From the welter of studies on sensory units Somjen has probably selected the most important. His choices are up to date. He describes currently unsolved problems and possible approaches to them. A fatal weakness in the book, however, involves the very concept of sensory coding. This concept may denote transformation of physically specified stimuli into neural activity, or it may denote the relationship of psychological events to such activity. Somjen first foreswears the latter interpretation of coding and thereafter continually violates his vows. The result is constant confusion about what belongs to physics and what belongs to psychology. For example, he labels visual neurons "red-green" or "yellow-blue" cells. Red, green, blue, and yellow are psychological experiences quite distinct from sets of physical stimuli on which they are contingent. Somjen's inability to distinguish the two concepts of coding culminates, among other things, in his suggested cure for the uncertainty of psychological measures of sensory magnitude. He proposes (p. 221) to identify "the physical mechanism of the brain corresponding to intensity of feeling and to measure that with physical instruments." Identifying "the mechanism," however, presupposes adequate measurement of psychological intensity. And so the circle closes.

All figures in the book are collected into a single middle section. Coping with numerous and often tangential textual references to the figures requires bimanual acrobatics.

Mature scientists will find some value in this book. Students will be led into bad habits of thought.

BURTON S. ROSNER
Department of Psychology, University of Pennsylvania, Philadelphia

Genetic Machinery

Developmental Studies on Giant Chromosomes. W. BEERMANN, Ed. Springer-Verlag, New York, 1972. xvi, 228 pp., illus. $18.80. Results and Problems in Cell Differentiation, vol. 4.

The title of this volume is somewhat misleading, in that, except for two brief mentions of ciliate Protozoa and a discussion of the amphibian lampbrush chromosome by one of the nine authors, the book deals exclusively with giant polytene chromosomes of flies. The reasons behind this heavy emphasis are to be found on the first page of Beermann's introductory article. He comments on past oversimplification of chromosome structure, and the error of explaining higher (eukaryotic) genetic machinery in terms of simple molecular models. Beermann believes that developmental events can be analyzed only after eukaryotic chromosome organization is understood in terms of structural, functional, and genetic units, and "the only material in which such a combined approach seems to be feasible is the giant polytene chromosome of the Diptera."

Beermann's chapter, entitled "Chromomeres and genes," makes excellent specialized reading, correlating the latest biochemical and genetical findings with electron microscope observations. Beermann introduces the reader to the two structural entities discussed at length in the succeeding chapters: chromomeric regions or "bands," and the genetically very active regions visible as "puffs." The next article, by Lezzi and Robert, takes the reader into the detailed effects of various agents, particularly ions and hormones, on chromosomes that have been isolated from salivary gland cells of midges of the genus *Chironomus*. The review of replication in polytene chromosomes by Rudkin is detailed, concise, and logically presented. Pelling's article on transcription in giant chromosome puffs includes detailed correlations with amphibian lampbrush chromosomes. Puffing patterns in *Drosophila melanogaster* and related species are discussed by Ashburner. He shows, in beautifully illustrated sequences, the value of studying chromosome puffing patterns in a genus in which so much is known of the genetics and in which "genetic engineering" is easily possible. Ribbert considers the available data on the relation between puffing and differentiation in trichogen and pulvillar epidermal cells in the blow fly, *Calliphora*, and the flesh fly, *Sarcophaga*. Here, the electron micrographs are not quite up to the generally high standard of the micrographs in the rest of the book. Berendes's article returns to the subject of salivary gland chromosomes with a discussion of the control of puffing in *Drosophila hydei*. It is well illustrated and reviews specific findings in the light of general problems of the control of chromosome activity. It would have made a good concluding chapter. It is unfortunate that Panitz's short article on Balbiani ring activities in the midge genus *Acricotopus*, because of its terminal position, tends to sound repetitious in places.

On the whole the book is a valuable addition to the series, and achieves the aim of the general editors: "to render a thorough and up-to-date picture of giant polytene chromosomes" and "to discuss all angles of general biological interest."

JOAN M. WHITTEN
Department of Biological Sciences, Northwestern University, Evanston, Illinois

General Relativity

Gravitation and Cosmology. Principles and Applications of the General Theory of Relativity. STEVEN WEINBERG. Wiley, New York, 1972. xxx, 658 pp., illus. $18.95.

