

investigators ought not to disregard the assumption of diverse and graded origins from the extreme specificity of individual nucleotide substitutions to gross structural change with deficiencies, position effects and recognisable whole chromosome losses. Nor ought we to disregard the fact that these gradations, represented at the levels of both the chemically specific gene and the whole chromosome, are already related to variation in human behaviour. For, as Ginsburg has very well shown (1958, *Persp. Biol. Med.*, 1 : 397) a large part of our knowledge of the genetics of behaviour in man has biochemical connections.

Summing up, the publication of these books and symposia marks a turning point in the development of genetics not only in man but also in the most general sense. For the first time we can say that in one species, which happens to be our own, genetics has established connections with the whole biology and with the whole history of the species. The possibilities of this momentous situation are thus opened for discussion and for exploitation.

1. *Lehrbuch der Allgemeinen Humangenetik*. By Friedrich Vogel. Springer, Berlin-Göttingen-Heidelberg. 1961. Pp. 753. 333 figs., 1 plate. Price DM 88 (1.59 Kg.)
2. *Genetics for the Clinician*. By C. A. Clarke. Blackwell, Oxford. 1962. Pp. 294 (with glossary). Price 47s. 6d.
3. *Twins in History and Science*. By Luigi Gedda. Charles C. Thomas, Springfield, Illinois. 1961. Pp. 240. 168 figs. Price £5.
4. *Monozygotic Twins Brought Up Apart and Together*. By J. Shields, with a foreword by Eliot Slater. Oxford University Press. 1962. Pp. 264. Price 50s.
5. *Clinical Aspects of Genetics*. Ed. F. Avery Jones. Proc. Confce. at R.C. Phys. Introd. by Sir R. Platt, March 1961. Pitman, London. Pp. 190. Price 25s.
6. *Medical Genetics (1958-1960)*. Ed. V. A. McKusick. Journal Book of Johns Hopkins School of Medicine. (Seminars with bibliographies). Henry Kimpton, London. 1961. Pp. 534. 71 figs. Price 108s. 6d.
7. *British Medical Bulletin* (Vol. 17, No. 3). Human Genetics : 16 original articles. Introd. by Sir R. Platt. British Council, London. 1961. Pp. 177-263. Price 20s.
8. *Genetic Mechanisms in Human Disease*. Chromosomal Aberrations. Ed. M. F. Ashley Montagu. Thomas, Springfield, Illinois. 1961. Pp. 592. Price £7. 16s.
9. *Chromosomes in Medicine*. By J. L. Hamerton (ed.) M. L. Barr, D. H. Carr, C. M. Clarke, C. E. Ford, M. Fraccaro, D. G. Harnden, P. E. Polani, R. W. Smithells, and N. D. Symonds. Heinemann. Pp. 231. Price 40s.
10. *The Human Chromosome Newsletter*. No. 7 Ed. by D. G. Harnden and P. A. Jacobs. Medical Research Council, Edinburgh. August 1962. Pp. 25.

THE STATISTICAL PROCESSES OF EVOLUTIONARY THEORY. P. A. P. Moran. Clarendon Press, Oxford, 1962. Pp. vii + 200. 38s.

Mathematical genetics started out in a small way early in this century when such writers as Jennings, Weinberg and Bernstein made important pioneering contributions to the mathematics of various situations encountered

in the laboratory or in human populations. In the period 1920-1930 it underwent a second birth when Fisher, Haldane and Sewall Wright independently grappled with the problems of Darwinism in natural populations with Mendelian inheritance. This was not the whole field of mathematisable genetics and these same writers and many others occupied themselves also with the statistics of experimental genetics, the inheritance of quantitative characters, the theory of inbreeding in artificially maintained lines and so on. Mathematical genetics thus became an extensive discipline in its own right with practitioners drawn from many walks of scientific life. The literature is correspondingly voluminous and dispersed. The publication of many excellent text-books and treatises by such writers as Mather, Kempthorne, Falconer and Bailey has been very helpful to students, teachers and research workers by providing both guides to the literature and unified expositions of various sectors of the theory. The theory of populations has, however, to the present been comparatively neglected in respect of unitary exposition. Several important aspects were treated very successfully in Li's *Population Genetics* and in Kempthorne's *Genetical Statistics*, but for some time it has seemed that a more comprehensive treatment would be desirable. In the first place Neo-Darwinism remains the aspect of genetics with the widest biological reference and interest. Secondly the post-war period has seen an intensive revival of interest in the mathematical problems arising in the subject, and the related one of population growth regarded both deterministically and stochastically. It is not easy for either the biological or the mathematical reader to assimilate and assess the relevance of the somewhat dispersed literature that has resulted. Professor Moran has therefore attempted a monograph that may serve both as an exposition of the principal results, and as a review of the literature serviceable to both the specialist reader and the biologist or mathematician wishing to familiarise himself with present directions of enquiry in particular branches of this group of studies.

To produce a book of this character and of moderate length as Professor Moran has done is not easy. It requires that some matters be treated with a light touch while others need detailed presentation if the exposition is to be really useful. He has steered his course with tact and skill. Both the mathematical specialist and the biologist of moderate mathematical attainment should be able to get from the work what they severally require.

Moran lays stress not essentially on mathematical rigour but on the kind of rigour that will be appreciated by biologists, and which concerns itself with careful statements of the exact assumptions under which any formula is derived. Thus he emphasises the importance of exact description of the "model" adopted for the genetical population under consideration. We are all with him here for one of the greatest difficulties in evaluating the significance of formulæ for evolutionary theory is assessment of the relevance of the mathematical model to real situations. As he says, exact presentation of the model is also useful because it points the direction in which future research needs to go and elicits the existence of important problems as yet unsolved.

