(for instance, he says little about the possible roles of crystal imperfections in surface charging).

The book consists of three parts. The first introduces the basic problems, the second is devoted to the theoretical aspects, and the third consists of interpretation of the experimental data in light of the considerations of the first two parts. Parts 1 and 2 will be of interest even to those readers not directly concerned with surface charging, for the author tackles such fundamental problems as the nature of solid surfaces and surface phenomena. His treatment of the quantum mechanical aspects is one of the most lucid (and readable) I have seen. His treatment of the nature and behavior of solid surfaces is also clear, and he demonstrates considerable insight into the subject. The author's only fault in this instance is that he makes virtually no reference to the important advances of the 1960's.

The reader will find Part 3 somewhat anticlimactic. The author tends to forget the basic purpose of the book and ends with a rather unnecessary discourse on textiles. This reviewer feels that the pages devoted to textiles could much more profitably have been spent on a summary of the problem, logic, and conclusions (no such summary appears in the book). The book also suffers from an extremely meager subject index. Nevertheless, the book's readability, its clear exposition of the subject, and the author's obvious familiarity with the field make it a worthwhile contribution. Those concerned with such apparently diverse subjects as atmospheric electricity, nucleation, mine and industrial safety, adhesion, and surface physics in general will find this book to be of considerable interest.

J. A. RYAN
Douglas Aircraft Corporation, Santa Monica, California

Cosmologist and Critic

Le Livre du Ciel et du Monde. NICOLE ORESME. Albert D. Menut and Alexander J. Denomy, Eds. With a translation from the French and an introduction by Albert D. Menut. University of Wisconsin Press, Madison, 1968. xiv + 778 pp., illus. $17.50.

Nicole Oresme completed his *Livre du ciel et du monde* in 1377, at the request of Charles V of France. It consists of a French translation of Aristotle's *De caelo* (*On the Heavens*), accompanied by Oresme's commentary interspersed throughout the text. In Oresme's opinion, "never in this world was there a book on natural philosophy more beautiful or more powerful." In this superb new edition, Albert Menut and the late Alexander Denomy have supplied us with the medieval French text and a modern English translation on facing pages, preceded by several brief introductory chapters. Their scholarship, from beginning to end, has been of the highest order, and we are in their debt for this contribution to the growing corpus of medieval scientific works in modern editions and translations.

In his commentary Oresme attempts, in the first place, to make Aristotle intelligible to the educated layman by explaining and illustrating the text of *De caelo*. But often Oresme finds the Aristotelian theory untenable, and on such occasions he vigorously attacks the Philosopher by calling attention to flaws in the argument, describing observations that teach otherwise, and noting inconsistencies between this and other Aristotelian works. It is thus evident that Oresme's Aristotelianism was far from rigid. Indeed, he was in the forefront of the attack on Aristotle in the 14th century; he was a leader among those who, without formulating a systematic alternative, were with increasing vigor expressing their dissatisfaction over the details of the Aristotelian system. Thus Oresme reveals himself to be an original and creative thinker not by formulating a new philosophy of nature but by advancing many novel and creative criticisms of the old philosophy of nature.

Some of Oresme's novelties are already rather well known: for example, he argues at considerable length for the diurnal rotation of the earth, before concluding against it (pp. 521–39); in the course of this exposition, he presents several of the arguments later advanced by Copernicus for the mobility of the earth. He also discusses the plurality of worlds, arguing that if there were more worlds than one, each would have its own center of gravity (pp. 167–79); he affirms the possibility of a void space beyond the heavens (p. 177); he even speculates about the possibility of oval planetary spheres (p. 391). His ideas about local motion are of particular interest: he argues, for example, that a perfectly smooth sphere rolling on a perfectly smooth table can be moved by any force however small (p. 493); he imagines a tunnel piercing the earth and notes that whatever makes a heavy body descend to the center of the earth will also cause it to ascend after passing the center (p. 145); as an alternative to Aristotle's simple ratio relating motive power, resistance, and speed, he defends Bradwardine's exponential function (pp. 111–13). Finally, among the topics that most fascinated Oresme were the mathematical perplexities associated with incommensurability and infinity, to which he returns repeatedly (pp. 103–11, 119–21, 197–205, 427, 599–603).

This volume will not be light reading for the 20th-century scientist; not only is the conceptual framework unfamiliar, but the commentary form of the treatise demands a maximum of concentration if the reader is to follow the argument. It is therefore likely to be of greatest value to professional historians of science. Nevertheless, for anybody who perseveres there are many treasures to be found and much insight to be gained regarding the nature of medieval thought.

DAVID C. LINDBERG
Department of the History of Science, University of Wisconsin, Madison

Philosophical Trends

Boston Studies in the Philosophy of Science. Vol. 3. In Memory of Norwood Russell Hanson. Proceedings of the Boston Colloquium, 1964–1966. ROBERT S. COHEN and MARX W. WARTOFSKY, Eds. Reidel, Dordrecht; Humanities Press, New York, 1968. xlx + 489 pp., illus. $18.50. Synthese Library.

Norwood Russell Hanson was an internationally known philosopher and historian of science who met an untimely death last year in the crash of the plane he was flying. The almost two score brief homages included in this volume dedicated to his memory testify to the high regard and warm affection in which he was widely held, and give the reader a good sense of Hanson's tempestuous intellectual and physical vigor. The volume also contains a useful list of his publications, and reprints an essay by him in which he states at some length and in characteristic style the logical grounds for his forthright atheism.

