of the structures, even for the most discussed operant, hippocampal theta rhythm.

Theoretically the behaviorist view is again the most strongly represented; nowhere is any more complex a view of conscious awareness presented than that it is an internal response. The most extreme of these papers is that by McGuigan, who argues for a modified version of the motor theory of thought, maintaining that one cannot think well without the involvement of the musculature, particularly that concerned with speech. It is unfortunate that no clinical neuropsychologist pointed out in the discussion of this paper that peripheral dysarthria, which prevents speech, leaves thought totally unaffected.

A few of the papers do move well away from a behaviorist orientation. Chapman relates evoked potential and information-processing tasks in the style of Posner and Sutton. Paivio discusses the psychophysiological correlates of imagery. Unfortunately these studies of his seem much less successful than his better known studies using orthodox experimental-psychological methods. Sperry discusses what has been learned from split-brain patients about the neuropsychology of cognition. This is an excellent survey of the field, but split-brain work has by now been surveyed a number of times and it is not clear that this particular disconnection syndrome provides so much more information than other neurological syndromes as to merit its greater popularity among researchers. One major lacuna of the book is the absence of any discussion of frontal lobe and aphasic syndromes, obviously directly relevant to its theme.

One paper that stands out is that by the McNeilages on the central processes controlling speech production. Almost alone, it begins from a theoretical perspective, outlining alternative models of the speech production process. The models, which are of considerable complexity, are then compared with reference to a number of different types of evidence, from the peripheral physiology of the speech musculature to the nature of speech errors. This theoretical orientation enables different types of evidence to be related through a structural model of a subsystem which may reasonably be conceptually isolated within a total model of brain function. This procedure contrasts with the methodology common among the other papers, a relatively atheoretical correlating of different types of measure. The McNeilage approach is much more similar to that used successfully in relating different levels of explanation in other areas of science and thus seems more appropriate for relating conscious experience with neurophysiology and information processing.

TIM SHALLICE
National Hospital for Nervous Diseases, Queen Square, London, England

Cell Movement

Locomotion of Tissue Cells. Proceedings of a symposium, London, Aug. 1972. Associated Scientific Publishers (Elsevier, Excerpta Medica, North-Holland), New York, 1973. viii, 382 pp., illus. $20. Ciba Foundation Symposium 14.

This symposium was prompted, as Michael Abercrombie, the chairman, points out in his introductory remarks, by the knowledge of how widespread actin and myosin are in metazoan cells, the recent advances in understanding muscle contraction at the molecular level, and the recent refinements of experiments on living cells that are converting into functional terms the steadily improving picture of the microarchitecture of the cell. The content of the symposium extends beyond an attempt to understand the locomotory machinery per se and provides an evaluation of many factors that regulate cell movement in culture and during development.

The overall role of microfilaments and microtubules in cell locomotion is soundly evaluated. In addition, a diverse range of motile phenomena expressed by the cell surface are dealt with. An attempt is made to integrate into a coherent picture of cell movement such properties and phenomena as membrane fluidity, surface particle movement, formation and behavior of lamellipodia and microspikes, and exo- and endocytosis. Opposing mechanistic viewpoints emerge to account for these phenomena, but the approach is highly successful in that it draws attention to potential mechanisms whereby the cell surface transmits the translational forces of cell movement to the substrate and receives environmental cues that modulate cell movement.

The contact behavior of cultured cells is reevaluated in the light of a large input of new information. The factors underlying monolayering and the phenomenon of contact inhibition and its role in establishing and maintaining supracellular organization are clarified as a result of a series of incisive and spirited discussions.

Of considerable significance are two papers that take a pharmacological approach to such diverse phenomena as cell movement in the developing sea urchin and exo- and endocytosis. The papers emphasize the need to extend this approach to the regulation of cell movement in the intact organism. A single paper deals with the relationship between cell adhesiveness and movement and puts forward the theory that cells can adjust their motile processes to compensate for changes in cell adhesion. Although it is criticized in the ensuing discussion, the theory is highly attractive if only because this possibility has been largely overlooked in studies of cell movement.

As a whole the symposium will serve as a sound introduction to the subject and as a powerful reminder for the expert of the many phenomena that are directly involved in, or that profoundly modulate, the locomotion of tissue cells.

COLIN S. IZZARD
Department of Biological Sciences, State University of New York, Albany

Relations among Invertebrates

Embryology and Phylogeny in Annelids and Arthropods. D. T. ANDERSON. Pergamon, New York, 1973. xiv, 496 pp., illus. $24. International Series of Monographs in Pure and Applied Biology: Zoology, vol. 50.

During the past century a large number of descriptive studies of the development of representatives of the annelids and arthropods have accumulated. The embryologists involved have for the most part limited their attention to a restricted group, or at best to no more than one major one, and, not surprisingly, a variety of terminologies, points of emphasis, and interpretations have emerged. Communication among these embryologists and synthesis of their findings by others has proven difficult if not impossible.

D. T. Anderson is exceptional in this field in that he has carried out extensive studies on representatives of many of the major groups of segmented invertebrates. This publication is an attempt on his part to bring order to the complicated and confusing situation in an effort to utilize the facts of