with the relationship between mortality levels and changes in economic factors, this book places him in the middle of a controversy that has been raging for some time over the causes of mortality decline. Preston comes to two major conclusions: that the experience of England and Wales between 1851 and 1900 was atypical with respect to causes of death involved in mortality decline and that the mortality declines that have occurred in the 20th century are the result of declines in infectious diseases but the latter declines are not attributable to economic factors. An interesting corollary of the second conclusion is that the infectious diseases, death from which is declining, are not so much well-defined diseases such as typhoid, diphtheria, and measles, the prevention and cure of which have been advanced by Western industrial medicine, as "influenza, pneumonia and bronchitis" or "diarrheal diseases," diseases produced by microorganisms that are diverse and often difficult to identify.

Preston's analysis leaves little doubt that the relationship between income levels and mortality has shifted over time and that factors exogenous to current national income probably account for most of the growth in life expectancy for the world as a whole between the 1930's and the 1960's. Preston leaves the reader curious what these exogenous factors are; if he has any ideas on the matter he seems disinclined to share them with us. Along the same lines, a fuller discussion of the mechanisms by which income levels, which do after all account for some of the decline in mortality levels, affect mortality levels would be quite interesting. Only in chapter 6, where he analyzes the sex differential in mortality, does Preston use other data—for example measures of crowding, data on nutritional levels, and measures of urbanization—to support the conclusions derived from the statistics on mortality by cause of death.

There are obviously many ways in which the data might have been analyzed further, and other readers will no doubt have suggestions for what Preston might have done. In *Mortality Patterns in National Populations* he doesn't tell us everything we've always wanted to know about mortality, but he tells us a great deal and in addition provides us with both the incentive and the techniques needed to answer many of the questions remaining.

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Redirecting Cognitive Science

Perceiving, Acting, and Knowing. Toward an Ecological Psychology. Papers from a conference, Minneapolis, July 1973. ROBERT SHAW and JOHN BRANSFORD, Eds. Erlbaum, Hillsdale, N.J., 1977 (distributor, Halsted [Wiley], New York). xii, 492 pp. $19.95.

Cognitive psychologists have come to realize that many of their paradigms and metaphors lead to a theory as sterile as that based on the bar pressing of the behaviorists' rats. The contributors to this book attempt to counter the sterility by proposing an "ecological psychology" in which the content of an organism's world forms the starting point for the study of its perceptual and cognitive abilities. The strongest feature of the book is its emphasis on the application of environmentally significant theories to a broad range of topics; discussions of perception, attention, child development, motor behavior, esthetics, speech, language, and semantic memory provide the hint of a framework for an ecologically relevant cognitive science. The introduction by Shaw and Bransford sets the scene by discussing the need for a new approach and by describing two additional issues considered in the book: whether perception is direct (not based on memory or inference) and whether there are interrelations between acting, perceiving, and understanding. Although these issues are not explicitly addressed by each contributor, they form a thread connecting the various sections of the book. The individual essays are uneven but basically strong. They are thought-provoking expositions of one view of current problems in cognitive psychology.

My admiration for the book is not without reservation. Perhaps because of the sweeping goal implicit in the book (nothing less than to revise the traditional approach to cognitive theory), the ideas expressed in the chapters seem overly vague, incomplete, and occasionally simplistic. Although the contributors argue that psychology must combine a description of the relevant properties of the world with a description of how these properties are registered by a perceiver, little serious attention is devoted to how, or indeed whether, ecologically significant information is registered.

As an introduction to direct theories of perception, Mace provides an uncritical summary of Gibson's early theorizing. Although the chapter is useful to the reader unfamiliar with this approach, it restricts the definition of an adequate direct theory too much. In laying down five conditions he thinks are essential for a direct theory of perception, Mace unintentionally, I think, excludes potential allies—a questionable practice when one is attempting to revise traditional thinking about the field of cognition.

Fortunately, this exclusionist view is offset by other contributors. Pribram argues that the constructivist and direct positions need not be antithetical; we directly perceive a representation of the world that is a product of the information existing in the organism and that existing in the world. Weimer correctly points out that arguments about direct and constructivist theories are based on omissions by both sides. A constructivist theory must base a representation on available information, and a direct theory must spell out how information is registered and how perception occurs. Merely specifying an ecologically relevant variable results not in a theory of perception but only in an exercise in geometry.

Gibson, in a selection from his forthcoming book, attempts to extend his theory of perception to the meanings (the structural and functional properties) of objects and events. He asserts that there are correspondences between a visual perception and an object's characteristics ("affordances"). Thus, if there is optical information that a surface is rigid, flat, level, and extended, then the surface affords "sit-on-ableness." In similar fashion, events may "afford" nutrition or poisoning. The problem with this view, which puts the meaning of objects and events in the nature of visual stimulation, is that it doesn't demonstrate, but only postulates, the existence of "affordances." It is an interesting hypothesis, but one that as yet has no empirical support.

A chapter by Shaw and Pittenger summarizes their research showing that a geometric strain transformation of facial profiles provides information about age while preserving individual identity over age. This is an important demonstration of invariants in visual form perception, especially since Shankweiler, Strange, and Verbrugge point out in their chapter that attempts at similar demonstrations in speech perception have not been fruitful.

Chapters by Turvey and by Weimer marshal the arguments regarding the interdependency of behavior, perception, and comprehension. One wishes the chapters had more specific suggestions about the nature of visual motor integration. Turvey discusses the physiological underpinnings of a general control theory of vision but gives little attention to how such a theory might be

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-