model of the individual neuron is formulated. This model is then used for the analysis of small nets, for example, of the kind that Lorente de Nó found in the spinal cord in 1937. The mathematical model is a cybernetic standard: a discontinuous threshold element receives a weighted linear combination of suitably delayed signals, and in due course emits an impulse for suprathreshold excitation. Propagation down the myelinated axon is represented by the rectangular pulse response of a passive *RC* cable, the pulse being regenerated at nonmedullated nodes. The model does not take account of any of the nonlinearities of function that follow from the spatial organization and time-dependent selective permeability of the neural membrane, save for the existence of a threshold for the emission of an action potential. Even such a simplified model is not sufficiently tractable for the analysis of small nets, and a semilinearized model is used in which the threshold nonlinearity is replaced by a linear ramp function. Nets of such semilinearized model neurons suffer from the defect that they modulate pulse amplitudes and widths, as well as pulse rates. This model is therefore invalid for a single neuron. It is claimed that this doesn't matter because a meaningful response in an organism is generally the algebraic sum of many individual responses. In my view this begs the question. For the analysis of small neural nets, a most precise rendering of the individual neuron is required, for it is details that count: space and time constants for conduction, the changes of threshold that we call adaptation and accommodation, and so on.

The second part of the book is quite different in that large scale models of the sensory and motor cortices are constructed. It is assumed that any cross section of the cerebral cortex that contains many neurons can be regarded as approximately uniform, and the cortex as a whole is taken to be a slab 48 centimeters long, 48 centimeters broad, and from 1.5 to 4 millimeters high, containing 10 billion neurons; that is, the slab is about 40 to 100 neurons thick with a mean spacing between neurons of about 40 microns. The basic idea is that the slab comprises many character-recognizing nets feeding, via reverberatory circuits for short-term memory, into long-term memory stores analogous to conventional digital computer stores. The character-recognizing nets are constructed, again in a standard cybernetic manner, from stimulus-amplitude-matching neurons (first used by W. K. Taylor about ten years ago) feeding into layers of AND-gate matrices followed by OR-gates followed by AND-gates. The signals issuing from such nets are invariant to changes of stimulus amplitude. In the auditory model there are also delay systems so that the output signals carry a representation of the basilar membrane responses, averaged over one or two seconds. In the visual model the final amplitude-invariant signals carry contrast and color information. These signals are then fed into a further net comprising short-line extractor neurons—SLEN's—followed by two more layers of AND-gates, reminiscent of the feature-detectors of Hubel and Wiesel. In such a way are "characters" transmitted to the memory systems. It is conjectured that scale and rotational invariances are obtained either by a transformation from polar to semilogarithmic coordinates or by multiply redundant representations of suitably transformed characters. An interesting feature of these character-recognizing nets is that stimulus-amplitude invariance is obtained by computing the *ratios* of stimulus amplitudes, in the AND-gate matrices that succeed stimulus-amplitude-matching neurons. In the model of the motor cortex, programmed sequences of motions are read out of long-term memory either by a noise generator in infancy or by association fibers from the audio, video, and somatic stores, via suitable decoding nets, into appropriate sequences of skeletal muscle groups. There is, however, no discussion of the role played by the cerebellum in such activity.

It is claimed that the analysis of neural models which are sufficiently simple that they are mathematically tractable can yield insights into the functional mechanisms of the organism, and also that "It may be true that 99% of the models are wasteful mutations, but the 1% that survives is more than sufficient justification for model making. Wild conjecture is a shock front that always accompanies the advance of science." No doubt this is true, but of course what determines the survival of 1 percent of the models is that in addition to providing plausible explanations of the working of neural machinery, they fit the facts of neuroanatomy, of neurophysiology, of neuroembryology, of experimental psychology, and so on. It is no longer sufficient to invent plausible models of possible nervous systems. In my view this is the major weakness of the second part of the book: the model is very far away from contemporary neuroanatomy and neurophysiology. There is no real attempt to connect the postulated structures and their activities with the data that have been obtained from electrode studies. On the other hand it seems likely that sharp predictions could be made concerning, for example, the activities of neurons in the postulated stimulus-ratio-taking matrices.

These caveats notwithstanding, the book as a whole is quite stimulating and should prove of interest to those workers in the neural sciences who are interested in models; but it is not to be recommended as an introduction to neural modeling for those bioengineers who have not had exposure to "wet" neurophysiology and anatomy.

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Gondwanaland

The Precambrian. Vol. 3. KALERVO RANKAMA, Ed. Interscience (Wiley), New York, 1967. viii + 325 pp., illus. $17.50. The Geologic Systems.

This volume is the third in a series which will provide regional summaries of Precambrian geology of the entire world. It offers reviews by six authors on the Precambrian in and around the western Indian Ocean (India, Ceylon, the Seychelles archipelago, and Madagascar) and in the Republic of Congo, Rwanda, and Burundi.

The Precambrian rocks occupy about two-thirds of peninsular India and some parts of the Lesser Himalayas in the extrapeninsular region. The author writing of the Indian shield has spent 40 years in its study. He recognizes five cycles in its geologic history, ranging in date from more than 2605 million to 500 million years ago. The Precambrian of peninsular India continues into Ceylon occupying nine-tenths of the island. Here the Precambrian Khondalite series has produced the variety of precious and semiprecious stones for which Ceylon is famous. The author suggests a new age of 1050 million years for the

series, placing it in the Eastern Ghats cycle of India.

