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## Foreword

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This is a very remarkable book, concerned with a holistic scientific understanding of the universe and its meaning, written by an eminent scientist who is also a very special human being. Giuseppe Del Re was born in Naples, Italy, in 1932, the son of Raffaello Del Re, a scholar in classical literature and philosophy, who was well known for his philological and critical work in Hellenistic philosophy. Giuseppe himself was first a student in classical languages (Latin and Greek) before becoming a professor of theoretical chemistry at the University of Naples. The main achievements in his primary research field, quantum chemistry, are marked by the “Del Re method” for the determination of atom charges in molecules (1958), and by the introduction of “maximum localization hybrids” in the molecular orbital method. Both procedures are still widely used. In his fundamental epistemology he propounds a basic unitary outlook upon reality seeking to overcome the dualistic frame of mind, long endemic in European thought and affecting science and philosophy alike. This is very evident in his examination of the chemical origin of life and his impressive development of “complexity,” with special reference to organization as a characteristic of living beings, resolution of the mind-body relation, and the emergence of meaning. At the same time he has devoted special attention to the philosophy of chemistry and its status as an independent discipline.

Professor Del Re has published over 180 scientific papers, and is best known for his work on the electronic states of molecules. He was one of the leading second-generation specialists in quantum chemistry, and is widely recognized for his particular interest in theoretical and epistemological issues in the present post-mechanist era. This is reflected, for example, in his contribution to a work on the brain-mind problem, in which he collaborated with Sir John Eccles, and which he edited for

the Pontifical Academy of Sciences. He is a member of the International Academy of the Philosophy of Science (Brussels), and the European Academy for Environmental Questions (Tübingen), and is a founding member of the International Center for Transdisciplinary Research and Studies (Paris). He is a member of the advisory board of three international journals of philosophy, *Hyle* (Karlsruhe), *La Nuova Critica* (Rome) and *Filosofia oggi* (Genoa). He has been a professor in Canada, Germany, France, Peru, Hungary, and most recently at the École Normale Supérieure in Paris.

The early chapters of this book deal with the scientific and philosophical issues now recognized as central for understanding the world: information, which makes a thing what it is; complexity, the newest general concern of science and technology; the order and intelligibility of nature; organization, the dynamical order characteristic of life, determinism, finalism and chance, and the processes associated with them; beauty and variety; meaning and communication; life and its history. Professor Del Re operates with a hierarchical or multi-layered concept of nature in accordance with which the whole reality of a material entity is characterized by a number of levels. This approach shows that science poses questions which point outside what it can investigate — questions which cannot be ignored if we are to make rational and responsible decisions. The great John Archibald Wheeler, a fellow member with Del Re of the International Academy of the Philosophy of Science, has spoken of the third era in physics as “meaning physics.” In this brilliant work, Giuseppe Del Re shows that this applies to much more than physics and chemistry, and yet what he calls a science for sciences. That is a science which points beyond science itself to a universal spiritual outlook embracing science, scientifically compatible with its most rigorous research and open-ended results.

This is a work of great relevance to the meaning of science and its openness to spiritual reality. With his musical metaphor Del Re explores the comprehensive outlook upon the world, which appears to be most compatible with the rise of molecular biology, systems theory, and the new cosmology. This approach is not altogether new, for already in the fourth century Athanasius had employed musical terms such as harmony and symphony, to express something of the kind of order, symmetry, and concord which he discerned in the created cosmos. But today Del Re applies that musical analogy or “image” to the scientific view of the universe to which rigorous science now gives rise after the immense developments in our understanding of the physical world. Thus, Del Re uses the “Great Dance Image” to give meaningful expression to the dynamical order of the universe as a coherent, evolving pattern in which all things participate as if in a dance or a ballet, combining general harmony and coherence with evolution, randomness, irreversibility. The intelligible universe is in

fact a dynamic open-structured coherent whole made of complex systems connected by a fine network of causal and non-causal relations, and characterized by semantic reference beyond themselves, which is finally to be appreciated as a hierarchy of meaning.

Here Del Re operates with the realization that the whole reality of a material entity comprises a number of levels, which science seeks to describe in terms of “elementary objects” differing in complexity and size, from that which treats a thing as composed of interacting elementary particles to that which treats it as a collection of a few parts. It is this holistic approach (in line with that of Clerk Maxwell in his “Treatise on Electricity and Magnetism”), argues Del Re, that overcomes the limitations of physicalism and mechanism and opens the way to understanding why life can result from a collection of physico-chemical processes. It also shows that in its very rigor science itself poses questions which point outside what it can investigate and which humanity cannot ignore if it is to make rational and responsible choices. This double emphasis upon the non-dualistic, unitary, and open understanding of the universe, and what Del Re thinks of as the “apophatic” or open-structured character of science, together have the effect of demolishing Stephen Weinberg’s contention that the more the universe appears to be comprehensible, the more it seems to be pointless (!), and of fulfilling John Wheeler’s prophecy about the new era of “meaning physics.” “Meaning,” Del Re argues, “can and should be treated as something objective, as a fact of reality,” which belongs to the purview of science. This book is not concerned with an examination of the details of science, but with the picture of the universe as a coherent whole to which science leads us. Hence in the later chapters Del Re shifts attention to man as a free agent, consideration of whom is fully consistent with science. Only man can use his reason to make rational judgments, engage in objective operations, choose between different courses of action, and reach a unifying spiritual grasp of reality. This calls attention to the relation between science and man’s built-in belief in a dimension of reality inaccessible to the senses.

If the Great Dance image suggested by science hints at a coherent, not-necessarily material reality, what, asks Del Re, is “the glue” that ensures coherence between the stars, man, and the spiritual level inaccessible to the analytical methods of science? For a satisfactory answer he turns to information theory and communication, which can be conceived as taking place, although in various forms and degrees of sophistication, among all things animate and inanimate. Communication can be intentional and the attribution of meaning extends to symbols regarded as gates to the spiritual dimension of reality.

Professor Del Re’s exploration of the epistemic character of scientific activity, and its built-in semantic thrust toward the spiritual dimension, leads him to the question of “the soul.” The “complexity” viewpoint

suggests that the soul of a living being is the organized activity which makes its development and persistence possible as a specific being, despite incessant exchange of matter and energy within a changing environment. The properties of the soul include self-consciousness, a major stumbling-block for cognitive science, artificial intelligence, and neuro-science. This is another point where science seems to point to realms which it seems incapable of grasping with its analytic methods.

What then of a “scientific” *Weltanschauung* or a view of the intelligible world, built on the model of science? Del Re argues that a way of interpreting the world to guide man’s actions demands a personal commitment and a personal path of justification: it is a spiritual enterprise. Then, with reference to the notion of in-built belief, and to statements of Poincaré and Polanyi about belief and faith, Del Re points out that the principles for our understanding of the world are adopted as an act of faith—even when they are strictly scientific ones. It turns out that what is special to the nature of the starting principle, which man needs for his psychological stability, is that validity results not only from information about the physical world, but from the history of mankind and the inner experience of each person. In this sense the principle that a spiritual dimension of reality exists and the universe is the world of a Creator—the Choreographer of the Great Dance—appears to be the only reasonable choice. What must be kept in mind, however, Del Re insists, is that there are two sorts of truth: logical correctness and faithfulness to reality. “A science refusing a *Weltanschauung* open on the spiritual dimension of reality is not science; it is a delusion liable to make man die from thirst on the bank of a water stream.” This holistic account of “a science for sciences” will be welcome to many people today, for it offers a scientific conception of the universe which is distinctly congenial with the Christian faith.

— THOMAS F. TORRANCE