The book opens with a brief but useful survey of the theory of population growth ignoring internal genetic differences. On the biological side Professor Moran stresses the fact that population growth is density-dependent. He cautions the reader against supposing that a successful fit of a logistic

growth-curve really indicates the presence of any simple law of density dependence. He gives a clear account of the Fisher-Lotka theory of age-composition and supplements it with Leslie's algebraic restatement of the same problem as appropriate for an organism with a fixed breeding period, and draws attention to other models developed by Leslie. Professor Moran provides an interesting discussion of various circumstances under which a Poissonian distribution of family size may be expected to hold. The next chapter is concerned with Mendelian segregation in random mating populations without selection and conveniently summarises the work of Haldane, Geiringer and Bennett on the achievement of equilibrium in tetrasomic populations. Professor Moran also contributes a proof that random changes of partner together with crossing-over lead to the value $1/7$ for the amount of double reduction at a locus far from the centromere.

The chapter on mutation and selection opens with an elementary discussion of the simplest problems as discussed in Sewall Wright's notation. He mentions examples due to Sewall Wright, Fisher and Crosby in which paradoxically the "mean fitness" of a population remains constant although evolution is in progress. He follows on with the Fisher theorem (stated for multiple alleles) on the rate of increase of mean fitness under random mating, and then gives the Kimura form of the amended result for non-random mating. (An alternative form was given earlier by Kempthorne; this seems to have been overlooked). Professor Moran gives a prudent warning as to the vagueness of meaning of "Malthusian parameter" as used by Kimura.

Professor Moran goes on to an extremely good review and unified treatment of the problem of "genetic drift". Ignoring selection he obtains the Fisher-Wright value for the rate of destruction of variance by drift, and Feller's values for the subsidiary eigen-values. This analysis is exact. He then gives a proof (by what appears to be Einstein's method) for the approximate Fokker-Planck differential equation governing the process. This leads to the Kimura solution for the probability distribution of the gene-frequency at time t , and to Kimura's formula for the chance of fixation. These results are extended to the case of mild selection without dominance. Professor Moran also considers an interesting variant model (apparently due to Hannan) which he treats exactly and which is interesting because it enables the error in the Kimura-type approximation to be estimated. A valuable discussion of the effective population size when there is inequality in the sexes follows. Professor Moran concludes by considering departures from random mating. This is the only place where the reviewer would quarrel with him, but it seems necessary to say *en passant* that the representation of non-random mating by a constant inbreeding coefficient f is of the most doubtful validity.

The next chapter on the survival of single mutants is exceptionally valuable, being eminently lucid, and removes many grave obscurities which remained in Fisher's presentation. Various results of Fisher and of Haldane are put in proper perspective and errors can be estimated with the aid of new results due to Professor Moran and his co-workers. The same is true of the next two chapters on stationary distributions of gene frequency where the treatment owes a great deal to Professor Moran's own recent researches.

The review of mathematical work by Sewall Wright, Fisher and Finney on self-sterility systems is excellent except that the author appears to have

overlooked an important paper by Fisher on the distribution of frequency of a self-sterility allele, and the earlier part of the discussion is in consequence somewhat "out-of-focus".

Leaving minor criticisms aside it is fair to say that Professor Moran is most warmly to be congratulated on producing a work of great distinction which will be of permanent value both for reference and as a stimulant to theoretical research.

A. R. G. OWEN.

GENETICS. R. C. King. London: Oxford University Press, 1962. Pp. 347. 60s.

In this volume, of some 350 pages, the author has attempted a very difficult task; he has tried to cover, in an up-to-date way, most of those aspects of genetics which usually receive attention in an intensive one-year course.

The author is to be congratulated on the extent to which he has succeeded. The writing is lucid and almost always authoritative; this is no mean achievement in a one-author textbook. The detected errors of fact are few and only two deserve mention. The brief discussion of the parasexual cycle is very ambiguous and, more serious, the interpretation of the χ^2 test is distinctly misleading.

The volume emphasises the difficulty in giving a really up-to-date and balanced account of genetics in a relatively small book. Clearly, the author has much to offer, but he has tried to put a quart in a pint pot. The inevitable result is an extremely uneven and unbalanced treatment of the material. For example, quantitative inheritance is dismissed far too briefly. Although recent advances are, in general, well integrated with classical studies their treatment is often too brief to be of real value. The well considered study questions and excellent references will be of limited value if the student uses only this text as a foundation.

There is a further deficiency in this work. An overall historical development has its difficulties, but also has much to commend it, and there are other approaches which have merit. In the present instance there is no conspicuous overall development and there are three important possible consequences of this. The student may, in places, lose interest, he will certainly not gain a full feeling for the evolution of his subject and he will not find any clear statement of the outstanding unsolved problems. Examples of this lack of apparent pattern are most serious in the first half of the text. For instance, the first two chapters deal admirably with cellular morphology and physiology and the third chapter gives an elegant account of chromosome dynamics. Unfortunately, all this comes before any clear statement of the basic problems and scope of genetics. The next chapter is titled, "Some Favourite Organisms of Geneticists". It is an excellent chapter, but its impact is partly lost since the description of the organisms is not sufficiently tied to the problems for which they are suited.

Despite these shortcomings, the volume will prove valuable when it is coupled to an appropriate lecture course. Its lucid writing and excellent references and illustrations are particularly outstanding. The specialist will find this book useful for its well selected and astonishingly up-to-date references in so broad a field.

J. A. ROPER.