for Kennedy's own interpretation of the constructive theory holds that such inferences are unconscious in nature.) (ii) It can be demonstrated that properties of the optic array can be unambiguously informative about their environmental origins. What more is needed for effortless, generally veridical perception?

Kennedy's analysis of the richness and completeness of the information available in the optic array, undertaken in the service of defending the registration theory of ordinary perception and extending this theory to picture perception, is a valuable contribution. But his oversimplified interpretation of the constructive theory blinds him to the fact that he has in no sense refuted the constructive theory blinds him to the the heart of the constructive theory is not so much the contention that inferences about the visual world must be made on the basis of impoverished and hopelessly ambiguous sensory information (though ambiguity and incompleteness are sometimes encountered, to be sure), but rather the idea that perception is a *selective process* by which incoming sensory information is integrated and encoded. The task, then, becomes one of specifying not only the stimulus variables that influence these selective mechanisms—such as Gestalt principles of organization and "figural goodness"—but also the nature of the internal processes that transform sensory input, as complete and informative as it may be, into perceptual experience.

The selective and constructive nature of perception is evident at a variety of levels, from the neural mechanisms for information reduction and recombination known to exist in the primate visual system, to higher-order mechanisms such as attention and expectancy. Moreover, viewing perception as a constructive process provides a framework for understanding other internal, constructive processes—such as mental imagery, which can occur in the absence of any appropriate external stimulus.

While the constructive theory portrays the perceptual process as actively and selectively building an internal representation of the visual environment, the registration theory, championed by Kennedy, ascribes to the perceiver no more than the ability to be "tuned to the invariants of structure" in the optic array (p. 45). Kennedy's view of ordinary perception prevents his analysis of picture perception from considering such matters as the possible effects of expectancy and context on perception of pictorial representations. Missing, also, is any mention of the relevant work on scene analysis and picture grammars emerging from the field of artificial intelligence. Yet despite these shortcomings, Kennedy's book, as an attempt to extend a unified theoretical position to the perception of a variety of pictorial displays, may stimulate other perceptual psychologists to consider and explore the fascinating problem of pictorial representation.

LYNN A. COOPER
Department of Psychology, University of California, San Diego

Neuroscience

Essays on the Nervous System. A Festschrift for Professor J. Z. Young. R. BELLAIRS and E. G. GRAY, Eds. Clarendon (Oxford University Press), New York, 1974. viii, 512 pp., illus. $43.50.

More than a decade has passed since we faced the challenge of writing a discussion of an article by J. Z. Young addressed to the problem of the twinned brain. We can still recall the excitement—and the anguish—as we read his closely reasoned arguments, drawn with equal grace from data on structure, on function, and on behavior. His stimulus led us into constructions that we had not previously considered, and although our effort is disappointing, even embarrassing, to us on current rereading, it is at least indicative of Young's enduring capacity to stir ferment in younger minds.

The volume under review appears to provide another example of this phenomenon. In celebration of Young's 67th birthday, Bellairs and Gray have put together a bound document which fulfills almost all the potentialities of "festschriftery" with virtually none of its drawbacks. Here is a pride of talented neuroscientists, all marked by their present, or past association with Young, giving status reports of the fields they know best. Unlike most contributors to volumes of this kind, the majority show commendable restraint in quoting their own work, draw broadly on the work of others, and come close to offering us a handbook in microcosm. Most of the classic handbooks in neuroanatomy and physiology, and their modern counterparts, seem cut from similar goods; attempting to be definitive, they end up being interminable. Not so here, where excellent judgment on the part of the contributors, or sensible editorial control, or both, have made most of the chapters broad as to sampling, rich in content, concise in form, and sometimes audacious in conclusions.

