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.

In the first Maxwell Knight describes and clarifies what the field naturalist is able to observe. This section, which covers the results of innumerable field observations and of experiments designed to clarify some of them, is arranged not by the types of animals but by the senses, and it brings together in logical cohesion a vast amount of data. In the second section, which is concerned with how the senses work, L. Harrison Matthews deals with the structural and functional bases for the sensory life of animals. The material is again arranged by the senses, although it includes two chapters on special topics—echolocation and monitors.

The volume should be a useful addition to the library of biologists interested in animal behavior. Its chief weakness as a source book is the lack of a bibliography and even of references in the text to the publications from which data have been extracted. It thereby falls short of providing the serious worker with what he needs, but for the amateur observer and the more superficial student it presents a readable and accurate presentation of the senses of animals.

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Stream and Lake Biology

Freshwater Ecology. T. T. Macan. Longmans, Green, London, 1963. x + 338 pp. Illus. $6.50.

Carpenter's small volume, *Life in Inland Waters* (1929), has been badly out of date for many years, and I have been searching fruitlessly for a modern volume that would replace it as required reading for university seniors and beginning graduate students who are thinking of doing work in freshwater biology. This book, at long last, fills such a need in admirable fashion. Macan is adept at weaving together such phases of freshwater ecology as communities, transport, behavior, interrelationships, physical factors (two chapters), chemical factors (four chapters), production, and methods. The whole treatment, however, is physiological, and the "integration" of many viewpoints has meaning far beyond the usual pedagogical implications of this word.

The style remains remarkably lucid and, in places, nearly conversational, despite the fact that Macan, carefully and in a scholarly fashion, has sifted a mass of data on stream and lake biology. Almost every page suggests further research problems, and for the receptive and perceptive student, this is perhaps the most valuable aspect of the book. To be sure, emphasis is on English and European aquatic ecology, but the principles discussed are common to aquatic habitats everywhere and most of the genera mentioned are also found in North America.

Much of Macan's own research interests have been in the ecology of freshwater insects, and an excellent summary of this field is appropriately placed in several chapters of *Freshwater Ecology*. There is a good summary of animal ecology through the Baltic Sea salinity gradient. The chapters on the ecological significance of temperature and dissolved oxygen are especially well done and free from the stilted qualities found in similar chapters in other texts. The 500 items in the list of references are well chosen.

The theme of *Freshwater Ecology* is perhaps best expressed by a sentence from the preface: "The only doctrine I wish to preach is toleration; the school that is brilliantly leading the world today may be nearing the end of its seam, whereas the school that has been plodding along an unprofitable road for years may be about to strike a rich vein."

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Note

African Natural Resources

A Review of the Natural Resources of the African Continent (UNESCO, Paris; Columbia University Press, New York, 1963. 437 pp. $15), a timely compendium of the natural resources of Africa, consists of 14 papers by as many authors. Each author catalogs the present sources of knowledge and suggests needed work with respect to a particular resource or field. An anonymous "outline" summarizes the volume as a whole. All except three of the papers include helpful bibliographies, several of them elaborately classified. Each paper also has a brief list of contents, but the volume suffers because it does not have an index, either general or to specific chapters. The group of contributors is cosmopolitan, but only the three specialists from the United Arab Republic now reside in Africa. One author, the director of a bureau, prepared his report "on the basis of notes provided by" five others. A review of such a collection of "reviews" cannot do justice to its subject in brief compass. Suffice it to say that the book touches on most aspects of its field and that it will be particularly useful to those who want to know where to find the available information, or to administrators or politicians who are seeking recommendations for action.

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New Books

Mathematics, Physical Science, and Engineering

Absorption Spectra in the Ultraviolet and Visible Region. vol. 4. L. Lang, Ed. Academic Press, New York, 1963. 414 pp. Illus. $20.

Acylation Reactions. Their applications and mechanisms. P. F. G. Praill. Pergamon, London; Macmillan, New York, 1964. 170 pp. Illus. Paper, $2.95.

Advances in Computers. vol. 4. Franz L. Alt, Morris Rubinoff, A. D. Booth, and R. E. Meagher, Eds. Academic Press, New York, 1963. 326 pp. Illus. $12. Five papers: "The formulation of data processing problems for computers," W. C. McGee; "All-magnetic circuit techniques," D. R. Bennion and H. D. Crane; "Computer education," H. E. Tompkins; "Digital fluid logic elements," H. H. Glaettli; "Multiple computer systems," W. A. Curtin.

Advances in Inorganic Chemistry and Radiochemistry. vol. 5. H. J. Emeléus and A. G. Sharpe, Eds. Academic Press, New York, 1963. 439 pp. Illus. $14.50. Eight papers: "The stabilization of oxidation states of the transition metals." R. S. Nyholm and M. L. Tobe; "Oxides and oxyfluorides of the halogens," M. Schmeisser and K. Brandle; "The chemistry of gallium," N. N. Greenwood; "Chemical effects of nuclear activation in gases and liquids," I. G. Campbell; "Gaseous hydroxides," O. Glemser and H. G. Wendlandt; "The borazines," E. K. Mellon, Jr. and J. J. Lagowski; "Decaborane-14 and its derivatives," M. F. Hawthorne; "The structure and reactivity of organophosphorus compounds," R. F. Hudson.

Analysis of Petroleum for Trace Elements. O. I. Milner. Pergamon, London; Macmillan, New York, 1963. 136 pp. Illus. $5.

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