lous," and so must be the ape's body; the latter was necessarily a "caricature of the human body." Fortunately, the zoological relationship between ape and man was far closer than Galen's theoretical demands seemed to allow.

In the living body, this "slime of fleshes and juices," Galen wrote, "there is yet an indwelling intelligence." To the student with an "open mind" here was real "evidence of a wise Creator," and he who could advance just this step would come to "understand the excellence of the intelligence in the heavens." Here is the core of Galen's argument in *On the usefulness of the parts of the body*. It and, even more, the wonderful interweaving of anatomical fact and physiological interpretation in the treatise have long been hidden from the English reader. May's translation now transforms this situation and makes easily available one of the most interesting and influential of ancient Greek medico-philosophical texts.

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Blood Protein

The Haptoglobin Groups in Man. R. L. KIRK. Karger, Basel, 1968 (U.S. distributor, Phiebig, White Plains, N.Y.). vi + 77 pp., illus. $4.80. Monographs in Human Genetics, vol. 4.

Haptoglobin is a hemoglobin-binding protein, present in the blood serum of many species, which was described unobtrusively some 30 years ago. The almost total indifference of investigators to this discovery was dramatically reversed when Smithies, in 1955, found that haptoglobin exhibited a remarkable genetic polymorphism. Since then many investigators in diverse fields have become actively engaged in carrying out studies of this interesting protein. Geneticists, biochemists, anthropologists, and physicians have all studied haptoglobin from their particular vantage points and have published their results in journals peculiar to their own fraternities. As a direct result, any but the most confirmed library hound is likely to be overcome by an attack of the snoozes if confronted with the task of assembling the scattered literature on the biology and biochemistry of the haptoglobin groups in man. All workers in the field are thus greatly indebted to R. L. Kirk, for his monograph is an admirable, up-to-date account, clearly and succinctly written, of the available information on haptoglobin. It will serve as a convenient reference book, for the author has tabulated the many mutant phenotypes in the haptoglobin system and has collated the world distribution of the various inherited haptoglobin groups.

Although the haptoglobin system has intrigued many scientists, it is probably of particular interest to those concerned with understanding the ways by which proteins evolve. The effect of nonhomologous crossing over, and other chromosomal rearrangements, on the structure of a protein molecule has been elegantly elucidated by detailed structural studies on this protein. Indeed, the chemical studies of haptoglobin are probably of more enduring interest than the plethora of uninterpretable data which have accumulated on the frequency of various haptoglobin mutants throughout the world. It is hardly astonishing that the gene frequencies for haptoglobin mutants vary in different populations; the significance of the variations, however, remains utterly obscure. Those who tenaciously adhere to the orthodox view that, if a gene exists in a frequency greater than can be accounted for by conventional rates of mutation, it is probable that the gene is maintained in the population by heterozygous advantage hold to a faith that in man is rarely experimentally testable. The brilliant example of the sickle-cell polymorphism and its importance in providing protection against infection with falciparum malaria may have given unwarranted encouragement to those who still seek to discover the biological significance of human biochemical polymorphisms by relentlessly tabulating variations in gene frequencies in different populations.

The volume is readable, well produced, and invaluable as a reference source, although it is not very much more than the sum of papers previously published. Ample illustrations, often redrawn from original sources, add to the clarity of the textual material. A more extensive discussion by the author, who has himself contributed very significantly to our knowledge of haptoglobin, of the general problem of human biochemical polymorphism would have added perspective and made the volume as stimulating as it is now informative.

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Views on Some Fossils

Notes and Comments on Vertebrate Paleontology. ALFRED SHERWOOD ROMER. University of Chicago Press, Chicago, 1968. viii + 304 pp. Cloth, $6.95; paper, $3.85.

A. S. Romer's new book *Notes and Comments on Vertebrate Paleontology* is an indispensable adjunct to his eminently readable and authoritative textbook *Vertebrate Paleontology*. Readers will recall that in the latter book broad coverage of the field is achieved at the expense of digressions into controversy which might or might not be enlightening, but which would certainly interrupt the flow of the story. In consequence, *Vertebrate Paleontology* has been criticized on occasion as being too neat, with too many answers and not enough questions. *Notes and Comments* resolves this point effectively and succinctly. In it Romer provides a view of the other side of the web that is vertebrate paleontology, to demonstrate how it has been put together, showing the patches and loose ends instead of the spectacular stretches of relatively continuous fabric that are usually portrayed. As he points out in his preface, to include this material in the text would have expanded it beyond all conscience. But by dealing with "personalities and polemics" separately, and including a supplemental bibliography of 509 entries, the author has the best of two worlds, that of factual coverage and that of opinion and philosophy, without enlarging the textbook to Teutonic proportions of four or five volumes.

Organization parallels that of the textbook, each chapter consisting of commentary on the contents of a specific textbook chapter. The general approach is historical and philosophical; a brief résumé of the history of knowledge of each group down to about 1933 is given, followed by discussion of progress (if any) since that date. Nothing is omitted, but the groups emphasized are, of course, those in which the greatest progress has been made or the greatest controversy aroused in recent times.

