their actions. As Popper has remarked, science itself cannot produce ethical principles, but this does not imply that there are no such principles; in fact the search for truth presupposes ethics since it requires open-mindedness, detachment, and respect for rational arguments, recognition of our fallibility, and intellectual honesty. Stephen Toulmin and Loren Graham have analyzed the connection between science and values, and this has become increasingly important in psychology, physiology, and sociobiology where science is used to study human beings.

Science is increasingly the cooperative endeavour of many people, and there are now many studies of the sociology of science, pioneered by Robert Merton. He defined four norms that comprise the ethos of science, namely universalism (truth claims are independent of race, nationality, religion, etc.); communism (the findings of science belong to the whole community); disinterestedness (the verification of results by other experts); and organized skepticism (the detailed scrutiny of results). Many authors including Andre Cournand, Michael Meyer, Jacob Bronowski, H. Richard Nebuhr, and Michael Polanyi have further elaborated the values intrinsic to science. This is not to say, however, that scientists are improved morally by their scientific work, but if they already hold these values they will be better scientists.

Scientists evaluate scientific theories according to certain criteria, and Kuhn lists these as accuracy, consistency, scope, simplicity, and fruitfulness. Ernan McMullin has pointed out that the historical development of science reinforces and clarifies these values, so that we can have some confidence that our theories give a true although incomplete account of nature. This moderate realism is held by most scientists, particularly by those engaged in experimental work.

The relationship between objectivity in morality and objectivity in science has been explored by Alasdair Maclntyre. He distinguishes between internal goods, namely those that show high aesthetic, imaginative intellectual and physical powers, and external goods that are the related rewards, such as money, status, reputation, and power. Since science is committed to the search for objective truth, considered as an internal good, it embodies a moral task. Furthermore, "the historical unity of the scientific enterprise has a moral character, as the continuity of a communal project directed toward the search for truth". Scientific knowledge of the natural world gives us some domination over nature, which can be used for practical ends, such as the improvement of our conditions of life. The applications of science may be good or bad, showing that science must be governed by ethical criteria. Society as a whole is willing to support science as long as it produces useful application, but hostility is easily aroused when it is applied for evil purposes.

The continual progress of science since the seventeenth century has yielded unprecedented knowledge of natural phenomena. Originally this was seen as

a road leading from nature to a recognition of its Maker, but from the mid-eighteenth century onward it was seen more as a road toward the independence of the human person from religious constraints. The de-divinization of the world can be understood in two senses: according to the first, "it means that the world is neither a part of God nor can be identified with God". Seeing the world as created by God is a central Christian belief that favoured the birth of modern science. The second sense, held by Schiller and Weber, is that there is no trace of God to be found in the world. Such views interpret "the methodological limitation of empirical science as the denial of anything that cannot be studied using the methods of empirical science". Thus "scientific progress should not be considered a major cause of the de-divinization of the world".

On the philosophical and theological level, Artigas recognizes the methodological gap between them and the sciences, and so proposes an interpretation based on coherence rather than proof. To assess his interpretation he applies the same criteria that scientists use to assess their own theories. His interpretation "in favour of theism and human spirituality possesses a high explanatory power because it accounts for many phenomena that, when seen in the light of agnosticism or atheism, are left completely unexplained". Theists "have no problem in accepting all scientific explanations and, in addition, provide explanations about other problems that would otherwise remain veiled in mystery". This also holds for teleology, as "the present world view provides a great amount of highly sophisticated evidence in favour of the teleological interpretation of the world". His interpretation has predictive power because "it provides a rational basis for responsible and creative human activity". The theistic perspective "respects the real complexity of the world and does not interfere with natural explanations but provides them with their adequate radical foundation", and is "coherent with scientific data stemming from a variety of sources, such as deterministic chaos, evolutionary theory, and natural dynamism".

In a final section, Artigas observes that "the current world view is highly consistent with the emphasis on God's respect toward creation. Divine action should not be conceived as opposed to natural agency; rather, it makes possible the very existence of created causes and fosters their own agency". Thus, "acceptance of Divine purpose makes it possible to understand how necessity, chance and purpose can be combined to bring about our world. Indeed, if naturalistic explanations were to be considered ultimate, we would be forced to attribute to blind natural forces a subtlety and foresight they cannot possess". We can recognize that the detailed and subtle workings of nature revealed by scientific progress shows God's power and wisdom. On a personal level, the extreme sensitivity to initial conditions shown by chaos theory emphasizes the importance of all our actions: everything we do can be transformed into actions directed toward the fulfillment of God's plans.

This brief summary of some of the main themes of Professor Artigas's book may suffice to show its importance and value. He has raised the level of the contemporary debate on the relations between science and religion and provided a sure guide to their complexities. He seems to have read almost every book on the subject, and gives judicious and sympathetic accounts even of views he does

not share. As a scientist himself, he does full justice to the value of science and to the subtleties of the scientific method. Whether one agrees with him or not, this is a book that cannot be ignored by anyone interested in these questions.