The major portion of the volume is devoted to the 25 chapters concerned with national or regional forests. These chapters, naturally, vary in scope and quality, in part because of the varying concerns of the authors and in part because of the great diversity of forests and culture that marks the modern world. The typical chapter includes brief accounts of physical geography, the major forest associations, the history of forests and their present condition, wood-using industries and their impact on forests, and the development of forest policy and management. Some authors consider the ecology and successional relationships of important species and types; others touch on these biological matters only slightly or not at all.

Since the publication of Zon and Sparhawk's work, quantitative information about forests has multiplied, especially information on the extent and merchantable volume of commercially accessible areas and species. But the authors of the present volume have wisely minimized the presentation of detailed tables. These the interested reader can readily consult in the statistical publications of the United Nations Food and Agriculture Organization.

It is hard and perhaps unfair for the untraveled reviewer to cite chapters that are especially successful as regional accounts. But any such list, I believe, would have to include the chapters on middle America, western Europe, the Mediterranean, tropical Africa, the U.S.S.R. (by the late Raphael Zon), Japan, and Oceania.

At the end of the volume is a final, general essay, "The outlook for the world's forests and their chief products," by Erhard Rostlund, a geographer on the faculty of the University of California. This essay, despite occasional slackness of statement and organization, is a brilliant and stimulating discussion. Rostlund examines and challenges many of the facile shibboleths often found in the pages of popular and technical literature: that presently inaccessible forests will be developed to answer all the world's needs; that "the half-promise of technology" will enable us to recoup, in the factory, what we have lost on the land; and that silviculture, aided by genetics, will soon permit us to manipulate forest stands as readily as we manipulate field crops. Rostlund may exaggerate the extent to which these and other illusions affect our attitudes toward the forest resource. Yet he has set up no straw men, and his discussion, at the least, should help us to place some current fads in proper perspective.

The contributors, editors, and publisher deserve credit for supplying a section of 110 excellent photographs, which illustrate the great variety of species, sites, and cultural environments involved in the concept of "forest."

The serious reader is not so well served, however, if he wishes to use this book as a starting point for further investigation. Eileen Teclaff's seven-page bibliographic note at the end of the volume is a good start, but it leaves many important gaps. Most of the regional chapters supply no more than a few citations on nomenclature. It is unfortunate that the editors did not insist on more adequate documentation and references for these chapters and thus make this excellent compendium even more useful.

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Theoretical Genetics. Richard B. Goldschmidt. University of California Press, Berkeley, 1955. x + 563 pp. Illus. $8.50.

This book treats of questions pertaining to the nature of the genic material and its action. Richard Goldschmidt, who in his experimental work and in his earlier theoretical discussions has made a large number of major contributions to our understanding of these problems, considers, in the present book, the status of his earlier ideas in the light of the recent evidence and discusses a number of questions which have arisen since his last book was written.

Theoretical Genetics is directed to the specialist in genetics, and its purpose is to present the point of view of the author to his colleagues and to support it with the available evidence. The book contains an extensive bibliography (50 pages), but it is not a review or a textbook in the usual sense, since it does not attempt to describe the material contained in the papers quoted. Frequently the experimental material contained in the papers is supposed to be known to the reader and is simply adduced to support the argument of the author. In other cases, the work is presented extensively and critically in its relation to the conceptual framework developed in the book. The book is conspicuous, in the biological literature, for the large number of verbatim quotations from the papers of other geneticists. These quotations usually embody the conclusions to which the other authors have come concerning the questions discussed. They serve, then, in the Aristotelian manner, as a starting point for Goldschmidt's development of his own ideas.

The book is divided into five parts of which the last two are relatively short, whereas the first three make up the bulk of the work. The arguments in all parts are closely interconnected, and cross references are accordingly frequent. The first part deals with the nature of the genetic material. Mutation is assumed to represent a change in the pattern of the genic material, and this picture leads the author to represent the organization of the chromosome as consisting of overlapping segments of genic material which, in turn, are overlaid by patterns of a higher order, so that a hierarchical order of organization of the genic material results. After thorough review of the evidence, Goldschmidt arrives at the conclusion—different from that of the great majority of geneticists—that the genic material is represented by the protein constituents of the chromosome, and that the DNA has a function necessary for the self-reproduction of the genic protein material.

The second part of the book deals with the function of the cytoplasm. The author denies a genelike activity of cytoplasmic components and regards the cytoplasm as a more or less specific substrate for genic action. For this reason he rejects the term *plasmagene* as misleading, since the self-reproducing cytoplasmic constituents do not show the specific effects on developmental processes characteristic of genes.

The third part discusses the action of the genic material. The emphasis here is on genic action in the development of higher organisms rather than on the control of biochemical activities, derived mainly from the study of microorganisms. Goldschmidt points out that, for the control of developmental processes, one of the fundamental modes of action to be postulated for the genic material is "stratification"—that is, the orderly arrangement of materials in the cytoplasm. Furthermore, genes must be assumed to control the speed of developmental processes and the thresholds involved in determination and differentiation, as was pointed out by the author in his earlier work.

The final two chapters contain applications of the viewpoints presented on the balance theory of sex determination and on the author's well-known theory of the origin of higher taxonomic categories by "macromutations"—that is, fundamental changes in the pattern of genic organization.

Most geneticists will disagree with some of the points made in the course of the discussion, and the main disagreements will be different for different geneticists. In this connection, it should be remembered that many of Goldschmidt's views which, when first proposed in his earlier works, were disputed by the majority of his colleagues have in the intervening time found widespread acceptance.

It is impossible, in a short review, to give more than a slight indication of the

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.

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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.

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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