The book does not pretend to be an unbiased appraisal of the field, but is rather a very personal expression of the opinions and point of view of A. S. Romer, nowhere more evidently than in his approach to formal taxonomy and nomenclature. His pungent remarks on these matters in the introduction and at intervals thereafter will annoy or amuse, depending upon the

problems to which the reader is accustomed in his own field of specialization. We also encounter some other perennial views defended with vigor and enthusiasm, such as the embryonic versus the primitive nature of cartilage and the fresh-water origin of vertebrates. But no inordinate amount of space is devoted to these old favorites, and controversies of broader scope, possibly more subject to ultimate resolution, such as those that concern the evolution of Lower Paleozoic vertebrates, the origin and nature of vertebrate classes, and the origin and taxonomy of mammalian orders, make up the bulk of the book. Whether he agrees with them or not, Romer's treatment of all opinions that he considers significant is fair, temperate, and knowledgeable.

It should be noted that the period covered by *Notes and Comments* has been marked by a great deal of activity in vertebrate paleontology, with respect to both new discoveries and development of theory. Romer has contributed heavily to this progress and continues active in the field, and his commentary, coming just at this time, is valuable not only as a review of the state of the art but also as a signpost for the future.

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Plant Form

Growth and Organization in Plants. Structure, Development, Metabolism, Physiology. F. C. STEWARD. Addison-Wesley, Reading, Mass., 1968. xii + 564 pp., illus. $15. Addison-Wesley Series in Life Sciences.

This is an unusual book by an unusual man. While it could not possibly be recommended for use as a textbook, or even as a reference source for a balanced review of the entire area of plant growth and development, it should be consulted by all advanced workers in the field as a provocative synthesis of the ideas of one of our most versatile and literate plant physiologists. For those who have never heard Steward lecture on "Carrots and Coconuts" (can there be anyone, anywhere, who has not experienced these tours de force, punctuated by toy-pistol clicks to signal slide changes?), this monograph will communicate some of the color, dash, and style of his memorable oratory, and also of his often controversial concepts of plant function.

The book was first organized as a series of lectures given to college teachers of biology. Steward has obviously chosen to expound at greatest length on topics closest to his own researches; thus of the slightly more than 500 references in the bibliography, 87 bear his name as an author, and another 10 refer to work done by his students or colleagues. The result is a skewness in content and in the analysis of subjects to which Steward has contributed. For example, one certainly gets the impression (pp. 141–42) that Steward and Caplin, not van Overbeek, Conklin, and Blakeslee, first introduced coconut milk into plant tissue culture media. Nowhere is it mentioned that Letham has isolated zeatin riboside, a cytokinin, from coconut milk and that its presence probably accounts for some of the properties of coconut milk; rather, the impression is left that the unique growth promotion elicited by coconut milk is due entirely to amino acids, auxins, inositol, and other components isolated in Steward's laboratory. In all the discussion of cellular totipotency in tissue culture there is no mention of the classic paper of Muir, Hildebrandt, and Riker, who probably first showed unambiguously that single isolated plant cells can grow to tissue masses from which formed plant organs can later be made to differentiate. The natural occurrence of 1,3-diphenylurea in coconut milk is stated as a fact, though doubts as to this have been publicly expressed, there being a possibility that the substance was accidentally introduced into the batch being industrially concentrated. All this takes many pages, while topics like tropisms, endogenous rhythms, abscisic acid, ethylene, and phytochrome are barely mentioned, despite their much greater importance.

On the other side of the coin, Steward is at his best when discussing broad questions of organization and form. It is here that his encyclopedic grasp of growth and differentiation brings him to clear and exciting expositions, punctuated by frequent references to insufficiently quoted older literature. His distrust of the practice of applying to higher plants facile explanations based on simplistic views of genetic regulation in procaryotes leads him to rely on more complex mechanisms. This may be good medicine for students who were raised in an age characterized by relatively uncritical acceptance for all organisms of events so far found to occur only in *Escherichia coli* and its relatives.

Both because of its insights and its controversial views of many subjects, this mind-stretching book deserves to be read carefully and appreciatively by a large audience.

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Turbulent Flow

Physics of Negative Viscosity Phenomena. VICTOR P. STARR. McGraw-Hill, New York, 1968. xvi + 256 pp., illus. $9.95. Earth and Planetary Science Series.

The most controversial thing about this book is its title. The motion of the ocean and atmosphere is almost invariably turbulent, the structure of the flow being governed by the balance among the energy inputs, the effects of rotation and stratification, and the interactions between the eddies of the turbulence and the mean flow. It is an old idea to seek an analogy between the random eddying motions in the turbulence and the random motion of the molecules of a gas; the latter gives rise to molecular viscosity acting on a macroscopic motion, the former being conceived to produce an "eddy viscosity" that acts on mean, larger-scale flow. The work of Taylor, Townsend, Corrsin, and others showed 20 years ago that the analogy is in principle erroneous; the "eddy viscosity" is not in general a local parameter but, because of large-scale exchange processes, one that depends upon the whole field of flow and its time history. Despite this, the idea is often a useful one in calculating the properties of simple turbulent flows, and its use in dynamical meteorology and oceanography is widespread.

Molecular viscosity is, for thermodynamic reasons, essentially positive; it represents a diffusive process. In turbulence, on the other hand, particularly in stratified and rotating fluids such as the atmosphere and ocean, inertial effects can lead to concentrations of momentum such as exist in the Gulf Stream and the atmospheric jet stream. If wave motions are involved, momentum can be extracted from the mean flow at one point and released elsewhere, the transfer being essentially radiative. If we insist on making param-