Book Reviews

AGEING CONTROL

The Immunologic Theory of Aging

By Roy L. Walford. Pp. 248. (Munksgaard: Copenhagen, 1969.) Dkr. 97.50.

DR ROY WALFORD is one of the pioneers of immunology as applied to age processes, and this book is a most powerful and critical presentation of his case. It is a tribute to the author that the book contains so much and such well organized material that, although it does present a theoretical case, it can equally be read as a general textbook of gerontology: it contains one of the best reviews of current theory and experiment to be published so far.

The association of immunological changes with age seems to be undoubted, so far as mammals are concerned. The question is whether they represent a point of access to the control of ageing—whether, in other words, ageing could be slowed or prevented clinically by slowing or preventing them. As Walford points out, several models are possible. They might represent a constant end-effect of several error processes whereby cells or molecules become not-self, or whereby, on the lines of Burnet's theory, immunocyte clones are mis-specified; they might represent one major outcome of a basic "clock" process; or they might constitute only a single group of dyshomoeostases in a general homoeostatic loss. Walford inclines to the first view—that autoimmunity cannot be ruled out as a main, if not the main, mode through which age information-loss is expressed. The possible syntheses between this outcome and the currently fancied error theories (mutation, cross-linking, free-radical attack on various systems, "error crisis" in synthetases, and clonal divergence) are all carefully explored in the light of what evidence there is.

With immunosuppression a growth-stock, it could be argued that theorizing now gives hostages to fortune. If an effective check on both humoral and tissue immunity appears shortly, the argument can probably be settled by direct trial. Of available agents, azathioprene and cyclophosphamide are highly toxic, though Walford has shown a life-prolonging effect for suitably chosen doses. The probable effects of anti-lymphocytic serum on the ageing process cannot yet be assessed, and it is in any event not as effective against humoral as against cellular immunity. If ageing autoimmune effects reflect clonal divergence, or some analogous error process, complete immunosuppression might be expected to suppress some manifestations of ageing—as anti-inflammatory agents suppress some overt pathologies—but aggravate the basic divergence. In order to control ageing, it would on this model be necessary to increase the body's censorship against mis-specified cells or molecules. Walford does not deal fully with this possibility, but it is implicit in the choice of models he advances. His reply to the argument that, autoimmune disease being apparently more prevalent in women, female life should on the autoimmune-ageing model be the shorter, is based chiefly on the selectivity of our statistics: a better case could perhaps be made on the adaptation of the female mammal to life with a half-foreign foetus. But these are perhaps the only omissions, and they derive from lack of space rather than from any reluctance of the author to deal fully and frankly with opposing arguments. In a vast body of background reading, errors are very few—perhaps the only questionable statement is that on page 150, that Tannenbaum's experiments on mouse dietary restriction gave negative results.

Our detailed knowledge of the immunology of old as against young mammals is limited, and much of what is known is due to a handful of workers, notably Walford himself and Makinodan. Many of the experimental results are, moreover, confusing to the theorist. Walford here reviews them fully, covering humoral and tissue immune mechanisms, transplantation immunity, analogies between syndromes such as amyloidosis, runt disease and progeria and the observable course of natural ageing, and the compatibility of immune models with observed or purporting modifiers of ageing rate such as radiation and calorie restriction. The actuarial and physiological criteria of ageing are fully discussed, and the author's approach to generalist theories of senescence which cover fruitflies, spiders and *Daphnia* as well as the more "immunological" phyla is robust and sensible. What might have been an indigestible or a dogmatic line is made consistently acceptable by a good prose style and a sense of proportion. In consequence the most partisan advocate of another theory of senescence is unlikely to emerge uninstructed or dissatisfied.

This is a brilliant and highly instructive performance. Gerontologists will read it with profit as a review of the contribution of immunology to their subject: immunologists and other biologists with even greater profit for the overview it gives of modern attempts to control ageing. It is rare to find a textbook which combines so fully and critically a well-argued hypothesis with a universalist survey of the entire field. ALEX COMFORT

HORMONES OF INVERTEBRATES

The Comparative Endocrinology of the Invertebrates

By Kenneth C. Highnam and Leonard Hill. (A Series of Student Texts in Contemporary Biology.) Pp. ix+270. (Arnold: London, December 1969.) 80*s* boards; 40*s* paper.

THIS is probably the first text which covers systematically what is known about the endocrine systems of all invertebrate animals. It is an introductory text intended for the sixth form in schools and for undergraduate courses; and the authors stress the ready availability of many of these animals, notably the insects, and of some of the hormonally active chemicals, the effects of which can be demonstrated by simple class experiments. Presumably they are writing on the basis of personal experience. The book is clear and lucid throughout. About half deals with the insects which lend themselves well to hormonal studies and in which the subject is most advanced. But no attempt is made to force the endocrine system of other invertebrates into the pattern created by the insects. It is noteworthy that completely novel arrangements of great interest are beginning to be uncovered in other groups; such as the work of Burnett and Diehl on the role of neurosecretory cells in growth, regeneration and the development of sexuality in species of *Hydra*; and the work of Cheat on the release of neurosecretory substance from the radial nerves of starfish into seawater whence it is absorbed by the tube feet of the same and other individuals to precipitate the shedding of gametes.

The authors compare the neurosecretory process with the liberation of neuromuscular transmitter substances at the axon termination of ordinary neurones. But perhaps a truer comparison would be with the continuous downward streaming of the axoplasm of all neurones (carrying with it mitochondria that pile up when the axon lumen is constricted) which presumably must be liberated somewhere. So far as the insects are concerned, the section dealing with the hormonal control of reproduction is particularly good. This is the subject with which the authors' own researches have been chiefly concerned.