more, there is little new in a methodological sense. Chang's statement of methodology is essentially a series of definitions of concepts, lacking clearly specified guidelines as to how one might actually go about discovering the organizational features of prehistoric societies. Trigger's paper, though more clear in this regard, reaffirms the traditional method of simply applying inferences drawn from ethnographic data to the archeological record, without adequate test. Methods of analysis also remain unchanged, since the implication is that, once sociological traits have been described, the analytical goal is to place them into foci, phases, and so forth—as has been done traditionally with artifacts. One must conclude, in agreement with Willey's appraisal, that the newness of this endeavor lies primarily in the nature of the data being examined. Instead of making inferences solely from the traditionally considered kinds of artifacts, settlement archeologists are making inferences from a previously inadequately examined class of artifacts—the structures, village plans, and site distributions of prehistoric peoples.

It is also important to note that although Chang conceives of the settlement approach as a beginning toward a science of society, there is little indication in the primary methodological papers (Chang and Trigger) that what are generally accepted as goals and methods of science are being advocated or employed. There is, for example, no indication of interest in explaining variability and change in social organization. Thus far, the goals appear to be primarily descriptive. Science attempts more than this; it involves a commitment to the search for nomothetic principles—laws or generalizations of process. In addition, this book lacks an awareness of accepted hypothesis-testing procedures; this too is fundamental to a science.

Nonetheless the book is important. It is important because of the continuing claim that settlement studies represent a new approach. It is also important, however, because it does present a departure from tradition—it provides a further demonstration that settlement data are indeed useful in drawing inferences about the ways in which past human societies were organized. The many specific examples (both real and expected) of the relationships between social organization and settlement characteristics are stimulating and useful. And further, these relationships are frequently presented in the form of descriptive cross-cultural generalizations. Such relationships are just beginning to be discovered, and the effort to find them must be encouraged.

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Heterogenetic Organisms

Plant Chimeras. W. NEILSON-JONES. Second edition. Methuen, London, 1969 (U.S. distributor, Barnes and Noble, New York). viii + 124 pp., illus. $4. Methuen's Monographs on Biological Subjects.

A chimera is defined as an individual organism composed of tissues of more than one genotype or plasmotype, the difference being maintained by continued growth of a terminal meristem. Thus unique to higher plants, chimeras are properly distinguished by Neilson-Jones from such other heterogenetic forms as grafts, transplants, and mosaics. The modern spelling has been adopted to avert confusion with the elasmobranch genus *Chimaera*. Of various types, the periclinal chimera, in which each cell layer is genetically homogeneous, is the most stable and most useful experimentally. Numerous varieties of vegetatively propagated horticultural species exist in a periclinal condition.

The general subject is presented skillfully according to its historical development. It is revealed how the early "graft hybrid" hypothesis was supplanted by Baur's chimera concept, now verified in scores of examples. As is typical of science, the exceptional cases often prove to be the most interesting ones. The composition of mature organs of periclinal chimeras was clarified by the discovery that the subepidermal layer, initiated as a layer of single-cell thickness, can thicken by anticlinal divisions. Anomalous variegations in certain monocots revealed extensive invasion of one layer by another even though the periclinal chimera maintains its integrity near the meristem.

Paraphrase of the contents of the first edition constitutes two-thirds of the new edition, updating being restricted almost entirely to the remainder of the text. The early portions are belabored and redundant examples of chlorophyll variegation presented at the expense of important new developments. For example, the classical research by Satina and her colleagues on *Datura* cytochimeras is treated briefly; although these workers successfully traced the origins of all parts of the leaf and flower to the respective histogenic layers, reference is made only to their research on the ovule. Also missing are accounts of: the demonstrations by Asseyeva, Crane, and Simmonds that mutants and established varieties of potato are periclinal chimeras with cores of other known varieties; Howard's x-ray-induced reconstitution of entire meristems from the epidermal layer in periclinal chimeras; and Günther's chimera of *Lycopersicon peruvianum* and *L. esculentum*, which breeds as the former but displays the self-compatibility and interspecific compatibilities of the latter. The extensive research on various problems in chimeras from induced mutation is scarcely mentioned.

For proper balance the book should have included additional applications of chimeras. Michaelis revealed how chimeras can be utilized to trace the origin of plasmon mutants and to discriminate between various hypotheses of origin. Fascinating mechanical discontinuities are known between component tissues of certain chimeras, and interactions of a nutritional or regulatory nature might be envisioned from the wealth of combinations that can be effected between species or between genotypes within species. Clearly a subject of such broad biological interest deserves a general treatment. Neilson-Jones's book provides the closest available approximation.

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Tools in Biology

Glass Microelectrodes. MARC LAVALLEE, OTTO F. SCHANNE, and NORMAND G. HEBERT, Eds. Wiley, New York, 1969. xviii + 446 pp., illus. $22.50.

