afternoon before the excursionists found anything archaeological to examine.

This is not to imply that the author's book is not a valuable addition to the literature of a rapidly growing subject. Even viewed as a short history of the chemical industry it is full of clues to follow up. Of particular value to the historian of technology are the later parts of the book with its hints on "where to find the facts", a table of works registered under the Alkali Act of 1863 (and we must remember that parliament's idea of an alkali is quite different from that of a chemist), a gazetteer locating the germinal foci of ICI's vast empire, and giving the locations of about a score of existing chemical firms founded more than a century ago.

A modern poet might wax lyrical over a cat-cracker; no early chemical works was a thing of beauty, but if W. A. Campbell's book does nothing more than stimulate interest to get more information about the origins of our industrial history on to the files, and existing archives into safe keeping, it will serve a very useful purpose.

ARCHIE CLOW

Behavioural Biology

The Biological Bases of Behaviour. By Neil Chalmers, Roberta Crawley and Steven P. R. Rose, assisted by Judy Hicklin. Pp. 318. (Harper and Row: New York and London, November 1971.) (Published for the Open University Press.) £5 cloth; £2.75 paperback.

THIS book is a "reader"—a collection of reprints from the *Scientific American, Science Journal, Nature* and various other journals and books, chosen by the editors in relation to a second-level course organized by the Open University on the biological bases of behaviour. The articles cover a wide range of neurobiological subjects from the basic structure and function of the nervous system up to emotion, learning, intelligence and mind. The numerous authors include some of the best-known people in the field, for example, Eccles, Katz, Huxley, von Békésy, Hubel, Hess, Olds, Miller, Sperry, Lorenz, Sherrington, Adrian and others of comparable prominence. The standard of writing of the individual articles is generally high, as one would expect from their origins. The collection will provide excellent background reading for students unversed in biological matters and will also be of interest to many others who work in unrelated fields but who have an interest in brain and behaviour. The volume could perhaps have been improved by the addition to each article of a short list of up-to-date references.

To an extent, the editors have chosen the easy way out in that they have compiled this book rather than written it. This method has the advantage that many of the papers are written by the leading people in the field (or, perhaps, rewritten by the staff of the *Scientific American,* after originals by the leading people in the field) and thus carry a certain authority. A disadvantage of the method is that, in the rapidly-moving world of neurobiology, several of the articles are bound to be out of date, in which case the authority lent by the author's name to what was originally an ephemeral work can be misleading.

Religion and politics both enter this book. And whereas it is arguable that, as manifestations of human behaviour, both subjects have a good place in such a work, they seem somewhat out of place in this particular context. Thus MacKay makes an intriguing attempt to demonstrate the existence of free will, using scholastic arguments involving paradox, while the political aspect is evident in some of the phraseology of the editors. Expressions such as "pseudo-scientific arguments" (p. 211), "To bolster political acts" (p. 211), "The segregationists of the southern United States" (p. 239), "The Powellite elements of the Tory Party" (p. 239) would be more at home in political tract than a text of biology.

The editors make a point of mentioning in the preface that they are concerned about the social implications of neurobiology, and this is all to the good. It would be a pity, however, to mislead students into thinking that it is scientific to state that all men are equal, while it is pseudo-scientific to state that some are more equal than others. Both statements are about on a par as far as their scientific nature is concerned; and the term "pseudo-scientific" in this context is normally to be translated as "contrary to what I believe".

R. M. GAZE

Mechanism and Vitalism

Interpretations of Life and Mind. Edited by Marjorie Grene. Pp. xvi+152. (Routledge and Kegan Paul: London, October 1971.) £2.25.

THIS report of the Study Group on the Unity of Knowledge contains eight papers presented to Michael Polanyi on his eightieth birthday. The sub-title is "Essays around the Problem of Reductionism", the aim being to combat dogmatic reductionism by developing a viable alternative, most of the participants being insufficiently aware that physics is already doing precisely that. The editor's contributions, a paper by I. Prigogine, and one or two others are useful, but some of them remind me of A. B. Johnson's warning (1836): "Much of what is esteemed as profound philosophy is nothing but a disputatious criticism of the meaning of words". The main themes are reducibility; the meaning of "mechanism"; the relations of behaviour, belief, and emotion; a critique of artificial reason; and Polanyi's tacit knowledge. Time can be saved by using Dr Grene's introductory notes to guide one to the papers most likely to be of interest, and her up-to-date bibliography gives references on reducibility.

Marjorie Grene considers the proposition "Biology is reducible to physics" and takes it to mean that all biological laws are derivable from universal laws of matter in motion. But, as she is aware, the classical concepts of matter and mechanics have long been transcended, for example in Maxwell's electromagnetic field. In 1939 Eddington pointed out that "the concept of substance has disappeared from fundamental physics; what we ultimately come down to is *form*", that is waves, fields, symmetry, and structure. This is even more true today. Physical theory, though retaining the title quantum *mechanics,* has gone beyond mechanism and has become a mathematical doctrine of symmetry and its breakdown, levels of particles and forces, the statistics of observables, and obscure "interactions". Thus the "problem of reductionism" in its original form has vanished, for physics itself is evolving methods for describing structures "at new levels" with "new" non-classical properties.

This is illustrated by a paper that I can recommend to physical scientists: Prigogine on "The Unity of Physical Laws and Levels of Description". He reports recent work of his Brussels school indicating that systems sufficiently far from equilibrium may display fluctuations leading to the formation of "completely new space–time organization"—a new structural level, with corresponding "coherent behaviour". Those interested in such structures on the frontiers of thermodynamics should compare Prigogine's references with McClare's extension of the Second Law (*J. Theoret. Biol.,* **30**, 1; 1971). Though such very new ideas must be approached cautiously, it is noteworthy that both authors suggest that complex molecules, which may or may not be biomolecules, are distinguished in certain respects from their thermal environment; for example, by their much more rapid internal resonance processes. Thus it is becoming clear that the entropy principle, correctly understood, under certain circumstances permits the occurrence of coherent processes in stable units constituting a new level of structure, as indeed it must.

Dr Grene suggests that "reducibility" may be a side issue. It appears, how-