

for a fraction of mental abnormality puts this problem in a different light, one which has long been evident to chromosome students. Structural changes in chromosomes—deficiencies and duplications, interchanges and translocations—smaller in size than those so far recognised, will undoubtedly be found to be responsible for great numbers of abnormal genetic conditions. Many of them will bear on problems of behaviour. The question that will then become of interest will not be the genetic specificity of each clinical entity, so beloved of the mendelians quoted by our authors, but rather the range of modes of determination of related groups of syndromes.

This book broaches many ancient topics from a new point of view. It does so, of necessity, without pointing to all their implications. Some of these implications, however, refer back to the investigation of behaviour genetics itself. For example, what are we to say of assortative mating, sexual selection, and reproductive or fertility selection? These all react on the breeding system and hence on population genetics. With these we are concerned not only with the interpretation of the experimental tests used but also with elements in a still wider field. For through them behaviour genetics concerns what we think of the processes of education, the modes of preservation of culture and hence of the evolution of society. This book is therefore likely to lead to the questioning of many lightly accepted assumptions in the field of the social sciences.

The bibliography is invaluable.

ANIMAL DISPERSION IN RELATION TO SOCIAL BEHAVIOUR. By V. C. Wynne-Edwards. Oliver and Boyd, Edinburgh. 1962. Pp. 652. 55s.

In all animal species—indeed in all living organisms with any future—the capacity for reproduction allows the population to increase in numbers so long as the food supply is sufficient. When food runs short, when the optimum density of population is passed, starvation may be expected to follow, a selective starvation such as may be invoked as responsible for evolutionary change on Darwinian principles. There is now, however, a body of evidence that animals have organised with increasing efficiency processes of population control which avoid starvation and thus reduce the competitive elimination of adults.

It is the purpose of Professor Wynne-Edwards to set out the methods of population control in animals and to show that, whether they are built out of instinctive or physiological processes, they have been acquired by natural selection. This selection has operated to maintain the species at its optimum density both for the efficiency of the individual and for the long-term survival of the race in its ecological continuum. The idea was discussed from the experimental point of view in a recent symposium by Coon, Christian, Snyder and others (*P.N.A.S.* 47 : 427-464, 1961).

The scope of the book is encyclopædic. The author makes use of almost every aspect of animal behaviour to show what its relation may be to the control of population, a control which he regards as the special responsibility of the male sex. He traces the history of the displacement of Darwinian ideas of sexual selection by the principle of the assertion of rights in territory. He examines the use of communications and conventions, of displays and ceremonial gatherings, for the regulation of territories and of numbers. He indicates the role of the sex-ratio and of polygamy, of the control and delay of sexual maturity, of habits of proclivity and cannibalism.

This exposition leaves no doubt that Professor Wynne-Edwards has discovered a principle contributing to ordered inference in most of the fields of study whose results he summarises. Two questions now arise. First, the author gives an exact place in his argument to assumptions of the genetic control of behaviour. There is, in my opinion, no alternative to this position : it is all according to Fuller and Thompson. But we have also to ask how we are to place this argument in relation to genetic evolutionary theory as a whole.

The answer seems to be that the establishment of breeding territory, of the fertility of the individual, of the ratio of the sexes, and indeed of all the other factors in the control of the population are parts of what we have been accustomed to discuss under the heading of the genetic system. We do so because they are selected and adapted as part of a system by virtue of the mutual relations of the mechanism of heredity and the processes of reproduction. A consideration of sex ratio control in which Professor Wynne-Edwards shows the macroscopic consequences but cuts off the microscopic basis (of which a great deal is known) shows how the academic treatment of animal behaviour effectively decapitates this genetic system. We cannot separate the control of numbers from the control of breeding as a whole. Bird song concerns both and we cannot directly demonstrate exactly how important each concern may be in each species so closely are they bound together.

