Hormones to kill insects

Insect Hormones and Bioanalogues. By K. Sláma, M. Romanuk and F. Sorm. Pp. ix+447. (Springer-Verlag, Vienna and New York, 1974.) $45.90.

WITH its various sections written by an insect physiologist and by two organic chemists, this is primarily a chemical study of two groups of insect hormones, the juvenile hormone and the moulting hormone (ecdysone), and of the numerous synthetic materials with similar physiological activities. The natural juvenile hormone in the body of the insect they call consistently the corpus allatum hormone (CAH) and all isolated chemicals, whether natural or synthetic, which show the same activities in greater or less degree, they call 'juvenoids'. Likewise the natural moulting hormone in the body is named the prothoracic gland hormone (PGH) and all natural and synthetic chemicals with the same activities they call 'ecdysoids'. This is a useful convention which avoids much unnecessary argument.

The chemical structure and the various syntheses devised for natural juvenoids and ecdysoids are described in great detail with clear and consistent structural formulae throughout, and at the end of the book a table of some 350 compounds gives structural formulae and the approximate dosage required for equivalent activities of each, in a range of a dozen or so insects which have been extensively used for assay purposes; and a further table gives an alphabetical list of the same 'juvenoids' according to their chemical derivation. Sorm and Romanuk have worked extensively in this field of organic chemistry in relation to both juvenoids and ecdysoids, and the book contains much previously unpublished information from their laboratory. But published work from elsewhere is well covered; although doubtless much more information remains in the hands of commercial firms which have been active in this field.

The table of activities provides a useful basis for reflections and speculations about the chemical factors concerned in the relative activity of juvenoids—but the figures must, of course, be interpreted with caution, since a 15-fold increase in activity of a given compound may result if it is applied to the cuticle at a dilution of 1:1,000 or more in a non-volatile oil, as compared with the usual method of application in a volatile solvent (such as acetone or octane) which leaves an undiluted residue of the active principle on the surface. And a similar increase in activity results if the application is spread in the form of small doses throughout the sensitive period in the life of the insect, as compared with a single application at the outset.

The authors are principally concerned with the possibility of juvenoids (and to a less extent of ecdysoids) being used as insecticides: to render insects non-viable by disturbance of their normal metamorphosis; to arouse dormant insects from diapause at some inclement season of the year; to sterilise females by adverse effects on their developing ovaries; or to produce non-viable embryos or teratological injuries to young larvae by applications to pregnant females or to newly laid eggs. As a background for such considerations Sláma provides a very full review of the normal hormonal physiology of insects and of the effects of ecdysoids and juvenoids.

The endocrinology of insects is beset with numerous pseudo-problems. What are the chemical effects of ecdysoids? Do they induce DNA synthesis, or RNA synthesis? When renewed growth results in cell multiplication (as it commonly does) DNA synthesis of course occurs; but if sufficient cells already exist it has long been known that moulting (with or without metamorphic change) can take place without DNA synthesis. Renewed growth commonly means renewed protein synthesis; it has long been known that within an hour or so of ecdysoid treatment RNA is increasing in the affected cells —but the same happens in many other cells without the need of ecdysoids. An early effect of ecdysoids at metamorphosis in some caterpillars is conversion of tryptophane into red ommochrome pigments; in fly larvae, the conversion of tyrosine into quinones to sclerotise the puparium. But all such effects are episodes in the growth process which ecdysoids initiate; they are not direct effects of the hormone. The juvenile hormone was originally described as 'inhibiting' metamorphosis; and that is a fair enough description. Unfortunately this was interpreted to mean an antagonistic relation between this hormone and the moulting hormone; an idea which has led to much unprofitable controversy. The earliest suggestion on the nature of the 'inhibitory action' of the juvenile hormone was that it accelerated the deposition of the new cuticle and thus arrested 'differentation toward the adult form'. This process was clearly demonstrable; but many years elapsed before it was realised that it is due to excessive amounts or precocious timing of moulting hormone supply and not to the juvenile hormone. Finally, it is often very difficult to distinguish between direct effects of a hormone and feedback or homeostatic effects resulting from its action elsewhere in the body. By and large Sláma adopts the rational view in dealing with these problems; but he gives a conscientious account of much of the literature, which tends to obscure the rationality of his approach.

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Liquid physics

Liquid State Physics: A Statistical Mechanical Introduction. By Clive A. Croxton, Pp. x+421. (Cambridge University: London, May 1974.) £10.

DR CROXTON'S intention in writing this book was to provide a guide to the uninitiated. On the whole, I think he has achieved this aim, although the book is not in any sense an elementary one. The material covered in the first chapter deals with the theory of imperfect gases and forms a sound basis for the latter sections. The method of correlation functions is introduced in the second chapter and is applied to the problems of the liquid state in the way associated with the names of Kirkwood, Rice, Percus and others. Chapters 3 and 5 aim to discuss the numerical side of the subject and to make a comparison between theory on the one hand and experiment or computer simulation on the other. Here the difficulty that faces all authors in writing textbooks on subjects which are developing rather rapidly is that some of the material necessarily is out of date even before the book is published. There are statements which doubtless Dr Croxton would now wish to modify in the light of recent work.

Chapter four is, to my mind, the most worthwhile in the book. The nature of the surface of liquids has been sadly neglected in the past both from an experimental and a theoretical point of view. Dr Croxton brings the special properties of the surface into the context of distribution functions and contact is made between theory and measurement by special reference to the surface tension. This is a field in which the author himself has made a major contribution and this fact is reflected in the clarity with which difficult ideas are explained. The chapter concludes with a short but very useful exposition of the way that the basic theory must be modified to handle surface properties of quantum liquids.

The final chapter is concerned with transport processes, and this is a subject which has been covered quite adequately in the past in a number of review articles. There is perhaps room for a little more comparison between the neutron diffraction work and theory, but this is compensated by the very comprehensive list of up-to-date references which the author attaches to the chapter.

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