As might be expected, the material is varied, ranging from ontogeny and differentiation, through synaptic morphology in a half dozen different systems, to respiratory neurons, the eternal problem of pain, and the possible central sites for learning. We found Wall's reformulation and extension of the gate theory of pain and Nadel and O'Keefe's discussion of hippocampal function in terms of cognitive mapping courageous if speculative. Similarly Colonnier weaves an ever-enriching fabric in cortical synaptology and spatial relations, and Boycott performs similar functions for the retina. Knowles recreates the early excitement over the concept of neurosecretion, and Merrill not only finds a function for medullary respiratory neurons but describes hitherto uncertain details of reticular axonal pathways with rather elegant antidromic microelectrode methodology.

It is necessary only to add that the editors have done the reader the courtesies of providing more than adequate indexes at the end and a businesslike history of the Anatomy Department at University College London, both before and during Young's stewardship, at the beginning. The Oxford University Press has performed its usual workmanlike job of supporting the project with solid binding, good typography, and satisfactory photographic reproduction. Unquestionably, this most satisfying volume does honor to Young, both in word and in deed.

MADGE E. SCHEIBEL
ARNOLD B. SCHEIBEL
Departments of Anatomy and Psychiatry, University of California Medical Center, Los Angeles

Honoring Dirac

The Physicist's Conception of Nature. Proceedings of a symposium, Trieste, Italy, Sept. 1972. JAGDISH MEHRA, Ed. Reidel, , 1973. xxiv, 840 pp., illus. $85.

To celebrate Dirac's 70th birthday in 1972, a mammoth conference was organized at the International Center for Theoretical Physics in Trieste. Dirac himself was there, together with the

other survivors of the little band of young men who created modern physics in the heroic years from 1925 to 1930 and a larger number of survivors from the less heroic years that came later. Everybody was invited to talk, on a not too technical level, about any subject not altogether unrelated to the life and work of Dirac. The talks were recorded, collected, and edited with a light hand by Jagdish Mehra. This book is the result. It has no unifying theme and very little structure. It is, in part, a collection of expository essays describing the present state of knowledge in various areas of science. It is also, in part, a mine of anecdotal history and personal reminiscence. It is also, in part, a gallery of self-portraits drawn by some of the most colorful characters of our century.

Mehra availed himself of the editor's privilege to include an 87-page monograph by himself entitled "Einstein, Hilbert, and the theory of gravitation." This is a substantial historical study, outlining the sequence of events that led the mathematician Hilbert to devote several years of his life to the elaboration of Einstein's theory of gravitation and to discover independently several of Einstein's main results. One of the striking features of this story is the intense personal respect that Einstein and Hilbert maintained toward each other, in spite of their sharp differences of viewpoint and their often overlapping discoveries. In those days, it appears, scientists were not only giants, but also gentlemen.

One of the contributions that will probably be of greatest interest to the unspecialized reader is "The origin of biological information," a 40-page essay by Manfred Eigen. This is a fragmentary but illuminating discussion of the difficulties that arise in trying to understand in Darwinian terms the prebiological phases of evolution. Eigen raises many questions and answers none. Because he is here talking in an informal and tentative manner, his statement is more convincing than the dogmatic article on the origin of life he published a few years ago in *Naturwissenschaften*. The problems of reconstructing possible pathways of prebiotic evolution in the absence of any kind of fossil evidence are indeed formidable. Successful attack on these problems will require, on the one hand, the boldness to imagine and create new concepts describing the organization of not-yet-living populations of molecules and, on the other hand, the humility to learn the hard way, by laborious experiment, which molecular pathways are consistent with the stubborn facts of chemistry. We are still at the very beginning of the quest for understanding of the origin of life. We do not yet have even a rough picture of the nature of the obstacles that prebiotic evolution has had to overcome. We do not have a well-defined set of criteria by which to judge whether any given theory of the origin of life is adequate. And yet, the origin of life is clearly destined to be one of the great themes in the science of the coming decades. It is a unifying theme, which will require the concerted effort of chemists, biologists, geologists, paleontologists, and perhaps even physicists, for its elucidation. Eigen has performed a valuable service in calling the attention of a new generation of physical scientists to the existence of this challenge. He has begun to ask some of the right questions. It is too soon to expect any answers.

