many problems in the years ahead that a rational management scheme could overcome. Perhaps the Royal Commission could extend its sights beyond estuaries, to the coast and nearshore waters, to identify important issues and to achieve an overall assessment of our needs, both now and in the future.

The MIT report represents a rational and sensible approach to these problems, and no one sector has been able to press its own problems at the expense of the others. This, in essence, is the virtue of the openness and flexibility of the workshop approach. But the shining ideals and grand concepts need both the will, the machinery, and the funds to advance further. The provision of these, both in the UK and US, is where the real challenge lies. G. HOWELLS

[1] "Resource Science: The nurture of an infant", *Bioscience*, **23**, 13 (1973).
[2] Third Report of the Royal Commission on Environmental Pollution, Cmnd 5054 (HMSO, 1972).

Activities of Wasps

The Wasps. By H. E. Evans and M. J. W. Eberhard. Pp. vi+265. (David and Charles: Newton Abbot, July 1973.) £3.65.

THE wasps are all those sting-bearing or aculeate Hymenoptera which are not ants or bees. About half of these are wasps in the more restricted sense—species which build nests and store food in them for their young. The ability to display this degree of maternal care involves many new behavioural traits; having a nest, for example, means having a sense of locality and a good memory and these in turn make such wasps a fascinating study because of the contrasts between some quasi-human behaviour and much rigid instinctive activity.

Dr Evans is an authority on the diggerwasps, a large group of solitary species on which he has published much original work. They show all stages from the simplest in which the wasp stores paralysed prey and lays an egg on it but then seals the cell to such species as *Amonophila pubescens* which brings her larva food as required, over several days, and is able to run two nests simultaneously, in different stages of development and requiring different treatment.

The other author, Dr Eberhard, has made brilliant studies of *Polistes* wasps. The colonies of these insects are very convenient for observation, the single combs being usually completely exposed, often hanging from the eaves of houses and the colonies being mostly small so that the individuals can all be marked with paint and their activities separately recorded. Species are found in both temperate and tropical climates and the resulting differences in behaviour enable us to see better what elements are fundamental and what are adaptations to local conditions. Thus in temperate climates only the fertilized females survive the winter while the males and workers die. To survive, the female has to be rather larger and to lay down a fat reserve of a rather different form. In the spring she can found a new colony unaided until her first daughters emerge. In the tropics, colonies would be perennial except that, when the dominant egg-laying female begins to fail, the colony disperses, usually founding new colonies with swarms.

It is not yet certain that in such species there is any distinction between egg-laying female and workers except a behavioural one, the egg-laying female being able to prevent the others from laying, so that they become workers by default. In such wasps there is still need for research to settle whether there is a caste of real workers which could not alone found new colonies. The more advanced social wasps which are also described often make much larger nests with a beautiful and elaborate structure, inhabited by thousands of wasps which in some genera may include a large number of egg-layers. In these wasps the egg-layers are sometimes quite distinct and easily distinguishable from the workers to the naked eye, as in the British social wasps. All these and many other topics are ably and lucidly discussed in this valuable introduction. O. W. RICHARDS

Motile Models

Motile Muscle and Cell Models. By N. I. Arronet. Translated from the Russian by Basil Haigh. (Studies in Soviet Science.) Pp. ix+192. (Consultants Bureau: New York and London, 1973.) $29.

THE title of this unusual book may mislead the prospective reader. What constitutes a model of a muscle or motile cell? By a model one often means a physical object or a mathematical theory which reproduces the important properties of a more complex system. But in the present context, model is used in the sense of a copy of the original. In 1946 Varga in Szent-György's laboratory introduced the glycerol-extracted muscle fibre as a model of a living muscle. Treatment with glycerol destroys the cell membrane or greatly increases its permeability and removes metabolites and soluble enzymes. What remains is a working model of the muscle which can be manipulated by the experimentalist since it is permeable to substrates and inhibitors of the contractile proteins. Whether the properties of the model reproduce those of the living muscle must be determined by experiment. Because the contractile proteins are relatively insoluble the model has proved to be a remarkable likeness of the original. Nevertheless there are differences, particularly in regard to inhibition of ATPase activity in the relaxed state.

The preparation of a glycerinated model is a simple technique, and has consequently been applied to a variety of presumed motile systems, including cilia, sperm, dividing cells, amoebae (and other organisms which exhibit protoplasmic streaming), myonemes of *Vorticella* mitochondria, and chloroplasts. The criterion for a successful model is simply the production of some form of movement on addition of ATP or other substrates. If the original is a highly ordered structure whose mechanical properties have been determined, one can establish that the model is a reasonable copy of the original. The technique has been successfully applied to cilia and flagella particularly by Gibbons who has obtained wave propagation and swimming movements with glycerinated sperm. For other systems it is difficult to decide whether the essential properties have been preserved and whether the response observed bears any relation to the normal function.

Arronet's book is a survey of studies on glycerinated models of all kinds. One use of models is for teaching purposes and perhaps the most interesting feature of this book is a collection of recipes for making models. Practical details are stressed and many of the methods seem to have been tested by the author.

The remainder of the book is a review of the literature on model studies. The presentation is more in the form of a recitation than a critical discussion. As long as the model is prepared from a muscle or cilium, one is on relatively firm ground, but for other systems extreme caution is required. Discussion of work on mitochondria and chloroplasts will serve as an example. Addition of ATP to these organelles, whether glycerinated or not, can lead to changes in shape and volume. The presence of a myosin-like contractile protein has been claimed and denied by a number of workers and at present it seems likely that the volume changes can be explained by ion movements. Yet Arronet concludes on the basis of ATP response of glycerinated mitochondria and chloroplasts that they "share a common mechanism of contraction with muscles, enzymatic interaction between the contractile protein and ATP".

Glycerinated models have been and will continue to be an important method in the study of motile systems. This book provides a useful collection of such studies and will serve as a valuable reference. E. W. TAYLOR