THE DOGMAS OF NATURALISM

THE METAPHYSICAL FOUNDATIONS OF MODERN PHYSICAL SCIENCE: A Historical and Critical Essay. *By Edwin Arthur Burtt. Kegan Paul. 14s.*

THIS book deals with a profoundly interesting subject: the uncritical assumptions which were made by the founders of modern physics, and through them became part of the unquestioned apparatus of ordinary thought. The critical portion of the book is admirable; the constructive part, by comparison, is somewhat disappointing. The author traces, through Copernicus, Kepler, Galileo, Descartes, and Newton, the amazing growth of modern science—a progress to which there has been nothing comparable in the history of the human intellect except the Greek discovery of geometry. He shows how irrational were many of the beliefs which led to the most fruitful discoveries, and what unwarranted prestige these beliefs acquired through their pragmatic success. All this is most convincing; but the moral drawn in conclusion seems hardly the right one. We are urged to revive certain mediaeval dogmas, such as belief in final causes. The true course seems rather that which the modern philosophy of physics is adopting, namely, the creation and assimilation of radically new ideas, such as space-time and the quantum, which refute both sides equally in most of the time-honoured controversies with which the seventeenth-century pioneers were concerned.

In regard to Copernicus and Kepler, one of the interesting historical facts which the author makes clear is the dependence of their discoveries upon the Italian renaissance. Copernicus went to Italy in 1496, and stayed there six years. He was greatly influenced by the Platonic anti-Aristotelian movement, of which the original motive was literary rather than philosophic or scientific. The Platonists were at the same time Pythagoreans, and as such assigned a more prominent place to number as the key to the universe than Aristotle had done. One of the prominent representatives of this school was Novara, Professor of Mathematics and Astronomy at Bologna:

"Novara was Copernicus's friend and teacher during the six years of his stay in Italy, and among the important facts which we know about him is this, that he was a free critic of the Ptolemaic system of astronomy, partly because of some observations which did not agree closely enough with deductions from it, but more especially because he was thoroughly caught in this Platonic-Pythagorean current and felt that the whole cumbrous system violated the postulate that the astronomical universe is an orderly mathematical harmony."

As everyone now knows, certain of the Greeks had advocated what we call the Copernican system. The discovery of this fact emboldened Copernicus, who felt that in his innovations he could still appeal to classical authority—a very vital matter in the atmosphere of the renaissance. Dr Burtt maintains that Copernicus had no strictly scientific grounds for his theory, but only an aesthetic preference. The scientific grounds, he says, were first supplied by Galileo.

Kepler, we learn, made his living by astrology, as people would not pay for astronomy. He remarked: "God gives every animal the means of saving its life—why object if he gives astrology to the astronomer?" (In spite of this observation, Dr Burtt maintains that he really believed in astrology.) It is interesting to reflect that if he had lived in the present age the police would have forbidden him to make a living in the only manner compatible with his studies. Under the influence of democracy, we restrict more and more the ways of transferring money from fools to clever men, such as card-sharping, gambling, and fortune-telling; business and politics are now almost the only legally tolerated methods, and these are too strenuous to be the merely occasional occupations of a hard-working astronomer. Who knows how many Keplers are lost to the world in consequence of such interference?

Copernicus and Kepler were fortunate men who, on inadequate grounds, advocated what afterwards proved to be important truths. The real founder of modern science is Galileo. It was he who showed the way of eliciting mathematical laws from observations. Greek mathematics was *a priori* (except in Archimedes): empiricism before Galileo was non-mathematical. *Mathematical* empiricism begins with Galileo: Galileo's experiments on falling bodies first

gave the world formulae for variable motions expressed in mathematical terms. This was the really essential step in the creation of modern scientific method; and for this reason I should myself rank Galileo even above Newton.

Galileo never said "*e pur si muove*" any more than Wellington said "Up, Guards, and at 'em." But he evidently thought it. Dr Burtt quotes a passage from a letter of his to Kepler:

"Oh, my dear Kepler, how I wish we could have one hearty laugh together! Here at Padua is the principal Professor of Philosophy, whom I have repeatedly and urgently requested to look at the moon and planets through my glass, which he pertinaciously refuses to do. Why are you not here? What shouts of laughter we should have at this glorious folly! And to hear the Professor of Philosophy at Pisa labouring before the Grand Duke with logical arguments, as if with magical incantations, to charm the new planets out of the sky!"

I incline to the belief that the souls of those professors now inhabit the State Legislature of Tennessee.

Newton, it appears, believed in absolute space and time, not so much on account of his rotating bucket, which gave a scientific ground, as because he wanted to provide for the omnipresence and everlastingness of God. Dr Burtt's discussion of this puzzling topic is, however, far from adequate; the whole matter is more difficult than he seems to realize.

The author is certainly justified in maintaining that we have no right to assume that all phenomena can be explained by the methods of mathematical physics. We have the right to *try* these methods everywhere, but their success in certain fields does not prove that they will be successful elsewhere. A metaphysic based upon the assumption that mathematical physics must explain everything is, therefore, to be rightly condemned as a dogmatism. This, however, affords no justification for the opposite dogma, namely, the assumption that mathematical physics does *not* explain everything. And mathematical physics itself has changed so much in recent years that a criticism of Newton is no longer so relevant as it was thirty years ago. We need new conceptions, not a revival of old ones. The historical part of Dr Burtt's work

is very interesting, as showing what absurd ideas may on occasion prove fruitful. (The present reviewer has noticed only one historical error, namely, that the solution of the cubic equation is attributed to Cardan instead of to Tartaglia.) But the constructive philosophy which he suggests at the end of his book is too retrospective to be of value in our present perplexities.

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