The discovery in 1965 of the 3°K background blackbody radiation by Penzias and Wilson has provided a powerful stimulus for research in the field of cosmology. Likewise the discovery of quasi-stellar objects and pulsars in the 1960's supplied the impetus for a host of new investigations in the field of relativistic astrophysics. Unfortunately, the rapid growth of papers in these fields, with the sudden appearance (and equally sudden demise) of new theories, has made it extremely difficult for the beginner to find his way through the literature and judge the value of new works in these fields. If nothing more, Weinberg's book will serve as guide through this maze. The author seems to have read just about every paper in these fields that has been written in the past 15 years and has succeeded in presenting the material in an extremely clear manner. In many cases he has succeeded in making understandable what was far from understandable in the original works. In his discussions the author tries to start from the beginning, so that the reader has a clear understanding of the underlying physical principles involved and the assumptions being made. There are very few rabbits pulled from a hat in these discussions. Furthermore, most of the discussions are more or less self-contained, so that the reader who has some background in the subject can read about one or another topic without having to begin on page 1.

As the subtitle of the work announces, the book concerns itself with both the principles and the applications of general relativity. The applications

are covered mainly in part 3, which deals with tests of general relativity, post-Newtonian celestial mechanics, gravitational radiation, and stellar structure, and in part 5, which deals with cosmology. Together these two parts comprise roughly half the book. I was especially impressed with Weinberg's presentation of post-Newtonian celestial mechanics. It contains one of the clearest discussions of the slow-motion approximation to be found anywhere. The treatment of gravitational radiation is also very good as far as it goes. Many of the calculations in this section appear to be original and are a valuable contribution to the subject. This section is especially useful for understanding current attempts to detect gravitational radiation. The long discussion of cosmology in part 5 is also extremely useful. It of course contains a review of classical cosmology. But its main value lies in the presentation of the recent developments to be found in chapter 15. The scope of this presentation can be judged by the list of over 300 references at the end of this chapter; of these, only about 20 predate 1960. There are even references to papers that had not appeared in print at the time of publication. I found the sections on the thermal history of the early universe, helium synthesis, formation of galaxies, and the theory of small fluctuations particularly helpful as introductions to these subjects.

In view of the excellent discussions contained in the sections of this book devoted to applications it is disappointing to find that the presentation of the principles does not achieve the same level of excellence. I find here that there is both too much material and not enough. There are many long sections devoted to derivations that can be found in any of a number of texts on tensor calculus and differential geometry. These derivations are always clearly presented and often novel, but they tend to obscure the essential ideas. The long discussion of symmetric spaces, for example, leaves the reader with no clear understanding of what he needs to know of this subject in order to understand the properties of various cosmological models. On the other hand, many of Weinberg's discussions leave one with the feeling that all questions of principle have been answered and that the future of general relativity lies solely in its applications. I believe that this difficulty stems in part from the fact that much of the material on the principles derives from books written prior to 1950. Since then a considerable amount of work has been done that has increased our understanding of the foundations of general relativity, but very little of this material is discussed in this book. For example, although a large amount of work has been done on the initial value problem, the discussion of it here is limited to just over one page with no references given. At the end we are told that the initial value problem "can be programmed for an automatic computer, once we find an initial metric at $x^\circ = t$ that satisfies the constraints." But it is just the problem of finding this initial metric, which only now seems close to a solution, that causes all the difficulty. It also lies at the heart of the quantization problem, but it is completely ignored in the section on quantization. Likewise, the section on gravitational radiation, though containing many interesting results, is concerned solely with the linearized theory. It ignores all the really hard problems and the large amount of work by Bondi, Sachs, and others on these problems. Finally, the author's discussion of the principle of general covariance is, I think, quite misleading. He resurrects an old argument of Kretchmann which has been seriously questioned by several authors, and which, if true, would rule out one of the strongest arguments for Einstein's equations for the metric.

To sum up, then, I would say that anyone seriously interested in modern cosmology and relativistic astrophysics will want to own a copy of this book. In these areas it is one of the best there is. One will have to look elsewhere, however, to find out what has happened in other areas of general relativity during the past 25 years.

