

tions, motion, reproduction, carriers of heredity, mutation, evolution. It is suggested that such a method will ultimately prove to be more illuminating and logical than starting from the material apparatus and the metabolic processes of life and describing them from a purely physical point of view, in the vague (and actually vain) hope that personality, consciousness, and the sense of freedom may somehow arise from the physical scheme.

In order to make the philosophical picture consistent and fruitful, we need the basic doctrine that conceptual activity is a fundamental feature of the Universe. Living matter is not just ordinary matter plus conceptual activity added to it. The functioning of the entire Universe is the outcome of conceptual activity; the presence of matter, the division between life and nonlife, and the emergence of material structures carrying life are results of its mode of operation.

When discussing the problem of life from the point of view indicated in the preceding paragraphs, one enters into a difficult and controversial domain of biological science. Readers may argue that this is reintroducing ideas of vitalism or of holism, or what other names have been used for notions now discarded by the majority of biologists and physicists. However, statements concerning the need for consideration of new forms of relationship in biology, reaching beyond those which can be expressed in the terminology of physics, are appearing in the scientific literature of the present day. Some biologists are explicitly referring to Whitehead's thoughts as presenting a possible new way of approach. On the other hand, those discussions in the literature on organic evolution and on the origin of life which attempt to limit themselves to purely physical processes often introduce expectations which are not fully analyzed and which on closer inspection appear to have a shaky foundation. Needless to say, the picture which is proposed in this essay does not discard the great importance of the discoveries of modern biochemistry and biophysics, but it attempts to find a way for their integration within a wider scheme.

PREFACE

The picture developed in the essay at the same time offers another perspective: it constitutes a background against which the relation between scientific knowledge in general and the value judgments of human life can be projected. The doctrine presented by Whitehead bridges the dichotomy of our thinking with regard to scientific results on the one hand and values on the other hand. It establishes a connection between scientific analysis and the expression of values in life and in art. It breaks through the idea of a universe moving according to inexorable laws devised for the behavior of matter. Since the picture considers both the physical world and our lives within it as manifestations of an all pervading conceptual activity, it puts us in the midst of all that happens. It can serve as a foundation for a way of thinking that does not oppose man to nature but connects him closely with her. It asks for universality in our search for truth instead of compartmentalization. It may give guidance in our attempts to harmonize our experiences and our conceptions, and it stresses that knowledge must not be disconnected from responsibility. The picture therefore directs itself to all those working in science or in domains of human relationship who are concerned about that which is sometimes called "the two cultures of our age." By giving a primary position to conceptual activity a way may be found for integrating human creativity and human aspirations with the findings of scientific investigation without surrendering ourselves to a social order completely ruled by technology and machinery. New ideas may spring up with regard to the philosophy of science. In a sense the picture contains a profession of faith. These are some of the consequences which come forward from an attempt to extend the principle of causality beyond its meaning in physics in the way indicated by Whitehead.

The origin of this attempt to present Whitehead's ideas and to discuss some of their applications goes back to studies which started about 1935. A few partial presentations have been given in publications which appeared in the Netherlands and in talks before small groups of scientists and others.

Exchange of opinion with many friends and colleagues naturally has had its influence upon my thinking and my interests, but the responsibility for the contents of the essay rests with me. It would be too much to mention the names of all those with whom I have spoken about this topic during the many years. I will restrict myself here to the names of L. G. M. Baas Becking, H. J. Jordan, A. J. Kluyver, H. A. Kramers, H. R. Kruyt, J. H. F. Umbgrove in the Netherlands, none of whom is still living; to those of Mr. Albert K. Herling, Greenbelt, Maryland, Dr. Martin A. Garstens, Silver Spring, Maryland, Mr. Milton Rogers, Baltimore, Maryland, and Dr. Thomas L. Lincoln, Institute for Fluid Dynamics and Applied Mathematics of the University of Maryland, who have read large parts of the manuscript when it was approaching its final state, and who in many discussions have given advice and inspiration; to Dr. C. B. van Niel, Pacific Grove, California, Dr. L. Edelstein, Rockefeller Institute, New York, and Dr. V. Lowe, The Johns Hopkins University, Baltimore, Maryland. My warm thanks are directed to them, but my indebtedness also goes to many others with whom I have spoken or corresponded, and who have helped by their interest and sympathy, or who by their teaching have contributed to form my mind. They have belonged to the circle of my parental home, to schools, to the University of Leiden, the Technical University of Delft, the Royal Netherlands Academy of Sciences in Amsterdam; still others belong to the University of Maryland and the Paint Branch Unitarian Church. In addition to them I wish to thank my wife deeply for all her support and her never-failing interest, and also to thank her who was before her and passed away. Finally I thank the office staff of the Institute for Fluid Dynamics and Applied Mathematics for much help in typing the manuscript.

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