

Preface

Time and again, when studying the history of scientific and philosophical thought in the sixteenth and the seventeenth centuries — they are, indeed, so closely interrelated and linked together that, separated, they become ununderstandable — I have been forced to recognize, as many others have before me, that during this period human, or at least European, minds underwent a deep revolution which changed the very framework and patterns of our thinking and of which modern science and modern philosophy are, at the same time, the root and the fruit.

This revolution or, as it has been called, this “crisis of European consciousness,” has been described and explained in many different ways. Thus, whereas it is generally admitted that the development of the new cosmology, which replaced the geo- or even anthropocentric world of Greek and medieval astronomy by the heliocentric, and, later, by the centerless universe of modern astronomy, played a paramount role in this process, some historians, interested chiefly in the social implications of spiritual changes, have stressed the alleged conversion of the human mind from *theoria* to *praxis*, from the *scientia contemplativa* to the *scientia activa et operativa*, which transformed man from a spectator into an owner and master of nature; some others have stressed the replacement of the teleological and organismic pattern of thinking and explanation by the mechanical and causal pattern, leading, ultimately, to the “mechanisation of the

world-view" so prominent in modern times, especially in the eighteenth century: still others have simply described the despair and confusion brought by the "new philosophy" into a world from which all coherence was gone and in which the skies no longer announced the glory of God.

As for myself, I have endeavored in my *Galilean Studies* to define the structural patterns of the old and the new world-views and to determine the changes brought forth by the revolution of the seventeenth century. They seemed to me to be reducible to two fundamental and closely connected actions that I characterised as the destruction of the cosmos and the geometrization of space, that is, the substitution for the conception of the world as a finite and well-ordered whole, in which the spatial structure embodied a hierarchy of perfection and value, that of an indefinite or even infinite universe no longer united by natural subordination, but unified only by the identity of its ultimate and basic components and laws; and the replacement of the Aristotelian conception of space — a differentiated set of innerworldly places — by that of Euclidean geometry — an essentially infinite and homogenous extension — from now on considered as identical with the real space of the world. The spiritual change that I describe did not occur, of course, in a sudden mutation. Revolutions, too, need time for their accomplishment; revolutions, too, have a history. Thus the heavenly spheres that encompassed the world and held it together did not disappear at once in a mighty explosion; the world-bubble grew and swelled before bursting and merging with the space that surrounded it.

The path which led from the closed world of the ancients to the open one of the moderns was, as a matter

of fact, not very long: barely a hundred years separate the *De revolutionibus orbium coelestium* of Copernicus (1543) from the *Principia philosophiae* of Descartes (1644); barely forty years these *Principiae* from the *Philosophia naturalis principia mathematica* (1687). On the other hand, it was rather difficult, full of obstacles and dangerous road blocks. Or, to put it in simpler language, the problems involved in the infinitization of the universe are too deep, the implications of the solutions too far-reaching and too important to allow an unimpeded progress. Science, philosophy, even theology, are, all of them, legitimately interested in questions about the nature of space, structure of matter, patterns of action and, last but not least, about the nature, structure, and value of human thinking and of human science. Thus it is science, philosophy, and theology, represented as often as not by the very same men — Kepler and Newton, Descartes and Leibniz — that join and take part in the great debate that starts with Bruno and Kepler and ends — provisionally, to be sure — with Newton and Leibniz.

I did not deal with these problems in my *Galilean Studies*, where I had to describe only the steps that led to the great revolution and formed, so to speak, its prehistory. But in my lectures at The Johns Hopkins University — "The Origins of Modern Science," in 1951, and "Science and Philosophy in the Age of Newton," in 1952 — in which I studied the history of this revolution itself, I had the opportunity to treat as they deserved the questions that were paramount in the minds of its great protagonists. It is this history that, under the title *From the Closed World to the Infinite Universe*, I have endeavored to tell in the Noguchi Lecture that I had the

honour of giving in 1953; and it is the self-same story that, taking the history of cosmology, as Ariadne's thread I am retelling in this volume: it is, indeed, only an expanded version of my Noguchi Lecture.

I would like to express my gratitude to the Noguchi Committee for its kind permission to expand my lecture to its present dimensions, and to thank Mrs. Jean Jacquot, Mrs. Janet Koudelka, and Mrs. Willard King for assistance in preparing the manuscript.

I am also indebted to Abelard-Schuman, publishers, for the permission to quote Mrs. Dorothea Waley Singer's translation of Giordano Bruno's *De l'infinito universo et mundi* (New York, 1950).

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