JAMES L. ANDERSON

Department of Physics,
Stevens Institute of Technology,
Hoboken, New Jersey

Books Received

Advances in Atomic and Molecular Physics. Vol. 8. D. R. Bates and Immanuel Esterman, Eds. Academic Press, New York, 1972. xii, 300 pp., illus. $19.50.

Alaskan Oil. Alternative Routes and Markets. Charles J. Cicchetti. Resources for the Future, Washington, D.C., 1972 (distributed by Johns Hopkins University Press, Baltimore). xviii, 142 pp., illus. Paper, $5.

Analytical Microbiology. Vol. 2. Frederick Kavanagh, Ed. Academic Press, New York, 1972. xxvi, 632 pp., illus. $28.50.

Annual Progress in Child Psychiatry and Child Development 1972. Stella Chess and Alexander Thomas, Eds. Brunner/Mazel, New York; Butterworths, London, 1972. x, 742 pp., illus. $15.

Antarctic Terrestrial Biology. George A. Llano, Ed. American Geophysical Union, Washington, D.C., 1972. xii, 322 pp., illus. $30.

Atlas of Colposcopy. Per Kolstad and Adolf Stafl. University Park Press, Baltimore, 1972. 146 pp. $24.50.

Basic Aspects of Central Vestibular Mechanisms. Proceedings of a symposium, Pisa, Italy, July 1971. A. Brodal and O. Pompeiano, Eds. Elsevier, New York, 1972. xii, 656 pp., illus. $57.50. Progress in Brain Research, vol. 37.

Basic Organic Chemistry. Part 4. J. M. Tedder, A. Nechvatal, A. W. Murray, and J. Carnduff. Wiley, New York, 1972. xii, 528 pp., illus. Paper, $14.50.

A Bibliography of Multivariate Statistical Analysis. T. W. Anderson, Somesh Das Gupta, and George P. H. Styan. Halsted (Wiley), New York, 1972. x, 642 pp. $34.

The Bimolecular Lipid Membrane. A System. Mahendra K. Jain. Van Nostrand Reinhold, New York, 1972. x, 470 pp., illus. $22.50.

Biochemical and Pharmacological Mechanisms Underlying Behaviour. A symposium, Porton Down, England, Mar. 1971. P. B. Bradley and R. W. Brimblecombe, Eds. Elsevier, New York, 1972. xii, 204 pp., illus. $24.50. Progress in Brain Research, vol. 36.

Biologie Cellulaire. Louis Genevès. Dunod, Paris, 1972. 2 vols. Vol. 1, xviii, 446 pp., illus. Paper, 46 F. Dunod Université, 564. Vol. 2, xii, 210 pp., illus. Paper, 35 F. Dunod Université, 565.

Biology of RNA. J. L. Sirlin. Academic Press, New York, 1972. xiv, 526 pp., illus. $24.50.

The Biology of Trematodes. David A. Erasmus. Crane Russak, New York, 1973. viii, 312 pp. + plates. $24.75.

Bio-Magnetics and Life. Dwight H. Bulkley. Rogue Press, 3226 E. Kelly Rd., Bellingham, Wash., ed. 2, 1972. 56 pp., illus. Paper, $2.95.

Born to Sing. An Interpretation and World Survey of Bird Song. Charles Hartshorne. Indiana University Press, Bloomington, 1973. xvi, 304 pp., illus. $10.

Bulletin of the Museum of Comparative Zoology. Vol. 144, No. 3, Social Biology of the Neotropical Wasp *Mischocyttarus drewseni.* Robert L. Jeanne. pp. 63–150, illus. Paper, $4.95. Vol. 144, No. 4, Studies in the Milliped Order Chordeumida (Diplopoda): A Revision of the Family Cleidogonidae and a Reclassification of the Order Chordeumida in the New World. William A. Shear. pp. 151–352, illus. Paper, $9. Harvard University Museum of Comparative Zoology, Cambridge, Mass., 1972.

The Bureau of Reclamation. William E. Warne. Praeger, New York, 1973. x, 272 pp., illus. $9.50. Praeger Library of U.S. Government Departments and Agencies.

Cancer. The Misguided Cell. David M. Prescott. Pegasus (Bobbs-Merrill), Indi-