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 electron 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 interesting, 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-