

fact is a statement of the relationship between perceiver and perceived. The concern with the perceiver is neither to be wondered at nor condemned. However, one danger does exist: the perceiver may become the subject matter, and social relationships (which are, after all, what sociology studies) may be left out in the cold.

Sociology, like any science (and Carl G. Hempel's lucid critique "The logic of functional analysis" shows that the word *science* is not a misnomer) is a mode of perceiving. Taking a cue from the brief résumé by Rapoport of simple game theory, we can note that scientific procedure demands players and rules. But the sociologist is both player and game analyst. Sociologists study a game (persons engaging in social relationships); their procedure is also a game (sociologists watching people engaging in social relationships). The trouble seems to be, in this complex game, keeping one's eye on the ball.

PAUL BOHANNAN

*Department of Economics & Sociology,
Princeton University*

Physical Sciences

The Neutrino. James S. Allen. Princeton University Press, Princeton, N.J., 1958. viii + 168 pp. \$4.50.

I have, on occasion, wondered about the sort of world we would experience if our planet, Earth, were to have a perpetual cover of cloud over its entire surface, as does Venus. No man, in this circumstance, would ever have seen the sun or the moon—or even one star! Would man ever have emerged from the grey winter of primitive knowledge to feel the warm shafts of intellectual sunlight that now occasionally pierce his ignorance? Certainly, wonderment upon gazing into the clear sky and the practical lessons of celestial mechanics would have been beyond the realm of his experience.

Yet there would have been those who sat by the ocean shore, watching the rise and fall of the tides, who counted the periods of night and day and season following season. Some would try to find the thread connecting such mysterious events to the more prosaic things of life. In the gradual building, through the years, of intellect with intellect, a sudden flash of understanding might have occurred in the mind of one man and suggested to him the existence of the sun.

One can see the initial disbelief in the eyes of his colleagues (those who adhered to theories of great whales in the depths who sloshed the seas with gigantic tails, and the like). But as those less skeptical than most used the strange hypothesis of a "sun" that must remain forever concealed from the eyes of men

to build a "sun theory" that would account for the tides and the night and day, disbelief might have turned into acceptance. But what a strange object this "sun" must be—describable to some extent, but hardly to be understood by mortals!

Providence has permitted man to see the stars, but at the other extreme of experience the vast regions of the subatomic are forever obscured from our vision. The myriad spaces of the very small, where reality begins, are beyond the range of our senses; and so we sit on the shores of a sea poorly charted—and wonder.

A quarter of a century ago, however, to one of our number, Wolfgang Pauli, came a flash of understanding. In his mind's eye he saw the neutrino. Rejected at first as just a poor excuse for forgetting the whales lashing our theories with improvident tails. Pauli's thought was soon embedded in our science. There it has continued to grow, bearing fruit as one of the most basic ideas of our times, while its consequences, one by one, are comprehended and fitted into place. But what a strange object this "neutrino" must be—describable to some extent, but hardly to be understood by mortals!

Allen accomplishes this description as adequately as a scientist of today can hope to do. He proceeds in a most readable but careful manner to lay the case for the neutrino before the colleagues of Wolfgang Pauli. In his eight chapters Allen reviews the experimental evidence and the theoretical case for the reality of the neutrino.

To compress into 163 pages of concise statement the volume of extant literature concerning the neutrino is no mean achievement. Allen relies heavily, of course, on references to the detailed papers to make the rigorous case, but in so doing he always keeps the principal threads of reasoning clearly in sight. The fine points of technique, experimental and theoretic, must be sought through additional reading.

Major puzzles concerning the neutrino are also treated. Is the neutrino of meson decay the same as that of nucleon beta decay, and as that emitted by nucleon capture of mu mesons? Is the strange new particle in the nuclear firmament indicative of a universal Fermi interaction? And is this poltergeist of modern physics the principal agent in the startling denial of the cherished parity rule?

