Physics

Introductory Topics in Theoretical Physics. Relativity, thermodynamics, kinetic theory, and statistical mechanics. Roald K. Wangsness. Wiley, New York, 1963. x + 315 pp. Illus. $8.50.

The subject matter treated by Wangsness in this deceptively slim volume is divided into four parts: (i) special relativity, (ii) thermodynamics, (iii) kinetic theory of gases, and (iv) statistical mechanics, with almost half of the book devoted to the fourth part. The last three parts, which deal with the same general class of phenomena, are closely tied to each other in the author's treatment, as they should be. In contrast, the section on relativity stands apart. Once completed, it is not referred to again in the book. It would be more appropriately placed had it been used as the final part of the author's recent book on classical mechanics and electromagnetism rather than as the first part of this volume, particularly in view of the fact that in this volume the discussion, aside from that of relativistic kinematics, touches only upon particle mechanics and on electrodynamics in empty space.

The present book developed from courses originally given by Wangsness at a naval laboratory, which probably accounts for the large number of applications that are included. The treatment is uncomfortably compact for an introductory volume. For example, the relativistic time dilation is dealt with in ten lines. Paramagnetism and ferromagnetism occupy less than ten pages, in which the magnetization is first expressed in terms of the partition function, then used to derive the Langevin theory of paramagnetism, the Weiss theory of ferromagnetism, and the heat capacities of systems described by the Weiss theory. In the presentation, which is aimed at senior undergraduate physics majors and first year graduate students, Wangsness succeeds in keeping the mathematics simple enough so that it should not cause trouble. There are two brief chapters that deal with mathematical topics—one with Lorentz transformations, the other principally with the properties of partial derivatives relevant to thermodynamics. However, the book is not recommended for students who intend to become physicists. The discussions and derivations are thin and sometimes done without proper care. Although no wrong conclusions are drawn, faulty reasoning mars the presentation. For example, instead of presenting Nernst's form of the third law as a plausible extrapolation from experience, a derivation is attempted, l'Hospital's rule for evaluating indeterminate fractions of the form 0/0 is invoked, and rigor is suggested, while in fact, it is nothing other than a plausibility argument. Such shortcomings are perhaps unimportant to a pragmatic person who is more interested in applying the several disciplines than in the disciplines themselves as parts of theoretical physics. For one with this bent, the book will serve as a reasonable and modern introduction.

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History of Biology

Georges Cuvier, Zoologist. A study in the history of evolution theory. William Coleman. Harvard University Press, Cambridge, Mass., 1964. xii + 212 pp. Illus. $4.75.

To the modern biologist, Georges Cuvier was an eminent French zoologist who did not believe in evolution and who delayed the advent of the theory by winning his debate with his colleague, Etienne Geoffroy Saint-Hilaire, an amiable scientist who tried somewhat ineffectively to defend the doctrine of *transformisme*. Cuvier's famous victory was more than Pyrrhic for it placed the winner prominently on the losing side in the evolution controversy. Cuvier died, however, nearly 30 years before Charles Darwin assured the evolutionists of their ultimate victory. During his life, he was ranked among the greatest of scientists and what he believed and published carried great weight, but today he is remembered chiefly because of his intellectual limitations. This, of course, is hardly fair. Cuvier deserves a less partial evaluation.

In this small book, William Coleman has given us a more complete Cuvier. He has demonstrated convincingly that Cuvier was much too complex to fit any of the neatly labeled pigeonholes into which we have stuffed him. We need no longer classify him merely as an antievolutionist and file him away among the historical exsiccatae, for Coleman has reinjected him with revivifying human juices. Cuvier need no longer remain the type specimen of the dogmatic scientist who refuses to face the logical implications of his advancing science. Cuvier was, in fact, a very complex individual, and both his virtues and his limitations were truly outstanding.

Cuvier's accomplishments were many and important although, ironically, their value lay in their contribution to the theory that he himself rejected. His investigations of the fossils found in the Paris basin and his systematic work on living forms, especially on fish, did much to assemble the factual evidence on which evolution is based. That he should miss the implications of his own labors is, of course, ironic, but we can easily understand why he did. He had an extremely orderly mind and a passion for systematizing, and his intense desire for nature to be well arranged gave him a craving for species that were stable and firm—for species that would remain where a competent systematist would place them. To Cuvier an orderly and rationally designed nature could not be based on units that shifted and evolved.

Cuvier was a very religious French Lutheran, and this has led to the general assumption that it was his religion which caused him to reject evolution. Coleman has shown, however, that Cuvier, like the good taxonomist that he was, sought to bring order into the universe and to arrange its different aspects into separate compartments. It seems obvious that he kept his religion and his zoology in different compartments. If the twain ever met, they met only *en passant* and neither disturbed the other. Cuvier was even able to harmonize his well-planned, well-integrated universe with one that had experienced a series of catastrophes, the latest one being Noah's Flood. He assumed, however, that the catastrophes need not have been universal. Nearly always, he thought, some part of the earth was spared and many of the animals and plants survived. These were the species that reentered the devastated regions and populated them again. God, of course, knew what he was doing, and soon everything would return to normal and God would have another continent to devastate.

