at the molecular end of the spectrum the faith of an earlier time in Crick's "central dogma" is not quite secure. When these factors are added to a resurgence of organicist philosophy and a revulsion against Jensenism, Koestler expects us to wonder whether neo-Darwinism will be modified by any Lamarckian additions. Koestler envisages just such a possibility. And so we shall PAUL GARY WERSKEY

Newton as Geometer

The Mathematical Papers of Isaac Newton. Edited by D. T. Whiteside. Vol. 4: 1674–1684. Pp. xxxii+678+4 plates. (Cambridge University: London, June 1971.) £18.

EACH new volume of Whiteside's exemplary edition of Newton's mathematical papers adds significant features to the picture we may try to form of this secretive genius. The present volume reveals Newton as a geometer: a third of it (part II) is devoted to remarkable geometrical research, datable from the years 1678–80 and in large part not previously known; another third (part III) reproduces unfinished drafts of treatises on fluxional analysis (about 1680) and computation by series (1684), which cast more light on the essentially geometrical character of the novel conceptions and methods he used in the *Principia,* but only grudgingly and inadequately published as a lemma in the second book of that work. Also in the remaining part of the volume, in which papers of more algebraical or arithmetical content from the decennium 1674–84 are collected, Newton's geometrical turn of mind is apparent, not only in his trigonometrical treatises (of mainly didactic interest), but even in his treatment of Diophantine problems.

Once more the documents (abundantly annotated by the editor with unfailing erudition and shrewd judgment) do justice of silly tales endlessly repeated by scientists lacking historical sense. This time, they expose the inanity of speculations too often expressed about the geometrical style of the *Principia*: how likely indeed that Newton would have deliberately clothed in ancient geometrical garb results of purely analytical computations! As Whiteside rightly points out, Newton's style was thoroughly in the modern tradition initiated in the sixteenth century and given its characteristic expression by the Cartesian school: this tradition built, of course, on the conceptions of the ancient geometers, but it blended them with the algebraic methods which had hitherto been left to develop along their own lines in the hands of practical men. In matters of mathematical thought and style, the innovator was Leibniz, not Newton. The fluxion idea was the most strikingly successful product of this blend of geometry and algebra: the kinematical conception of a curve as a trajectory resulting from the composition of two motions had been revived by the Italians and brought to Cambridge by Barrow; Newton's decisive step was to algebraize it—a step nearly missed by René de Sluse, who was familiar with Torricelli's kinematical method of drawing tangents to curves and also knew in special cases how to derive an algebraical expression for the subtangent from the Cartesian equation of the curve. Newton's success is due to his superior grasp of the algebraical side of the problem, embodied in his method of series expansion. The third part of the volume under review contains in this connexion documents of the highest importance, in which we see Newton endeavouring (not altogether correctly) to answer Leibniz's queries about the universality and completeness of his method. Had these drafts not been put aside when Newton concentrated on the writing of the *Principia,* the later priority squabble might have been avoided, or at least might have taken the more useful course of an objective confrontation of the two rival approaches.

The most surprising items, however, are found in the second part of the volume, among Newton's unpublished papers on geometrical topics. They give us the clue to Newton's motivation for including in the first book of the *Principia* the purely geometrical section V on the construction of conics. It appears that he wanted in the first place to challenge Descartes's boastful assertion that his analytical solution of Pappus's problem transcended the scope of the ancient methods. Indeed, as we now learn, Newton produced a general solution based on simple geometrical reasoning, which he regarded as a tentative restoration of the hidden analyses performed by the ancient geometers. This led him, however, rather naturally to a more general and deeper investigation of the universal characterization of conics: the tract on this subject, reproduced in the volume, and of which only the beginning was inserted in the *Principia,* is a masterpiece which places Newton among the very few geometers of the time who rank as precursors of projective geometry; it shows in fact that he not only recognized the fundamental projective properties of the conics, but explicitly introduced the notion of projective correspondence. The material here made available (the editor promises us more in the same vein for later volumes) allows us to understand the true meaning of Newton's admiration for the ancients: he was better than anyone entitled to appreciate their methods after he had rejuvenated them and given such proof of their latent power. L. ROSENFELD

Power and Environment

Power Generation and Environmental Change. Edited by David A. Berkowitz and Arthur M. Squires. Pp. xxiii+440. (MIT: Cambridge, Massachusetts, and London, 1971.) $16.95.

THIS book is the proceedings of the symposium on "Power Generation and Environmental Change" held by the American Association for the Advancement of Science at the annual meeting on December 28, 1969.

The book is divided into five main sections, beginning with a short discussion on the broad aspects of the main problem: the impact on the environment of the steadily increasing demand for energy coupled with an increasing population. What effects will this have on the quality of our air and water and on the ecology of plants and animals? Two approaches are possible to control harmful effects: the first is to use even more technology to prevent air and water pollution and to recognize that society must bear the cost; and the second is to ration the consumption of energy per head and to limit the increase in population.

The second section deals with nuclear power stations and possible effects of radioactive releases on public health and safety. It discusses only light water reactors, of the boiling-water or pressurized-water types, and gives some data on the radionuclides released in the liquid effluent and gaseous emission. As far as gaseous emissions are concerned the pressurized water reactor in normal operation produces even less than a coal-fired power station, which it is agreed presents a negligible hazard. The emission from a boiling water reactor is, however, at least four orders of magnitude greater. Several contributions discuss the relation between radiation dose and cancer, the possible genetic consequences, and the radiation dose limits which should be adopted to reduce such risks below "natural" or other more familiar risks. It is here that there is the greatest controversy, and estimates by different authors of a radiation exposure situation vary by a factor of up to 10,000.

Hydroelectric generation and pumped storage systems, discussed in the third section, need have no adverse overall effect on the environment, and in fact often make it possible to provide improved facilities to enjoy the countryside. Nevertheless the author of the contribution on ecological effects paints a frightening picture of "a sepulchral forest of submerged trees", and "a man whose home is drowned, whose form of livelihood is interrupted, whose urine turns to blood, whose eyes go blind, or who shakes with malaria because a lake was created".

The fourth section is devoted to power