Since the papers of Ling and Gerard 20 years ago, the glass microelectrode has been constantly used and abused by biologists in their attempts to ascertain the internal conditions of cells and the properties of the membranes. This collective volume is of practical help to experimentalists who make and use electrodes; some of the 19 contributions are of as much relevance to macro- as to microelectrodes, notably the chapters dealing with the choice of

the optimal internal filling of *p*H electrodes and with the adsorption of ions on electrode glasses. One sees on the one hand how temperature sensitivity can be minimized and on the other the origin of transient effects on electrode potential in response to changes of external solution. The importance of surface conductance, due to adsorbed ions, is stressed, and it appears that the ion selectivity of the outer layers of fixed groups may differ radically from the property of the glass as a whole. These adsorbed ions and the consequent ion selective channel give rise to the "tip potential," well known as an artifact to users of open microelectrodes. There is evidence that a trace of thorium salt in the fillant markedly lessens the source of uncertainty. Design details of electrodes for measuring intracellular *p*H and concentrations of K, Na, Cl, and Ca are to be found, together with discussion of sources of interference. Most contributions are from biologists who provide examples of the results obtained with their devices. We see that, in agreement with earlier data, the internal *p*H of nerve and muscle cells remains just over 7 when external *p*H is varied between 5 and 8; only carbon dioxide is effective in producing acidity. The activity coefficient of internal potassium is about 0.7, as predicted from solution data, but that of internal sodium is only about 0.4. A Russian group points out the similarity of this reduction to one obtained by incorporating the sodium salt with polyacrylamide. Intracellular chloride can be measured by a Ag-AgCl electrode situated internally at the base of a glass microelectrode into which cytoplasm moves by capillarity. A micro-*p*H-electrode has the *p*H-sensitive glass as a fine open capillary tube into which the sample is sucked; the outside of the capillary tube corresponds to the inside of the conventional bulb type. A microversion of an ion-exchanger fluid Ca electrode can be used to measure the concentration of the ion down to 0.1 m*M*, though care has to be taken to correct for interference from the other ions present. A microscale oxygen cathode is described. It was applied to show the depletion of oxygen at the core of a small (about 1 mm diameter) bundle of muscle fibers when they were made to contract. To minimize the depletion it is necessary to use a high oxygen tension, for example, with 98 percent O_2. A rate of 30 impulses a minute could be tolerated, but it is also important to interpose rest periods, because the oxygen at the core takes a minute or so to return to the resting level. Injection of substances into cells is discussed. Uncharged molecules can be introduced by ultrasonic vibration of a micropipette inserted in the cell; the technique has been used with fluorescent markers.

The methodology of using microelectrodes, including twin and concentric variants, is described. Particular chapters are devoted to the retina, cytoplasmic resistance, and heart muscle. The problem of extracting the membrane resistance from the input resistance when one is dealing with a syncytial structure is attacked by use of a number of alternative models of the cable analogue. Circuitry for voltage clamping and for neutralizing cross talk between channels fed from twin electrodes is useful to have for reference. A section describing the phenomenology in its own jargon of biological membranes may serve by contrast to direct attention to the use of model systems (such as Rudin and Müller's bilayers doped with ionophores). The electrodes and techniques described in this volume should help the biologist to obtain physicochemical data from his material. Where we can with models match the behavior of the living membrane, there is every hope of speedy progress in our understanding.

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Particle Theory in 1967

Fundamental Particle Physics. 1967 Tokyo Summer Lectures in Theoretical Physics. GYO TAKEDA and YASUA HARA, Eds. Syōkabō, Tokyo; Benjamin, New York, 1968. xii + 180 pp., illus. $8.50.

The Tokyo Summer Institute of Theoretical Physics has been held for about a week every summer since 1965 in Oiso, a famous beach site 40 miles west of Tokyo. The lecture notes have been edited by G. Takeda and his collaborators and published each year. The book under review is the third in the series and contains eight articles on theoretical particle physics. The topics and authors are: universality and symmetries of hadrons, P. G. O. Freund; chiral dynamics, Y. Yamaguchi; current algebras, S. M. Berman, T. D. Lee; *CPT* and weak interactions, T. D. Lee, K. Nishijima, M. Gourdin; and Regge poles, N. Nakanishi. Each of these articles is a short, comprehensive review of the author's own recent work. They are valuable for senior graduate students and research workers who intend to study the general ideas and developments in these specialized topics without engaging in the delicate technical details. Since the character of these articles is more or less the same, let me as an example review Yamaguchi's article with some detail.

One of the central activities in particle theory around 1967 was to describe the chiral invariance of hadronic interactions in terms of a phenomenological (or effective) Lagrangian from which various hadronic reaction amplitudes are calculated by a simple prescription based on the perturbation theory. One of the intentions was to obtain the results of current algebra (previous fashionable activity) with considerable economy. A simple, elegant approach due to Ohnuki and Yamaguchi is well described in this 18-page article. The article is self-contained and very comprehensive. Although many papers on this topic have been published since then, I think the basic ideas and techniques of the phenomenological Lagrangian approach are all here. The article would be appropriate for the person who wants to learn the basics of the approach rather than its whole development. For the latter, the current literature of the time must be read.

This judgment may be applied to most of the articles in the book. The book is also valuable historically as a synopsis of the activities in particle theory around 1967.

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Books Received

Abundant Nuclear Energy. Proceedings of a symposium, Gatlinburg, Tenn., August 1968. W. W. Grigorieff, Coordinator. Division of Technical Information, U.S. Atomic Energy Commission, Oak Ridge, Tenn., 1969 (available as CONF-680810 from Clearinghouse for Federal Scientific and Technical Information, Springfield, Va.). vi + 354 pp., illus. Paper, $3. AEC Symposium Series, vol. 14.

Advances in Geophysics. Vol. 13. H. E. Landsberg and J. Van Mieghem, Eds. Academic Press, New York, 1969. x + 270 pp., illus. $14.50.

Advances in Physical Organic Chemistry. Vol. 7. V. Gold, Ed. Academic Press, New York, 1969. x + 354 pp., illus. $13.50.

(Continued on page 419)