Explaining some puzzles while it uncovers others, Pauli's and Fermi's neutrino continues to be a fascinating subject for today's physicist. That the story is far from complete is underlined by Allen in his preface, wherein he states that his volume should be considered a progress report of neutrino physics through May 1957. He expresses the

common belief that the subject is far from closed and that active research in the field will continue. I hope that Allen is even now assembling the sequel to his first report, and that he will have much that is new and illuminating to present in his next volume.

CLYDE L. COWAN

*Department of Physics,
Catholic University of America*

Géologie de l'uranium. Marcel Roubault. Masson, Paris, 1958 (available from Stechert-Hafner, New York). 462 pp. Illus. \$13.

Marcel Roubault is director of the School of Applied Geology and Mineral Exploration, and a professor on the faculty of sciences, of the University of Nancy, and he has been president of the Committee on Mines of the Atomic Energy Commission of France. This book was written with the collaboration of Georges Jurain of the faculty of sciences of the University of Nancy. A preface by Francis Perrin, high commissioner of Atomic Energy for France, is included. Under such authorship it may be assumed that the work has met with the approval of the French Atomic Energy Commission.

More than half of the book (282 pages) includes a survey of the geological features concerned with the occurrence of uranium and thorium. Heretofore, the role of France in the development and exploitation of uranium resources has been given less attention than developments in other parts of the world. Roubault has filled this gap by writing an excellent French text in which a large, well-illustrated section is devoted to uranium occurrences in France; another fair-sized section is devoted to occurrences in Madagascar. This is a welcome addition to uranium literature. Further geological discussions of occurrences in Europe, as well as of localities in Australia and South America, and brief descriptions of deposits in the U.S.S.R. are included. Discussions of the Belgian Congo, South Africa, the Colorado plateau, and the Canadian shield are also given.

One section (51 pages), illustrated with conventional figures and two exceptional colored plates, is devoted to uranium minerals. Another section (50 pages) is devoted to prospecting and covers detectors, probes for drill holes, airborne surveys, and radioactive anomaly maps. A short section is devoted to the reserves of uranium and thorium. The minerals of thorium and the occurrences of thorium are also covered.

The text contains a number of well-chosen photographs illustrating textures of uranium ores. The numerous geologic

diagrams of mining areas and sections of uranium deposits, particularly of occurrences in France and elsewhere in Europe, will be found useful.

The emphasis of the book is primarily what one would expect from an able student of mineral deposits who writes for others in the same field. The principles of uranium occurrence take precedence, and an abundance of illustrative material has been introduced to support the text. Future books, written in English, on the geological occurrence of uranium will doubtless show the influence of this French text.

PAUL F. KERR

*Department of Geology,
Columbia University*

Manual on Rockets and Satellites. vol. 6, *Annals of the International Geophysical Year, 1957-1958.* L. V. Berkner, Ed. Pergamon, New York, 1958. xx + 508 pp. Illus. \$25.

One of the greatest scientific achievements of recent times—the International Geophysical Year—has just been completed. A very large part of the Geophysical Year program was centered around the use of rockets and satellites, the subject of this book. The book is a compilation of articles by authors from all of the many countries which participated in this gigantic, world-wide undertaking. The fact that publication of this book was possible, that the IGY itself was possible, is a tribute to the willingness of scientists everywhere to cooperate in a difficult, complex, and closely integrated scientific effort.

Lloyd Berkner, who edited the volume, was the reporter for rockets and satellites of the Comité Spécial de l'Année Géophysique Internationale; he was greatly assisted in accumulating and preparing the information for publication by associate editors Reid, Hanessian, and Cormier. The editors are also indebted to scientists too numerous to mention who were responsible for the individual articles. Although it was published in 1958, the book was prepared in the middle of the IGY effort; in the main, therefore, it discusses the plans of the various countries for carrying out their IGY programs in the areas of satellite research and rocket probing of the upper atmosphere. Now that the IGY is officially over and has been succeeded by the program of International Geophysical Cooperation, one can see in retrospect that the planning for the IGY was good; the experiments as actually carried out are described quite well in this book.

