direction in which the argument of the book tends. The wealth of material covered, the large number of issues considered, and the critical way in which the material is treated will make the book highly rewarding and stimulating reading for every geneticist. The manner in which concepts of genetics which have become widely accepted are challenged will induce the reader to reevaluate the evidence on his own and to establish his own position more firmly. In this way, the book is certain to contribute to the clarification of the fundamental concepts of genetics and to play a large role in the future development of the science.

ERNST CASPARI
Center for Advanced Study in the Behavioral Sciences

The Dentition of the Australopithecinae. Transvaal Museum Memoir No. 9. J. T. Robinson. Transvaal Museum, Pretoria, 1956. 179 pp. Illus.

Since the finding of a single juvenile skull in 1924, the discovery of australopithecines in South Africa has accelerated remarkably. Amid all the polemics, it has also become increasingly evident that these creatures give crucial evidence on human origins. Now J. T. Robinson, able successor to the late Robert Broom, has published data on no fewer than 526 teeth (many isolated, but many associated in skulls or jaws), which come from five localities and represent the entire dentition, both deciduous and permanent.

The value of this contribution, even on the descriptive level, can hardly be overemphasized. Measurements and elementary but useful statistics are given for all the samples. Representative teeth are clearly figured, chiefly by photographs twice natural size. Verbal description is sufficiently detailed and comparative. Taxonomy within the group now achieves a sound basis. Robinson clearly demonstrates that the five locality samples represent two, and only two, well-distinguished taxa, which he prefers to call genera: *Australopithecus* and *Paranthropus*. Whether these are, indeed, best called genera and whether each includes two or more distinguishable local populations are relatively unimportant questions, in part matters of taste and in part a subject that requires still more extensive analysis. (A third group, Robinson's *Telanthropus,* is regarded by him as truly hominine and is omitted from the present study.)

The accumulated evidence is now overwhelmingly in favor of hominid affinities for the australopithecines. There are strong diagnostic differences between the dentitions of pongids (true apes) and hominids (true humans and strictly manlike forms), and in almost every important dental character the australopithecines are more like the hominids than like the pongids. In connection with the skeletal evidence, here mentioned but not spelled out, this surely indicates that australopithecines are more nearly related to the typical human than to the typical ape stock. It is also clear that the australopithecines are in many respects more primitive than the higher or unquestioned human beings (hominines, technically) and that they display some, at least, of the characteristics possessed by our own ancestry at stages more remote than, for example, Java man (*Pithecanthropus*).

These are the more important conclusions that may now, after a whole generation of fierce dispute, be taken as definitive. The exact taxonomic expression of these facts will always be open to some disagreement and will eventually depend on phylogenetic details that are not yet cleared up. Robinson now grants that the known australopithecines are too recent to be directly ancestral to *Homo* in any strict sense. He considers his *Australopithecus* and *Paranthropus* to be two divergent lines that probably evolved contemporaneously with each other and with still another divergent line that was to eventuate in *Homo*. The two recognized australopithecine lineages are supposed to have evolved at different rates, *Paranthropus* more slowly, and thus to represent (in general, not in all details) successive structural stages in the rise of the hominines.

Here an alternative hypothesis may be suggested. *Paranthropus,* the less hominine-like group, seems, on present evidence, to be later in age than *Australopithecus,* and both are probably contemporaneous with true hominines. It is more consistent with this evidence and at least as consistent with the morphologic facts to consider *Australopithecus* and *Paranthropus* to be essentially successive stages in the evolution of nonhominine stocks derived from prehominines. Then *Paranthropus,* the later group, would be not structurally more primitive but more specialized divergently away from the hominines and might even, to some extent, be convergent toward the apes. *Australopithecus,* which is in fact more manlike, would be phylogenetically nearer to the split from the prehominines. The characteristics of the true human ancestry would be more nearly approximated by projecting backward from *Paranthropus* through *Australopithecus,* not in the reverse direction, as Robinson tentatively suggests.