Another chapter that may be recommended to the general reader is "From relativity to mutability," by John Wheeler. Wheeler, one of the greatest physicists now living, is also famous as a gifted teacher. He writes as he teaches, with exuberance and a ceaseless flow of poetic imagery. He leaves the students, even those who can grasp little of the technical substance of his argument, with a vivid impression of what it is like to be a creative scientist. His style of writing is so personal that everything he writes is a self-portrait. Recently he published an article entitled "From Mendeleev's atom to the collapsing star," which inspired some anonymous joker to circulate in samizdat a parody called "Rasputin and the transmogrification of science." The parody was so good that many of us suspected it could only have been written by Wheeler himself. Wheeler's chapter in this book might also have been written as a self-parody. It is Wheeler at his best, a man in love with science and intoxicated with the mystery of the universe.

The final section of the book is a record of the talks and unprepared remarks at the symposium banquet. Here are to be found some splendid "Dirac stories," told by people who know Dirac personally and have no need to invent or embellish. A "Dirac story" has always a special flavor that arises from Dirac's uniquely logical mind. The book ends with this one told by Eugene Wigner: "Once Polanyi, Dirac and I had a luncheon together and we discussed questions of science, society and all those things. All the time Dirac did not say a word. So when we went out I told Paul, 'Paul, why don't you speak up?' . . . 'There are always more people,' he said, 'willing to speak, than willing to listen.' "

FREEMAN DYSON
Institute for Advanced Study, Princeton, New Jersey

Books Received

Anthropology and Education. An Annotated Bibliographic Guide. Jacquetta H. Burnett with the assistance of Sally W. Gordon and Carol J. Gormley. Published for the Council on Anthropology and Education by HRAF Press, New Haven, Conn., 1974. viii, 160 pp. Cloth, $8; paper, $3.50.

Aqueous Dielectrics. J. B. Sasted. Chapman and Hall, London, 1973 (U.S. distributor, Halsted [Wiley], New York). xiv, 302 pp., illus. $18.50. Studies in Chemical Physics.

Aspects of Prehistory. Grahame Clark. University of California Press, Berkeley, 1974. xiv, 162 pp., illus. + Plates. Paper, $2.65. Reprint of the 1970 edition.

Astrophysical Concepts. Martin Harwit. Wiley, New York, 1973. xiv, 562 pp., illus. $14.95.

Atlas of Binary Alloys. A Periodic Index. Karl P. Staudhammer and Lawrence E. Murr. Dekker, New York, 1973. xx, 92 pp., illus. $19.50. Monographs and Textbooks in Material Science, vol. 5.

An Atlas of the Mammalian Ova. Shuetu Suzuki. Igaku Shoin, Tokyo, 1973. xii, 140 pp., illus. $34.

Biological Mineralization. Isadore Zipkin, Ed. Wiley-Interscience, New York, 1973. xviii, 900 pp., illus. $45.

Biological Systematics. Herbert H. Ross. Addison-Wesley, Reading, Mass., 1974. vi, 346 pp., illus. $12.95. Addison-Wesley Series in Biology.

The Biology of Animal Viruses. Frank Fenner, B. R. McAuslan, C. A. Mims, J. Sambrook, and David O. White, Academic Press, New York, ed. 2, 1974. xvi, 834 pp., illus. $48.

Biology of Microorganisms. Thomas D. Brock. Prentice-Hall, Englewood Cliffs, N.J., ed. 2, 1974. xii, 852 pp., illus. + plates. $15.95.

The Biology of the Algae. F. E. Round. St. Martin, New York, ed. 2, 1974. viii, 278 pp., illus. Cloth, $19.95; paper, $8.95.

Black Holes. The End of the Universe. John Taylor. Random, New York, 1974. 176 pp. $5.95.

Block and Graft Copolymerization. Vol. 1. R. J. Ceresa, Ed. Wiley-Interscience, New York, 1973. xviii, 372 pp., illus. $24.95.

Blueprint for Medical Care. David D. Rutstein. MIT Press, Cambridge, Mass. 1974. xxvi, 284 pp. $8.95.

Chemical Applications of Molecular Beam Scattering. M. A. D. Fluendy and