An excellent introduction by Berkner gives in capsule form the reasons for the IGY rocket and satellite effort and ex-

plains the principal experiments that were planned to implement this effort. The book then describes many of the programs in detail, each chapter being made up mainly of articles by individual experimenters. Despite the diversity of the contributors, there is good continuity.

The first 100 pages are devoted to a description of the rocket programs planned by Australia, Canada, France, Japan, the U.S.S.R., the United Kingdom, and the United States. This section is replete with photographs and drawings of the experimental equipment and of the rockets. Included also are reports of some of the earlier results—data on pressures, densities, and temperatures in the upper atmosphere. The section ends with a detailed schedule of the types, dates, locations, and principal experiments of the United States rocket firings.

It is interesting to note that the principal objectives of the U.S.S.R. and United States programs were remarkably similar. These dealt primarily with the following areas of research: structural parameters and optical properties of the atmosphere; ultraviolet, x-ray, and corpuscular solar radiation; aurorae; cosmic rays; ionospheric phenomena; the magnetic field of the earth; micrometeors and meteorites; and physical and chemical processes in the upper layers of the atmosphere.

The next 330 pages of the book give a description of the satellite programs planned by the United States and the U.S.S.R. This is an excellent treatise on the problems that arise in the launching and use of close-in earth satellites. This section, again, is a compilation of separate articles, but it is a well-integrated, effective treatment of the satellite problem and of the principles employed by these two countries to conquer the problem during the IGY. The section deals first with general satellite information, with problems relative to the orbit and its determination, and with the scientific information that can be garnered from the expected perturbations of the orbit. This is followed by a presentation of the U.S.S.R. satellite program, in which the experimentation is dealt with in very general terms; the experimentation plan closely resembles that for the rocket program. Following this is a treatment of the United States satellite program; much more detailed information is given on the launching vehicles and on the experiments planned. Quite a bit of space is given to the optical and radio satellite tracking programs and to the effort that was made to interest groups in the United States and abroad to participate in them.

One of the major problems in an effort of this magnitude is that of gather-

ing the large number of data received and of assembling them in world data centers where they will be available to students for years to come. The planning for this is treated in the 20 pages that follow. The book closes with two addenda, which report the first three successful satellite launchings.

This book is of great interest in that the reader will see evidence of the tremendous effort made by many groups to allow man to break away from the environment in which he has been confined since the beginning of history. The plan was successful. New objects in nature have been created, and the door is now open for us to make full use of this new frontier. Our knowledge of the universe had been limited to what we could see through our murky atmosphere. Now, through the medium of satellites, we can see the rest of the universe in its full spectrum, and we are only beginning to sense the increase in our knowledge which will thereby be made possible. For any who desire an understanding of the problems and pains involved in work with rockets and satellites, this book brings together as does no other single source a wealth of useful information.

JOHN P. HAGEN

*Vanguard Division, National
Aeronautics and Space Administration*

Geology of the Great Lakes. Jack L. Hough. University of Illinois Press, Urbana, 1958. xviii + 313 pp. Illus. \$8.50.

The Great Lakes occupy deep basins in ancient crystalline and sedimentary bedrock, but they are truly a product of the Ice Age. Hough has published a summary of information on the lakes and their formative history, but in the same year that the basic concept of multiple glaciations has been subject to severe criticism. Accordingly, this book represents an era of thought on the records of the Great Lakes which may be subject to revisions of interpretation in the future.

Changes of concept in lake history have been many over the years. In 1915 Frank Leverett and Frank B. Taylor summarized the information to that time in a U.S. Geological Survey monograph. Twenty-four years later the evidence for an important submerged lake stage unknown to those authors was discovered and described by George M. Stanley; this altered the accepted understanding of the historical record and introduced new problems. These Hough, whose long experience in the Great Lakes has given him extensive knowledge of their sediments, has endeavored to