

implemented. Weimer virtually ignores the difficulties inherent in a motor theory of vision, dismissing the problems by making reference to the early work by Festinger on eye movements.

Some of these difficulties may be inherent in the pioneering approach of the book, which does provide arguments for the directness of perception, the relation between perceiving, acting, and knowing, and the importance of an ecologically relevant psychology, even though few specific formulations are proposed. I hope that because of this book psychologists will no longer have to argue the need for this type of theory but can proceed with its development.

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The Upper Atmosphere

Radar Probing of the Auroral Plasma. Proceedings of a summer school, Tromsø, Norway, June 1975. ASGEIR BREKKE, Ed. Universitetsforlaget, Oslo, Norway, 1977 (U.S. distributor, Columbia University Press, New York). 464 pp., illus. Paper, \$28.

In 1958 W. E. Gordon suggested that powerful radar systems operating at frequencies well above those reflected by the ionosphere could be used to probe the upper atmosphere. Although there would be no coherent reflection, there would be an "incoherent scatter" consisting of randomly phased contributions from individual electrons in the ionosphere, each with an effective cross section of about 10^{-28} square meters. This was certainly not a new idea; Gordon's contribution was to look at it seriously and to point out that, although incoherent scatter was an extremely weak effect, it was not entirely negligible and could in fact be detected by sufficiently powerful radars (megawatts of peak transmitter power, acres of antenna area).

Gordon's predictions were confirmed by the observations of K. L. Bowles in 1958, but it was soon realized that the theory of the scatter was more complex than Gordon had thought and that the signal was a bit easier to detect. In the years that have followed, the theory has been worked out in great detail, and the technique has become a powerful tool for probing the ionosphere from the ground. From the power and spectrum of the scattered signal one can deduce elec-

tron densities, electron and ion temperatures, ion composition, collision frequencies, and mean drift velocities of the charged particles, all as a function of altitude and with good time resolution. Furthermore, many characteristics of the neutral upper atmosphere can be deduced, through the use of the charged particles as tracers.

There are five active incoherent scatter observatories in the world. The most spectacular is the National Astronomy and Ionosphere Center located near Arecibo, Puerto Rico, with a 1000-foot-diameter reflecting antenna in a natural sinkhole and a 2-megawatt, 430-megahertz radar. Another impressive sight is the dipole array, with 18,432 elements, that is the antenna for the 4-megawatt, 50-megahertz incoherent scatter radar of the Jicamarca Observatory located near Lima, Peru. The other three observatories are located near Boston, in Alaska, and in France.

A sixth facility (the European Incoherent Scatter Radar in the Auroral Zone project, or EISCAT) is now being constructed in northern Scandinavia with support from Finland, France, Great Britain, Norway, Sweden, and West Germany. Both geographically (latitude of about 70°) and geomagnetically (magnetic shell parameter = 6.3) it will be substantially north of the observatory near Fairbanks, Alaska. It will provide a unique facility for studying auroral phenomena in great detail and at times will be able to probe processes occurring on "open" field lines connected directly to the solar wind.

The summer school that this book records introduced European students and young scientists to the incoherent scatter technique in general, to EISCAT in particular, and to some of the physical problems that EISCAT will be investigating. The 20 chapters correspond to the lectures and are tutorial in nature. The topics covered include incoherent scatter theory and technique, some incoherent scatter observations (particularly in Alaska), some aspects of ionospheric and magnetospheric physics, and various experiments that will complement EISCAT observations. The chapters are generally more than lecture notes but less than comprehensive review papers.

Proceedings of this sort are very valuable for the participants, particularly if they are available at the time of the meeting or shortly thereafter, but they are less so for others and tend to become dated with the delay of publication (more than two years in this case). The chapters on incoherent scatter theory and electrostatic waves in a plasma are inter-

esting, but these topics have also been dealt with in various excellent review articles and original research papers available in the open literature. The same can be said for the discussion of radar techniques, except for the considerable material that deals specifically with the EISCAT system. I found it surprising that there was no discussion of the sophisticated procedures used at Arecibo. The material on actual observations and on the theory of auroral and magnetospheric processes is also amply covered in the open literature, which is inevitably more up to date.

The book would make useful reading for someone planning a research program using the EISCAT facility, which the Europeans hope will begin observations in mid-1979, but others may find it too specialized in some areas and a bit dated or abbreviated in others.

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Observational Cosmology

Décalages vers le Rouge et Expansion de l'Univers. L'Evolution des Galaxies et Ses Implications Cosmologiques. Papers from two colloquia, Paris, Sept. 1976. Editions du Centre National de la Recherche Scientifique, Paris, 1977. 620 pp., illus. Paper, 180 F.

Hubble's discovery of the expansion of the universe led to a prolonged effort to measure the rate of both the expansion and its deceleration. This program, which leads to an estimate of the age of the universe, has been vigorously pursued by Hubble and his successors for 50 years now and, despite its conceptual simplicity, has proved to be exceedingly intractable. The problem, in brief, is that it is not easy to measure the intrinsic luminosity of the galaxies and that, in any case, the luminosity of a remote galaxy is expected to undergo significant and poorly understood change in the time it takes for its light to reach us. God has not very liberally strewn His world with standard candles.

Nevertheless, the program has made steady, unspectacular progress. It is now widely accepted that the age of the universe is known from such studies within a factor of 2, and the rough agreement of this age with the age of the elements as determined from their radioactivity and with the age of the oldest stars as determined from studies of stellar evolution has convinced almost everyone of the validity of Hubble's view that the red-

shifts of galaxies are caused by velocities of recession and that these velocities, leaving aside a small component due to individual motion, result from the expansion of the universe. A small minority of astronomers maintain, however, that some few galaxies, and perhaps all quasars, exhibit anomalous redshifts that are caused by some as yet unknown physical process unconnected with their peculiar motions or with the universal expansion.