The Seychelles archipelago, a group of rugged islands in the western Indian Ocean, consists of almost wholly Precambrian granites (650 million years old). It has been suggested that these granites are remnants of Gondwanaland left behind after continental drift. Further geophysical and marine geological research will shed more light on this speculation.

Precambrian rocks occupy two-thirds of the island of Madagascar. The island has been extensively surveyed and completely mapped in less than 40 years. Six cycles of geological evolution in the Precambrian are recognized, ranging in date from more than 2420 million to 1060 million years ago.

The chapter on the Precambrian of the Congo, Rwanda, and Burundi is extensive and makes up more than half of this volume. The authors of this chapter divide the area into five districts and recognize five cycles, ranging in date from more than 3000 million to 500 million years ago. One of the cycles (Katangan cycle) in Katanga is world renowned for its mineral deposits (Cu, Co, Zn, and U). The senior author is coauthor of *The Geochronology of Equatorial Africa* (1966), which presents more geochronological data.

English-speaking geoscientists will welcome the reviews on Madagascar, Congo, Rwanda, and Burundi, since much of the existing literature is in French and in journals that are not readily available. It is convenient to have the reviews of the Precambrian of Gondwanaland collected in one volume.

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Anthropology Today

Biennial Review of Anthropology, 1967. BERNARD J. SIEGEL and ALAN R. BEALS, Eds. Stanford University Press, Stanford, Calif., 1967. x + 368 pp. $9.

Anthropology is fortunate that Bernard Siegel (joined now for the first time by Alan Beals) devotes so much care to his series of biennial reviews. Having said that—and it is true—I must record finishing the 1967 volume with considerable malaise. The discomfort has two sources, as far as I can tell: the editors have, by sticking to the recognized subdivisions of anthropology, missed the main point; and most of the contributors have, by looking at the diversity within their specialties rather than the way they fit into the rest of the subject, obscured it even further. Individually, editors and authors have done their jobs well. But what emerges is a discipline suffering from hyperdevelopment of isolated nuclei.

In the first decade and a half after World War II—before general systems theory had diffused and before primatology and the new archeology had flowered—it was stylish to argue that the unity of anthropology was an artifact of men such as Boas and Seligman, who could make sweeping contributions to the several branches of the subject because it was an infant subject. What good, some of us asked, could physical anthropology do a social anthropologist? What use linguistics to an archeologist?

But things look different today—and that difference is not reflected in this book. Most branches of anthropology have not quite caught up with the new unity sufficiently to create the broad generalizations that will make that unity obvious to all. But unity is nevertheless coming on strong. Therefore, one has the feeling that these up-to-date summaries are out of pace with the times.

Three articles ably summarize contributions on language and the relationships between linguistics and anthropology (Durbin), on physical anthropology (Bleibtreu), and on social organization (Tyler). There is no need, in any of these fields, for a "new view."

Two articles do provide needed new views: MacNeish on Mesoamerican archeology and Halpern and Brode on peasants. MacNeish's new view emerges both from a great deal of new work and from methodological innovation. It is made clear that one of the problems in archeology is that progress necessitates not merely the rewriting of the subject but the rewriting of history itself. The long article on peasants needs special comment because, I suspect, it will come to be a "funnel" through which all future research will pass. As such it is useful—and demands high standards when we criticize it. Brode's contribution to the article is a review of economic anthropology which unfortunately will prolong the myth of serious breach between the followers of Karl Polanyi and everybody else. It is a great pity that this fuss (there is no other word for it) should not, in this of all contexts, have been cleared up. The dispute grows out of a failure to distinguish unstated assumptions about peasant economy on one hand and "primitive" economy on the other. Halpern's part of the article deals with a summary of everybody's—but *everybody*'s—definition of "peasant," with the political aspects of "peasant society," and with the place of "peasants" in a continuum between tribal peoples and urban peoples; there is a review of peasants in the Soviet setting and elsewhere, and some comments about American attitudes toward peasants.

Finally, there are two articles that prove conclusively that at least two of the subdisciplines of anthropology must either reform or perish: Pelto's on the wasteland of psychological anthropology and Murphy's on the lumber room of culture change. Murphy does the sensible thing—he gives the bibliography and reviews briefly four of the contributions he most admires. Pelto has more stamina: he tries to arrange the contributions of psychological anthropology in some sort of order to bring sense into the field. He notes that this specialty is becoming constantly less enchanting. I agree, and would add that perhaps the reason is that comparatively few contributors to it (from either side) know both anthropology and psychology. He says that interest in psychoanalysis is waning; that may be true, but I suspect that the number of anthropologists who actually know something about psychoanalysis rather than merely are "influenced" by it is growing. Pelto's arrangement is an admirable tour de force, but I think he has not been firm enough in his judgments or harsh enough in his criticisms.

The good of the biennial review is that the articles set a useful bibliography into context. Specialists can and will use them. But the book, taken as a whole, does not give an overview of anthropology during the years that are covered. I hope every specialist whose subfield is covered in this book will buy a copy. I also hope that nobody will judge the condition of the entire discipline by it.

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