which could well have wider application. Other papers touch on the historical aspects of the subject, stereotactic surgery for intractable pain and some clinical anomalies of pain sensation. The humanitarian interests of the sponsors are represented by two papers on the avoidance of unnecessary pain in laboratory experiments.

A printing error on p. 241 has resulted in part of the text being omitted and leaves one Table unexplained. This seems to merit an erratum slip in future copies sold.

A. M. HALLIDAY.

Macromolecular Specificity and Biological Memory. Edited by F. O. SCHMITT. The Massachusetts Institute of Technology Press. 1963. Pp. 119. Price $23.

The somewhat forbidding title of this book conceals an account of a very remarkable symposium held at Massachusetts Institute of Technology in the spring of 1961. Its purpose was to probe informally into the possible mechanisms for the coding, storage and recall of memory traces in neural tissue. The outcome is as exciting and stimulating as the list of the distinguished participants would suggest. This includes R. D. Adams, M. P. Barnett, Fernández-Morán, Galambos, D. Gitlin, H. Hydén, V. M. Ingram, Kliver, Lorente de Nó, Morrell, Polay, F. O. Schmitt and O. H. Schmitt, Sperry, Tallant and others. Each contributed to the speculations, but brought also a summary of solid, original and often startlingly new work bearing upon the subject. It is not uncommon nowadays to read reviewers criticizing the growing custom of publishing proceedings of symposia and conferences. There may well be some truth in such criticism, but how else is one to record material as valuable as this together with the relevant bibliography, all in the space of 117 pages?

Some of the first contributions in this volume deal with the cybernetic aspects of the problem, and these are followed by a discussion of the genetic problems posed by protein specificity and its possible modifiability by nerve impulses. The distinctive property of nerve cells, besides conduction of impulses, is their large content of cytoplasmic RNA and the ability to produce correspondingly large quantities of protein. The amount of RNA increases up to a point with the age of the individual, and this suggests that this substance and the proteins produced by it play a leading part in the storage of memory traces. An analogous process is perhaps the production of antibodies in certain somatic cells. It is not surprising therefore that much of the discussion was concerned with the dynamic aspects of RNA composition in nerve and glial cells. Electronmicroscopical studies of neurons and glial cells coupled with biochemical investigations of the various parts of these cells obtained by ultracentrifugation have shown the untenability of some of the classical concepts in the neuron theory. In particular, the old "class structure" of the cellular population in neural tissue, with the subservience of glial cells to the more aristocratic neurones is coming under a long-overdue attack. New data show that the glial cells fill almost entirely the space between capillaries and neurones, except at synapses. But they are not only the active substrate of the blood-brain barrier, but seem themselves able to propagate impulses, which are, however, different and, perhaps, complementary to those of neurones. Glial cells are probably also coupled reciprocally with neurones in the dynamic changes occurring in the RNA bases during activity. Furthermore, the hierarchical concept of glial structure is undermined still further by the demonstration of a lack of clear-cut distinction between the various kinds of glial cells. Other contributions deal with the neurophysiological aspects of learning and the psychological implications of this problem, and, finally, there are also a few brief clinical reports on the amnestic syndrome.

It would be impossible to claim that all the contributions could be understood by many readers. Some are too specialized. In fact, if there are still clinicians harbouring illusions about their ability to keep abreast with the basic sciences, let them try this book as a kind of do-it-yourself psychometry. Yet no one can possibly finish reading it without learning much that is fresh and challenging.

L. CROME.

The So-called Extrapyramidal System. Edited by SIGVALD REFSUM, HANS M. LOSSIUS and PER DIETRICHSON. Copenhagen, Stockholm, Göteborg: Universitetsforlaget. 1963. Pp. 363. Price 50*s*.

This volume (also published as supplement 4, Vol. 39, 1963, to *Acta Neurologica Scandinavica*) consists largely of the report of a Symposium at the 16th Congress of Scandinavian Neurologists at Oslo in 1962, dealing with the extrapyramidal system; there are a further 100 pages on free subjects (including an interesting investigation on vessel-plaque relationships in disseminated sclerosis). One outstanding paper from the Symposium is a consideration of the anatomy by Brodal, who emphasizes that it is not possible to separate anatomically the pyramidal and extrapyramidal systems. Broman reports on the figures for Parkinson's disease obtained from a survey of the frequency of various neurological disorders in

Götegorg (population about 400,000). This survey should yield badly-needed figures on prevalence-rates, and the final results will be eagerly awaited, as will those of a similar survey being conducted at the present time by Dr. Henry Miller in Carlisle. Autopsy studies are reported by Norhølm and Tygstrup on 12 patients who had had stereotaxic operation: the best clinical results were in four patients in whom there was an extensive lesion of the internal capsule, whereas two operations producing lesions restricted to the ventro-lateral thalamic nucleus were ineffective.