Even when they may not offer the only possible or perhaps most probable explanation, Robinson's interpretations are worthy of close attention. The data that he presents constitute one of the greatest contributions ever made to the vexatious problem of our own origins.

G. G. SIMPSON
American Museum of Natural History

Animal Navigation. How animals find their way about. J. D. Carthy. Scribner's, New York, 1956. 151 pp. Illus. + plates. $3.95.

The observed facts of, and in some cases the fancies about, animal navigation have long mystified scientists and laymen alike and have frequently been blanketed with the terms *instinct* or *sixth sense*. With the flourishing of sensory physiology and the invention of mechanical devices which enable human beings to apprehend certain physical phenomena, such as polarized light, which were previously obscure to man's senses, some of the mysteries of animal orientation are being unraveled. The understanding of the orientation of bats by echolocation, for example, awaited the invention of an acoustic system which is sensitive to high-frequency sound, despite the fact that Spallanzani, in the late 18th century, had gathered strong (although not so interpreted) experimental evidence for acoustic orientation. A chasm, in part technologic and in part intellectual, lay between the experimental observation of an association between unobstructed hearing and oriented flight and the clear appreciation that sound which is inaudible to man is the information-carrying medium.

J. D. Carthy, in *Animal Navigation,* deals briefly with the investigations of orientation in a variety of lower invertebrates, arthropods, fish, birds, and mammals. The coverage is broad and, as a result, sometimes superficial or noncritical. Many ingenious and beautifully designed experiments are, however, woven into a book, with a great deal of charm and understanding. Although very few of the observations or experiments are reported in sufficient detail to permit the reader the pleasure of evaluating the conclusions himself and to reveal the full scope of the problem that is presented or of the ingenuity that is involved in its solution, Carthy uncovers for those not yet initiated a truly fascinating world of specialized senses and, indeed, of senses not yet identified, and he draws examples from a very wide background. A short list of suggested books is included. A brief bibliography would have been very welcome.

This is a light and pleasant introduction, free from sensationalism, to the fields of sensory physiology and behavior. It should provide provocative reading for laymen and investigators of other

disciplines and should, also, make fine supplementary reading for students in introductory zoology courses. Scholarly but popular surveys, such as this, of appropriate areas of the natural and physical sciences are increasingly welcome.

ALVIN NOVICK
Harvard University

The Open Sea. The world of plankton. Alister C. Hardy. Houghton Mifflin, Boston, 1956. 335 pp. Illus. + plates. $6.50.

There have been so many books about the sea and its life, especially in recent years, that it seems impossible that anything new could be said, or that it could be said in a fresh and stimulating way. But Alister Hardy (of Oxford University) has somehow achieved the impossible and has written a book about the sea that reads as if it had been written fresh on the morning of discovery. The enthusiasm with which he approached his task is the key, of course, and it is his ability to convey his enthusiasm without lapsing into purple or mauve patches that makes his book both good reading and sound science. Even the details in small type are full of delightful surprises. Of course, as a zoologist, I may take more delight in some of these than a physical oceanographer would, but perhaps it is he who has permission to skip the small type.

Although the book is primarily about the sea around the British Isles and the plant and animal life found within it, many of the organisms discussed are similar to, if not the same as, those in other parts of the world. Thus, while the addition of a few more examples exotic to the British Isles would have increased the value of the book for American readers, there are enough similarities to make it a valuable and useful introduction to the study of plankton anywhere. It could even serve as a good textbook for introductory courses. The chapters on pelagic larval forms, vertical migration, and deep-sea life are of universal application, and it is refreshing to see so much good, sound zoology here and throughout the book.

There seems to be one school of scientific popularization that holds that readers are not interested in details and that they should be offered only the broad outlines of a subject and not be confused by being presented with both sides of controversial matters. The contributions of this school are usually written by people who are professional writers—or popularizers—rather than scientists, and all too often there are indications that the writer has extended himself beyond the limits of his information without being willing to admit as much. The other school of popularization, of which this book is a splendid example, holds only to the premise that the author should be an expert on the subject he chooses to discuss, and that he is the judge of how best to present it.

