Although many of the observations described here have already been published elsewhere and although several of the principal speakers have outlined their views in other recent symposia, the book remains fresh and valuable on the basis of the discussions alone. Provocative speculations are plentiful, but so are earnest and pertinent warnings about experimental procedures and hidden assumptions. The discussions emphasize further the diversity of current opinion as to the nature and sequence of molecular events that permit cells to maintain their ionic steady states or to function as secretory units.

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**Biochemie der Ernährung.** K. Lang. Steinkopff, Darmstadt, Germany, 1957. xv + 411 pp. Illus. DM. 54.

Many futile attempts have been made to expound the subject of nutrition with a minimum regard for chemistry. This volume certainly does not belong in this class. It is a worthy and very substantial book which treats in an excellent and thorough manner the chemistry of many food constituents. The treatment of carbohydrate chemistry (9 pages), the chemistry of fats (17 pages), and protein chemistry (50 pages) is less elementary than might be supposed but not, in general, as adequate as is the treatment of the vitamins, which occupies approximately one-half of the volume and has to do not only with the chemistry of the vitamins themselves but with their functional derivatives. The lack of attention to carbohydrate chemistry, for example, may be justified on the grounds that other books dealing with this subject are available and advances in the carbohydrate field do not impinge very directly on current advances in nutrition. There are about 650 excellent references cited in the volume, and it constitutes a sound piece of work.

In recent years it has become evident that nutrition cannot be treated in a thoroughgoing manner without reference to genetics. It is clear that genetic variations cause different species, strains, and individuals to have differing nutritional needs. This book has, from my standpoint, a serious fault in that the relationship of biochemical genetics to nutrition is not discussed. The time has already come, in my opinion, when the biochemistry of nutrition cannot be treated in a scholarly way with a disregard of the role that genetics plays.

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## History and Philosophy of Science

**Copernicus.** The founder of modern astronomy. Angus Armitage. Yoseloff, New York, 1957. 236 pp. Illus. + plates. $5.

Many American readers already know Angus Armitage as the author of *Sun, Stand Thou Still,* a popular account of the life and work of Nicolaus Copernicus, first issued in 1947 and recently more widely circulated in paperback under the title *The World of Copernicus.* Fewer are aware that that elementary volume was itself the by-product of an earlier and more scholarly study, *Copernicus: The Founder of Modern Astronomy.* Since the earlier volume was and is the only serious and detailed study of Copernicus' astronomical research in English, this revised and expanded edition is very welcome.

Armitage begins his book with a condensed sketch of the development of planetary astronomy in antiquity and the Middle Ages. His second chapter recounts most of what is known of Copernicus' life, the progress of his astronomical research, and the composition of his *De Revolutionibus Orbium Coelestium.* Then follow four chapters dealing in detail with Copernicus' astronomical system. Two closing chapters and an epilog (all added for this edition) discuss the gradual acceptance of the new astronomy, its physical verification, and, very briefly, its subsequent fate. There are also three useful appendices and a brief index.

The five chapters dealing with Copernicus and his work are the heart of the book, and they are uniformly readable, reliable, and illuminating. But three of them—those that discuss Copernicus' treatment of the motion of the earth, the moon, and the planets—are also something more. Readers unwilling or unable to grapple with the complexities of the *De Revolutionibus* itself will find in these chapters the only reasonably full account of Copernicus' real contribution to modern astronomy: a sun-centered, mathematical planetary system able to compete with the earth-centered system of Ptolemy. In the 16th century the concept of a moving earth was not novel. It was the mathematical demonstration that a moving earth was compatible with existing standards for predictive planetary astronomy that gained for Copernicus enduring fame.