But the bulk of the book is made up of 18 other papers, most of them originally presented at meetings of the Boston Colloquium for the Philosophy of Science, together with comments on a number of them by participants in the

sessions. The papers range over a large variety of topics: some of them deal with substantive scientific problems in theoretical physics and linguistics, some with sociohistorical questions concerning developments in science, and some (the majority of them) with methodological and far-flung philosophical issues. They also vary considerably in the clarity and cogency of their reasoning —indeed, in a disappointingly large number of instances the reasoning, such as it is, is capricious. But whatever one may think of the merits of the various articles, few will dispute the opinion that the book is outrageously overpriced.

The volume is perhaps most interesting because a number of new trends and current fashions in the philosophy of science are represented in it. Three examples of these tendencies must suffice. In self-conscious opposition to the positivism and pragmatism of a generation ago, a growing number of writers are now making obeisance to the allegedly important role in science of what they commonly call "metaphysics." Wartofsky must be counted as belonging to this group, and in his contribution to the volume he not only maintains that metaphysics is a "heuristic for science" but seeks to explain why this must be so. However, despite the length of his paper, he leaves quite obscure what he takes to be the differentia of metaphysical statements, so that it is difficult to make out what it is he is trying to explain or what is his explanation.

Again, according to a currently influential doctrine, if a scientific theory is false its falsity can be definitively established, while if a theory is true its truth cannot be shown to be even probable. Joseph Agassi subscribes to this view. But he thinks it is apparently incompatible with the fact that scientists often accept some theory for a relatively long period, so that science exhibits a degree of stability and is not in constant flux; and his paper is an attempt to account for this ostensible anomaly. However, his problem is intelligible only on the assumption that there is no such thing as confirmatory evidence for a theory, and hence no rational basis for accepting a theory—an assumption which seems to me highly dubious.

The third example of recent innovations in the philosophy of science is the contention that rational criticism of a scientific theory requires the development of as many theories as possible that are contraries of the given theory, with an examination of the allegedly "observational" evidence for the latter in the perspective of those alternative theories. In consonance with this view, Paul K. Feyerabend maintains in his paper that as a consequence of the increasing specialization of science and of its "autonomy" in relation to other human concerns, the "rationality" of science has declined since the Middle Ages; and he also tries to show that the empiricism advocated in Newton's methodology of science, like Calvinism but unlike Catholicism in matters of religious doctrine, is a major source of intellectual illiberalism. I am not sure how serious Feyerabend is in making these and similar allegations; but in any case, his commentators in the volume, who do take him seriously, make abundantly clear how fanciful are most of his factual claims.

ERNEST NAGEL
Department of Philosophy,
Columbia University,
New York, New York

Human Bones

The Skeletal Biology of Earlier Human Populations. Symposia of the Society for the Study of Human Biology, vol. 8, London, Nov. 1965. D. R. BROTHWELL, Ed. Pergamon, New York, 1968. viii + 288 pp., illus. $11; to members, £2.

Considering the many famous British names which come to mind in connection with studies of the biology of human populations during the last 100 years—Darwin, Huxley, Pearson, Keith, for example—it is surprising that no one in Great Britain got around to forming a society for the promotion of this field until 1958. The official organ of the flourishing new society is *Human Biology*, published in the United States since 1929. In addition the society produces a symposium series of which the present volume is the eighth. As evidence of the society's increasing international complexion six of the 13 papers in the present volume are contributed by other nationals: three from the United States, two from Canada, and one from Hungary.

The entire group of papers gives a good indication of the ways in which anthropologists are now looking at human skeletons. Particularly fashionable are the studies of what used to be called "anomalies" but are now referred to as "discontinuous" or "nonmetrical" or "discrete" variations. R. J. Berry of the Royal Free School of Medicine in London lists 30 such variants for the skull alone, and J. E. Anderson of the University of Toronto adds others for the mandible and postcranial skeleton. Both authors view these variants as useful genetic indicators of group relationships.

Interest is high also in congenital malformations and pathological changes in bones. As regards paleopathology, A. T. Sandison of the Western Infirmary in Glasgow contributes some wise observations, which, coming from a practicing pathologist, are timely. W. A. Marshall of the Institute of Child Health in London relates the presence of transverse lines in the radii of living children to the disease records of the same children, thus providing a better basis for interpreting the lines seen in earlier populations.

Other papers deal with skeletal plasticity, growth, stature increase, paleodemography, and the biochemical and radiological approaches. Of special interest is a new view of the claimed secular increase in stature in recent times. Neil M. Huber of the University of California at Berkeley regards the evidence for this increase as nothing more than the attainment of maximum stature at progressively younger ages. He found the adult long bones from early medieval Alemannic row-graves in southern Germany to be about the same length as those of present-day Americans.

A typographic error on page 4 is good for a laugh: "public symphysis" for "pubic symphysis."

T. D. STEWART
Office of Anthropology,
Smithsonian Institution,
Washington, D.C.

Books Received

Active Nitrogen. A. Nelson Wright and Carl A. Winkler. Academic Press, New York, 1968. xii + 602 pp., illus. $27.50. Physical Chemistry Series.

Advances in Chemotherapy. Vol. 3. Abraham Goldin, F. Hawking, and Robert J. Schnitzer, Eds. Academic Press, New York, 1968. xiv + 407 pp., illus. $18.50.

Advances in Chromatography. Vol. 6. J. Calvin Giddings and Roy A. Keller, Eds. Dekker, New York, 1968. xx + 339 pp., illus. $16.75.

Advances in Extractive Metallurgy. Proceedings of a symposium organized by the Institution of Mining and Metallurgy, London, April 1967. Institution of Mining and

(*Continued on page 1042*)