The second and perhaps an even greater question concerns the relation of this work with man. Wynne-Edwards points out that his guiding assumption, that species of animals are adjusted to restrict their populations and to avoid starvation by planning rather than by war, was first expounded by Carr Saunders in *The Population Problem* in 1922. But Carr Saunders was considering only man. The abyss between man and the animals, as we know, is academically deep and almost impassable. But, according to our author, it can be passed. The wealth of knowledge accumulated about animal behaviour fits rather closely the conclusions reached by Carr Saunders forty years earlier from the interpretation of history and the study of primitive peoples. The ceremonial processes, the territorial rites, the abortion and infanticide, the regulated initiation, even the homosexuality, show the same results even though the social mechanism is different and the rationalised explanations are new.

Here, however, the connection with the genetic system not only intrudes, it actually dominates the whole problem. For in man we note that the social behaviour related to population control has had grafted on to it the most elaborate and diverse of all breeding systems, that developed by paleolithic man to avoid the mating of near kindred. The breeding system in man is more concerned with kinship than in any other animal and it is interlocked with the varied aspects of population control. It is interlocked to an extent and for a reason which Carr Saunders could hardly have realised.

One important advance that Professor Wynne-Edwards has made allows him to return his debt to human studies. It is that population control in animals enables them to avoid over-exploiting their habitats, and thus jeopardising their posterity. In this respect it shows the characteristic property of genetic systems, to which I have often called attention, that they are adapted to meet the needs of the future. This principle was not noticed

by Carr Saunders. But how overpoweringly important it has become for man ! It is only now that we realise that ever since the origin of agriculture man has been destroying his habitat. He has been doing so by the unlimited application of one new invention after another, application always for his immediate profit.

Thus civilised man is no longer obeying the rules which applied to his ancestors and indeed still apply to all animal species and to all primitive men. Civilised man was aware that he had created a new order but was unaware that he was destroying an old order. One of the rules that civilised man is no longer obeying throws a new light on the history of evolutionary theory. For we remember that Darwin and Wallace both took the idea of the struggle for existence in nature from Malthus' observation that starvation limits survival in man. We now see, however, that when the Darwinian poet spoke of "nature red in tooth and claw" it was true only of civilised and domesticated man, especially nineteenth and twentieth century man. It was much less true (as Kropotkin showed) of the general process of evolution in animals or of man in a state of nature. It was only with civilisation that men began to pursue a policy of unlimited and competitive expansion.

Nor is this an idle historical retrospect for it forces us to notice what happened when man became domesticated or civilised. The rapid changes that have followed in the conditions of his subsistence, in the regulation of his populations, and his relation with disease, have consequences which have left his technical advances and his intellectual understanding some way behind. Indeed some way behind what he needs to assure a return to equilibrium and a prospect of survival.

Professor Wynne-Edwards' book has more in it for more readers than the method of presentation allows him to make clear. Perhaps he will develop his views in a lighter volume. Let us hope he will then reverse his present order and give us his premises and his problem in the first chapter developing his conclusions at the end.

C. D. DARLINGTON.

AN INTRODUCTION TO THE CYTOGENETICS OF POLYPLOIDS. G. W. P. Dawson. Pp. 96. 28 text figs., 1 plate. Oxford: Blackwell Scientific Publications. 1962. 10s. 6d.

To begin at the beginning of the book I think Mr Dawson has chosen an unfortunate title. Contrary to the opening sentence of Chapter 1 the word polyploidy by most people is restricted to mean, precisely, numerical change in complete chromosome sets and not, as in the book, any change in chromosome number. An account is, however, given of the genetical and cytological consequences of all categories of numerical change; *auto-* and *allopolyploidy*, *aneuploidy* and the addition of supernumerary or *B* chromosomes.

Throughout the book there is a welcome blend of formal genetics with the description of chromosome behaviour, including tetrasomic inheritance, the consequences of mutation and selection and, at the end, a brief reference to ecological and taxonomic matters associated with changes in chromosome numbers. The scope of the book is in fact adequate and suitable for the readers envisaged, namely undergraduates in Biology and Agriculture. Less suitable, however, is the presentation of some of the material. The account of chromosome pairing and fertility in polyploids is especially unhelpful. For example it is unusual and misleading to refer to zygotene or pachytene associations of two, three and four homologous chromosomes