The volume under review contains the proceedings of two conferences devoted to these issues. The conferences were held consecutively; they had the same participants and organizers and were, in effect, one conference. The organizers apparently wanted to have a wide range of viewpoints represented and to stimulate as much controversy as possible. Some, perhaps skeptical of the value of public debate in furthering critical inquiry, chose to stay away. Nonetheless, the published proceedings provide a useful and fairly complete summary of work recently done within the framework of the Hubble program as well as of the work of its critics.

Reading this volume I could not escape the impression that there is something slightly odd about the tone of discussion in contemporary observational cosmology. It is at once inconclusive and strangely dogmatic. Opinions seem to be more strongly held than the evidence for them warrants. Some cosmologists seem to live in private worlds and are deeply persuaded by evidence and arguments that seem to their colleagues to be quite unpersuasive. Few make observations whose implications they find surprising; there are not many discoveries reported here. But if you want to know the state of play in the continuing effort to determine the characteristics of the universal expansion or just how weak the case for nonvelocity redshifts is, this is a good place to begin.

Aside from these well-worn paths, there are many new and interesting things here: Tully and Fisher on their new program of radio redshifts, Tinsley and White on different aspects of evolutionary change in galaxies and clusters of galaxies, Kellermann and Shaffer on apparent faster-than-light motions in radio sources, and Roberts on how constant some of the natural constants are. There are also two superb reviews of the whole cosmological enterprise: one by Gunn on observational tests in cosmology and the other by Rees on the nature of the redshifts. Both of these *vaut le voyage*.

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Hemoglobins and Their Disorders

Human Hemoglobins. H. FRANKLIN BUNN, BERNARD G. FORGET, and HELEN M. RANNEY, Eds. Saunders, Philadelphia, 1977. x, 432 pp., illus. \$18.

As a result of three decades of intense investigation, human hemoglobin and its abnormalities have been established as the prototype for understanding the mutational origin and the molecular pathology of hereditary disease in humans. Hemoglobin research has flourished in several fields. Clinical investigations have elucidated the natural history and pathophysiology of hemoglobin disorders, some of which (the sickling and the thalassemia syndromes) are among the most prevalent genetic defects in African, Mediterranean, and Asian populations. Genetic studies have uncovered a multitude of abnormalities; human hemoglobin is unique in that it is the only mammalian genetic system in which abnormalities in protein structure as well as in protein synthesis and in developmental patterns are known and well characterized. An equivalent to the number and heterogeneity of the structural human hemoglobin mutations can be found only in bacterial genetic systems. In parallel, biochemical investigations during the last decade have led to the delineation of the structure and function of normal and abnormal hemoglobins at the stereochemical level and to the discovery that abnormalities in hemoglobin synthesis reflect problems in the production, structure, or function of globin messenger RNA. This book brings all these products of basic and clinical investigation together.

The book has ten chapters, four presenting introductory information and the remainder discussing specific hemoglobin abnormalities. The coverage of the subject is of uniformly high quality. The early chapters of the book contain the best available syntheses of hemoglobin function and its modulation in health and disease; this material provides an excellent background for the analysis of the physiological effects of mutation in the chapters describing the sickling disorders, the unstable hemoglobins, the variants that have abnormal oxygen affinity, and the hemoglobins that produce methemoglobinemia. The bibliographic coverage in these chapters is complete, and the tables provide good summaries of the described mutants and their properties. The clinical descriptions are accurate and to the point.

About a third of the book is devoted to the most common hemoglobin abnormalities, the thalassemias and the sickling

disorders. These chapters are excellently balanced between review and synthesis, reflecting the research and clinical experience of the authors. The chapter on thalassemia is preceded by a vigorous review of globin biosynthesis and globin messenger RNA through 1976, but this part of the book will soon be outdated by the rapid progress in the investigation of mammalian globin messenger RNA and DNA.

The only weakness of the book is in matters of population genetics. There is only sporadic reference to the population frequencies of hemoglobin defects, and Allison's demonstration of the selective advantage of the sickle cell trait carriers vis à vis falciparum malaria, one of the major contributions in human population genetics, is allotted only eight lines.

The book is readable, lucid, and comprehensive. It contains almost everything known about human hemoglobins, and it will be a useful companion for clinical and experimental hematologists as well as for teachers who want to use hemoglobin to illustrate principles of biochemistry or human genetics.

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Albumin Structure, Function and Uses. Victor M. Rosenoer, Murray Oratz, and Marcus A. Rothschild, Eds. Pergamon, New York, 1977. xiv, 398 pp., illus. \$45. *To order this book circle No. 350 on Readers' Service Card*

Anatomy of Domestic Birds. R. Nickel, A. Schummer, E. Seiferle, W. G. Siller, and P. A. L. Wight. Translated from the German edition (Berlin, 1973). Parey, Berlin, and Springer-Verlag, New York, 1977. xii, 204 pp., illus. + plates. \$42.30. *To order this book circle No. 351 on Readers' Service Card*

Biology of Benthic Organisms. Papers from a symposium, Galway, Ireland, Oct. 1976. B. F. Keegan, P. O. Cédigh, and P. J. S. Boaden, Eds. Pergamon, New York 1977. xxxiv, 630 pp., illus. \$50. *To order this book circle No. 352 on Readers' Service Card*

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