R. T. C. PRATT.

Brain Function and Metabolic Disorders. By BARRY WYKE. Butterworths. 1963. Pp. 242. Price 50*s*.

The title of this book is misleading and was not, I suspect, chosen by the author. The subtitle, "The Neurological Effects of Changes in Hydrogen Concentration", is a better guide to its contents. Dr. Wyke presents a thorough review of the effects of changes in the partial pressure of carbon dioxide on the electrical activity of the nervous system as assessed by electro-encephalography. He summarizes our knowledge of the effects of changes in pCO_2 on nervous conduction, on the responses of the reticular activitating system and on neurologically isolated parts of the C.N.S., and shows how this knowledge can form a basis for speculation about the overall effects of changes in pCO_2.

The difference between the effects of changing pCO_2 and changing blood pH is emphasized, and it is suggested that the ability of dissolved CO_2 to penetrate the cell membrane is involved. Wisely, he does not attempt to explain how the intracellular CO_2 produces the observed changes in electrical activity. He discusses the effects of changes in pCO_2 and pH on blood flow and convincingly shows that the neurological effects are not merely secondary to circulatory changes.

This is a careful and detailed compilation. The References and Index occupy 77 pages. The textual errors are few—the calculation on page 1 is incorrect, the legends to Figures 4 and 14 both have errors in their final sentences. Dr. Wyke's prose style is heavy and repetitious and his habit of inserting multiple internal cross-references may help the casual reader but will irritate any serious reader.

This book provides a summary of data of great interest to the respiratory physiologist, the anaesthesiologist and the animal physiologist. All these groups may benefit from an awareness of the variations in reflex responses, cerebral activity and depth of anaesthesia that may follow changes in arterial pCO_2.

B. S. MELDRUM.

Die Gedeckten Schäden des Gehirns (Closed Injuries to the Brain). Experimental Investigations with One, Two, or Repeated Blows with a Blunt Instrument to the Skull. By FRIEDRICH UNTERHARNSCHEIDT. Berlin, Göttingen, Heidelberg: Springer-Verlag. 1963. Pp. vi + 124 and 67 illustrations. Price DM. 48.

There have been many clinical investigations of patients who have received repeated blows to the head. These include epileptics and also athletes such as boxers and even soccer players, who can repeatedly head a wet football. However the actual physics relating to the stresses applied to a loose body like the brain attached to the inside of a closed box, the skull, have not hitherto been adequately studied, nor has the application of an increasing degree of force to an animal skull either on one or several occasions. The author used a concussion gun, mostly on cats but also on rabbits. The intensity of the blow, the number of blows, and the period of survival until the animal was sacrificed, as well as the pathological findings, are fully recorded. The minimal blow necessary to produce commotio cerebri, unconsciousness, subsequent paralysis, etc. without fracturing the skull, were noted. The blow was generally applied from above. A distinction was made between pathological changes appearing at the moment of impact and secondary reactive changes occurring later, as the result of alterations in the blood circulation. For instance, where a single blow failed to produce any pathological changes or alterations in behaviour (sub-concussional), repeated blows of this character caused secondary organic changes. Such changes were chiefly in the cerebellum with fall out of cells and proliferation of glia. Changes in the cerebral hemisphere were less marked but consisted of scattered ischaemic alterations of nerve cells and proliferation of glia in the white matter.

A single blow sufficient to cause commotio cerebri produced no discernible organic changes but repeated blows caused in addition to the ischaemic changes mentioned, widespread necrosis of parenchymatous cells. These again were secondary effects dependent on circulatory changes.

The character of these secondary changes is different according to the period of time occurring between the blows. If these followed at intervals of one or two days, secondary changes occurred in the cerebral hemispheres in the form of foci of necrosis of parenchymatous cells. These changes were organic