But Copernicus gave a strange demonstration. Armitage shows what others have mentioned—the *De Revolutionibus* was modeled, both in organization and in mathematical detail, upon Ptolemy's *Almagest.* To describe the earth's orbital motion about the sun, Copernicus compounded three perfect circular motions; three more were required to describe the moon's motion about the earth; two or more circles (epicycles and eccentrics) were used to trace the motions of each of the planets about the moving center of the earth's orbit. When he was through, Copernicus' system was quite as good as Ptolemy's, but it was neither more accurate nor appreciably simpler. Copernicus' single concrete improvement (one which attracted many later astronomers to his work) was in lunar theory, and to this, ironically enough, the concept of the earth's motion was irrelevant.

Armitage's account of Copernicus' life and of the acceptance of his theory are less unusual. But they are appropriate appendages to his central study, and they are admirably done. The same is not so clearly true of his opening and closing chapters. The first seems far too condensed and simplified to achieve its purpose. Readers can and must find elsewhere both the historical and the conceptual background of Copernicus' work. The last chapter, dealing with the physical verification of the Copernican theory, adds even less to the volume and will very probably mislead. The physical problems raised by Copernicanism are scarcely discussed in earlier parts of the volume. Collected in this summary form, without either historical or technical context, they become almost a parody of the sort of history to which other parts of the book make such notable contributions. But these criticisms are directed only to the frame of Armitage's study. They do not at all reflect on its central chapters. These remain an invaluable aid to all those wishing to learn more about Copernicus and about the astronomical system he designed.

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**Science and Human Life.** J. A. V. Butler. Basic Books, New York, 1957. 162 pp. $3.95.

The book under review is a work with a philosophical keynote, written by a British scientist whose special field is biophysical chemistry. The author starts from the questions, What are we? What is the basis of human life?, and tries to discover what science, which has revealed so much of the constitution of the universe, can contribute to the answer.

Human beings, who in the prescientific era thought of themselves as the dominant figures in the universe learned, first, that they were only the top members of the earthly animal kingdom, which, in its turn, is an infinitesimally small dwarf among the billions of islands of organic life that may exist on planets of the stars. Second, doubts were even

raised about whether *Homo sapiens* is a rational creature at all, or, as might be inferred from Freud and his school, an irrational one driven by impulses of mainly sexual origin. The author points out that the question whether the scientific findings of our age give a true picture of human nature is not an academic one but is "practical and necessary because, in the last resort, our attitude to all human questions depends on our idea of human nature."

The first section of the book—entitled "Science and the Individual"—reports what modern science has revealed about life as a chemical phenomenon, about the machinery of reproduction and evolution, about the conception of man as an automaton, and about the problem of mind and matter.

Equipped with the necessary stock of scientific knowledge, the reader is led in the second section of the book—"Science and Human Society"—into the field of humanities, where the author turns out to be a humanist himself, crossing the border from science to practical philosophy. While no full and definite answer can be given to the questions put in the introduction, the author explains clearly the great complexity of human nature. Considerations are given thereby to practically important questions such as, for instance, the problem of human values, the lack of correlation between living standard and true happiness, and the responsibility of statesmen in our age in which means of global self-destruction are available.

A bibliography is added to the volume, in which, regrettably, the works by Butler's American colleague, the biochemist Roger Williams, are lacking. Williams' findings of the great differences between human individuals make important contributions to the very subject of Butler's book. Certainly Butler cannot be blamed for having overlooked Williams' work, in view of the vastness of the book market. Still, a closer cooperation between scientists working in the important field of "humanics" is desirable.

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**Histoire Générale des Sciences.** vol. I, *La Science Antique et Médiévale.* (Des origines à 1450). René Taton, Ed. Presses Universitaires de France, Paris, 1957. 627 pp. Illus.