Hardy has worked with plankton for more than 30 years and is one of the best known experts in the field. We are fortunate, therefore, that he was willing to write this book and that he found time to add to it the personal touch of his own paintings. Indeed, we are doubly fortunate, for a second volume, on the fisheries, has been promised.

In reading this book, I have had but one regret—that it could not have been the first to introduce me to the open sea and its life.

JOEL W. HEDGPETH
Scripps Institution of Oceanography

Rauwolfia: Botany, Pharmacognosy, Chemistry and Pharmacology. Robert E. Woodson, Jr., Heber W. Youngken, Emil Schlittler, and Jurg A. Schneider. Little, Brown, Boston, 1957. 150 pp. Illus. + plates. $5.50.

About 25 years ago, chemists and pharmacologists in India began to study crude extracts of the old Indian drug *Rauwolfia serpentina.* As a result of this interest, *Rauwolfia* was recently introduced into Western therapeutics and, in less than half a dozen years, not only has become a widely used agent itself but has introduced the concept of tranquilizers to medicine. At the same time that the clinical uses were being explored in hypertension and in the psychoses, further extensive botanical, chemical, and pharmacological work was inspired, and it is the latter fields which are considered in this book. The discussions are straightforward approaches from each of the disciplines concerned and, in places, are quite technical. The book's appeal is therefore to the serious worker rather than to the casual reader.

The first section deals with the botany of *Rauwolfia* and its relatives. The genus is widely tropical in distribution and is not found naturally in Europe or the United States. An intense search has been made for related species high enough in alkaloidal content to be commercially profitable. Both *Rauwolfia vomitoria,* from Africa, and *Rauwolfia tetraphylla,* from tropical America, are being exploited and may prove to be satisfactory species for cultivation.

The second section of the book is on pharmacognosy and describes the physical characteristics, histology, and crude-drug characteristics of the various species.

The third and most extensive section deals with the chemistry of the many *Rauwolfia* alkaloids. In 1952, Emil Schlittler, the author of this section, together with Mueller and Bein, reported the isolation of reserpine, an indole alkaloid, from the crude drug. This was the first alkaloid which showed the typical properties of the whole drug and has, in large part, replaced the crude extracts in medicine. More recently, two other pure alkaloids with reserpinelike actions have been isolated: rescinnamine and deserpidine. Reserpine has been synthesized by an elegant procedure of some 20 steps.

The last section deals with the pharmacology of *Rauwolfia.* The actions of about 30 of the alkaloids are described briefly, and those of reserpine, extensively. This drug has been called phrenotropic, because it influences the function of the mind. Although complex, the influence is in the direction of sedation or depression but toward tranquility rather than toward sleep. The body temperature tends to drop, the blood pressure to be lowered, the pupils to narrow, and the respiration to be slowed. By contrast, the gastrointestinal tract shows increased activity. These actions appear to result largely from a somewhat specific depression of central sympathetic tone. A rather striking biochemical concomitant is a profound serotonin release from the tissues, especially of the central nervous system. Therapeutic use is not discussed in any detail.

Reserpine has high interest, both for its own effects and because it opens new doors of investigation in the field of neuropharmacology, and this book will, accordingly, be most welcome to workers in these fields.

WINDSOR CUTTING
Stanford Medical School

Pharmacognosy. Edmund N. Gathercoal and E. H. Wirth. Revised by Edward P. Claus. Lea and Febiger, Philadelphia, ed. 3, 1956. 731 pp. Illus. + plates. $12.50.

In this edition, Edward P. Claus has ably revised and modernized a justly popular textbook. Classification of plant and animal drugs on the basis of their chemical constituents replaces the previous taxonomic classification, in accord with changing trends in pharmacognosy, with the progressive deemphasis of botanical subject matter in the pharmaceutical curriculum, and with the later thinking of the original authors.