Coleman has given us not only a clear description of Cuvier's major accomplishments but also a number of

minor facts that may be known to only a few biologists. For example, he shows that Cuvier even grasped the negative aspect of natural selection, the aspect that several other scientists had recorded before Darwin, but naturally he missed its full implication. To quote (p. 160):

> Like the action of geological catastrophes, Cuvier's "competition" could eliminate certain creatures but it could not create them. It was more a salubrious world-wide sanitary mechanism than a natural force leading to the emergence of new zoological forms.

Many other odd bits of information could be quoted, such as the fact that Cuvier believed in preformationism a full half century after the competing hypothesis of epigenesis had become the dominant view. This and other items like it perhaps are not of major importance, but they are nice things to know. All in all, *Georges Cuvier, Zoologist* is both a pleasant and important addition to the history of biology.

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Philosophy of Science

The Nature of the Natural Sciences. Leonard K. Nash. Little, Brown, Boston, Mass., 1963. xx + 604 pp. Illus. $7.50.

In this book Leonard Nash attempts, with feeling and conviction, to explain to us the nature of the natural sciences as they are understood and practiced by scientists and to correct the (in his opinion) distorted accounts of science which have gained widespread acceptance as a result of the writings of philosophers, especially the philosophers whom Nash calls "positivists." Unfortunately, although he writes informatively and interestingly about science and its practice, his depiction of the philosophical theories which he wishes to criticize hardly does them justice, with the result that the overall usefulness of the book is considerably impaired. Thus he says: "I have sought everywhere to deal with 'real' science, as it has been created and appraised by 'real' scientists. The 'ideal' science analyzed in neat philosophic syllogisms may be attractive in its straightforwardness, but is lamentably 'ideal' in that nothing like it has ever existed in this world" (p. viii). Although one can certainly sympathize with the desire to arrive at a more complete picture of the whole enterprise of science than that usually given in philosophical treatments, it is hard to know who or what is the intended target of this barbed criticism; certainly no reputable philosopher since the Middle Ages has attempted to analyze science in terms of the syllogism! Perhaps, by "neat philosophic syllogism," Nash means what is usually called "logical argument," but in that case the criticism still goes awry, because no philosopher has ever claimed to *describe* the method of scientific investigation, in its actual practice, as consisting in logical argument; rather, the claim is that the results of scientific investigation must be *justified* by logical argument of some type. Nash's retort that for the scientist "the 'context of justification' is *included within* and inseparable from the 'context of discovery'"—that is, that "the theory's effectiveness as instrument of discovery *is* the supreme justification for its acceptance by scientists" (p. 295)—does not detract from the fact that the philosopher's specific business is with justification—that is, with a logical process—and not with psychological description, however important the latter may be heuristically.

Nash wishes above all to defend his belief that "science discovers to us something of the nature of the real world" (p. 356), although he admits that he does not "pretend to grasp *how*" (p. 363). He says he finds that belief "beneficient" and "justified by no inconsiderable body of evidence." He then says: "By positivists, empiricists, instrumentalists, operationalists, phenomenalists, and others of the Pyrrhonist tribe, the evidence is ignored, the belief dismissed as 'meaningless,' and *reality* cast aside as 'only a comfort word'" (p. 356). This hardly seems a just appraisal of the work of such philosophers as Berkeley, Kant, Mach, Carnap, Whitehead, and others. The author then criticizes Bohr for having denied that "the purpose of science is to disclose the real essence of the phenomena," averring that this very purpose lies "at the focus of the work for which Bohr will be longest remembered" (p. 356). This criticism of Bohr contrasts strangely with the author's earlier statement: "I say nothing of what science could or should or might be, or of what scientists could or should or might think. I have instead said only what I believe science has been and is, and what scientists have thought and do think" (p. viii). Was not Bohr a scientist? It seems that if one sets out to write on the philosophy of science, one has to do the very thing that Nash states it is his intention to avoid—namely, to criticize and correct actual practice in terms of an "ideal."

On the whole, Nash's approach to the problems of the philosophy of science, as it is revealed in his claim that his "perspective on science" has a "breadth and balance not to be found elsewhere—simply because the depiction of real science is so very rarely essayed" (p. viii)—reminds one of the person who set out to solve all serious philosophical problems by a very simple expedient that no one had ever thought of before: by just telling the truth.

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Animal Behavior

The Senses of Animals. L. Harrison Matthews and Maxwell Knight. Philosophical Library, New York, 1963. 240 pp. Illus. $7.50.

In this day of increasingly numerous avian life history studies characterized by careful and detailed documentation, much is known of the great variety of behavior patterns exhibited by bird species. A large portion of these data have to do with what the birds do with, or as a result of, the sensory impressions they receive from their environment. In fact, so similar are birds to human beings in the way their activities are motivated by sight, sound, touch, smell, and taste that we are apt to take these factors almost for granted. It is fortunate that all classes of animals are not so like us in their sensory apprehensions and that, as a result, we are aware of the vast problems necessarily brought to our attention by a study of the causes of animal behavior. This volume offers a convenient digest of much of this material, and inasmuch as it is written in nontechnical language, it should be useful to a great many students of all classes of animals.

The book is divided in two sections.