The first volume of the new series of *Histoire Générale des Sciences,* under the editorship of René Taton, is the most complete and up-to-date survey of the science of these periods in any language. It is of course a collection of studies by experts in the different periods and cultures covered by this volume. But, surprisingly enough, the editor has managed to achieve a stylistic unity that is rather remarkable. As the title indicates, the volume includes science in antiquity and the Middle Ages. It contains three parts. The first part is devoted to pre-Greek science, more specifically, the science of Egypt, Mesopotamia, Phoenicia, Israel, ancient India, and ancient China. The second part is a study of science in the Greco-Roman world, covering, first, the science up to and through the time of Aristotle and, next, Hellenistic and Roman science. The third part includes science of the Middle Ages and, more particularly, that of Islam, India, China, Byzantium, and western Europe.

I think that the best thing about this volume is the fact that it reflects recent research more directly than any other survey volume of which I know. Obviously, with such a broad coverage, it cannot replace some of the standard single-volume studies of shorter periods. For example, the student and reader will still want to consult Neugebauer's brilliant survey of mathematics and astronomy in his *Exact Sciences in Antiquity.* It might be thought at first that the present volume would not completely displace the excellent single volume of Brunet and Mieli covering the ancient period, for that latter work contained a good number of source readings. Still, as the reader examines this volume more closely, and particularly the excellent section on Greek science, he will find woven into the context many fairly long representative passages from the original authors. I think that the reader who is coming to this field fresh, without much previous training, might perhaps do well to read this single volume and to accompany it with a reading of Cohen and Drabkin, *Source Book in Greek Science* —the best single collection of documents on Greek science.

Painfully small and inadequate is the description of the content of Arabic exact sciences. Thus, astronomy is brushed off in only two pages, mechanics and optics are virtually untreated. The chapter on the science of western Europe in the Middle Ages is, in my opinion, very good indeed, although I would like to have seen more space devoted to it (with some of the peripheral material, like that on Phoenician science, Hebraic science, and so on, dropped).

There are, of course, matters of detail I would quarrel about. The author gives the impression that the medieval source of Hero's formula for the area of a triangle in terms of its sides is the *Liber Embadorum* of Savasorda. It had already been stated in the material of the *Agrimensores.* The first time it appeared in Latin *with a proof* was in the *Verba Filiorum* of the Banu Musa, translated by Gerard of Cremona. The medieval section of the volume is quite up-to-date and gives a brief and accurate picture of the main movements in the high and late Middle Ages, but the account of early Latin medieval science, such as it is, is very brief and inadequate.

The volume includes 48 quite handsome plates, and the editor and the Presses Universitaires are to be congratulated on the volume's fine appearance.

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**Roots of Scientific Thought.** A cultural perspective. Philip P. Wiener and Aaron Noland, Eds. Basic Books, New York, 1957. x + 677 pp. $8.

Aside from prefatory matter, illuminating in its own right, which the editors have provided, the body of this volume consists of 33 papers (by 29 scholars) which first appeared as integral articles in *The Journal of the History of Ideas.* At least a dozen of them are acknowledged as classics in their kind. They have been arranged in roughly chronological order and range in subject matter from early Greek science to recent cosmology, though the heaviest concentration is on the 16th and 17th centuries. There are studies of individual scientists and scientific experiments, of philosophies of science, and of institutions, organizations, and ideas whose influence upon the development of science was more than peripheral. Yet this is not merely an anthology, nor is it only a guide for the antiquarian whose interest happens to be, *per accidens,* the scientific past. For each of the writers is in some measure concerned with the broader lines of interpenetration between science and the other components of culture—philosophy, industry, commerce, religion, and art; and the general theme, which each article has been chosen to illustrate, is that the *idea* of science has cultural roots. To be sure, the idea of science may be in principle distinguished from the positive discoveries and theories of science per se, but the two cannot be held asunder if we wish to comprehend the history of either. No one can read the papers of Moody, Koyré, Randall, and Zilsel and still suppose that the history of science may be written simply as the chronicle of discoveries. But neither can anyone suppose that a simple theory of historical (or cultural) causation can account for these. This double lesson is, perhaps, the chief contribution this volume makes, over and above the particular contributions of each of its remarkable chapters. It is these, of course, which are the most rewarding, and they can be read with fascination and profit quite in-