REVIEWS

EXPERIMENTAL DESIGN AND ITS STATISTICAL BASIS. By D. J. Finney. Cambridge University Press. 1952. Pp. xi+169. 68s.

The public is by now perhaps broken in to purchasing an elementary exposition of less than 200 pages for thirty shillings. In time, in fact, we may look back on such a price as cheap ; yet as things stand the attention of publishers should be drawn to the buyers' attitude towards this extraordinary inflation of book prices.

The University of Chicago Press are to be congratulated on production which is quite excellent. From Dr Finney we can be sure of a solid and masterly exposition. In contrast to some of his previous works in this new one the greatest attention has been given to lucidity, and the style is light and easy.

Evidently the author has medical applications largely in view, and it is to be hoped that the book will be widely read by those concerned with clinical trials. The subject of experimental design had, however, a largely agricultural origin, and thinking in academic circles is still so class-conscious that it is with reluctance that the qualified member of a Learned Profession realises that he has anything to learn from a country bumpkin. Finney gives a helpful suggestion when he writes of the technical terms that from its inception have been used in this subject :

> " The words taken over from agricultural research often help the reader to visualize a problem : they must never be thought to limit the application of the methods."

A difficult point of exposition is presented by the factorial principle in experimentation, for in its train come a great wealth both of new theoretical concepts, and of practical " tips and dodges ". Dr Finney has a certain affection for the " fractional replication ", and, rather surprisingly introduces it before his discussion of confounding. For teaching purposes both should, I believe, but especially the first, be introduced to the student with some warnings as to the new element of uncertainty introduced, sometimes to good purpose, and sometimes pointlessly.

This device, like that of the split-plot, is surely an accessory of occasional utility, but as the latter once did is liable to arouse the same sort of attraction as the latest level of the waist-line !

In all ways, however, this is a most attractive little book, and should serve well to spread competent principles of experimentation into new fields.

R. A. Fisher.

POPULATION GENETICS. By C. C. Li. The University of Chicago Press. 1955. Pp. 366. 75s.

This book, which is a revised and somewhat enlarged edition of Professor Li's *Introduction to Population Genetics*, published in 1948 by the National Peking University Press, consists of an exposition of the " statistical study of Mendelian consequences in populations ". The statistical study of quantitative inheritance and experimental work in population genetics are not included in this survey. Professor Li's account of what is left extends over twenty-three chapters and falls roughly into three parts, the first eight chapters dealing with equilibrium in large random mating populations in the absence of mutation and selection, the next nine chapters with the theory of inbreeding, and the last six chapters with the effects of mutation and selection in finite as well as very large populations.

In the first two chapters the author describes the derivation and application of the " Hardy-Weinberg " law which is simply the binomial distribution of the equilibrium genotypic frequencies for a diallelic locus in a random mating population. Chapter 3 is headed " Genetic Variance and Correlation " and here Professor Li introduces some confusion. On page 29 he describes the genotypic variance as genetic and then partitions this into what he calls an " additive genic " component, which is what Fisher in *The Genetical Theory of Natural Selection* first labelled as genetic variance, and a component due to dominance. However, in other parts of the book where he refers to genetic variance (chapters 8, 11, 21), the author assumes that there is no dominance and so considers genetic variance with its original meaning.

The distinction between genotypic and genetic variance is of fundamental importance in population genetics and the American practice of using several variants of the original terminology paves the way for confusion and error. We shall refer later to the very serious error into which Professor Li is led in chapter 19 as the result of confusing genotypic and genetic variance. After two chapters given to extending the " Hardy-Weinberg " law to sex-linked loci and to autosomal loci with multiple alleles, there is a discussion of its further extension to loci in autopolyploid organisms. It is a great pity that Professor Li here does not give an exact or clear account of inheritance in autopolyploids but writes instead about assumptions of random chromosome and random chromatid segregation, adding at the end that most segregations are " somewhere in between " those expected on these bases. The exact and general treatment of this problem has been available in the genetical literature for several years. The development of the theory of polysomic inheritance owes much to the experimental work with the tetrasomic plant, *Lythrum salicaria*, begun by Fisher and Mather almost twenty years ago, but this work does not involve any assumption about, or evidence for, chromatid segregation being always equational as Professor Li suggests on page 77 of his book.

After dealing with autopolyploids, the author goes on to discuss equilibrium in populations with self-sterility alleles. On page 83 he mentions the obvious fact that the frequency of a self-sterility allele cannot exceed 50 per cent. in any population. On page 350, however, he gives a frequency distribution for self-sterility alleles in which the gene frequency ranges from 0 to 100 per cent. This would seem to be a case where Wright was wrong. In chapter 8 there is a short discussion of the equilibrium situation at a pair of linked loci in a random mating population.

Of the nine chapters devoted to the theory of inbreeding, the first two deal with matrix methods in self-fertilisation and sib mating, the third with equilibrium in populations in which there is some inbreeding, and the remaining six chapters are taken up with the explanation and application of the methods of path coefficients. To the reviewer it seems that far too much space has been given to these correlation methods. However, the author has followed Sewall Wright's work very closely. At the end of chapter 13, he writes :

> " The novel and simplifying feature of Wright's method, apart from the technique of path coefficients, is the introduction of the gametic variable into the analysis. In physical reality only a zygote can assume a measurable value (such as weight, height, etc.) ; consequently, only the correlation between zygotes can actually be observed. But, by introducing an abstract gametic variable and the abstract correlation between gametes, the analysis becomes much easier."

What Professor Li fails to point out is that the analysis becomes much easier simply because this method cannot, from its nature, take account of the phenomena of dominance and epistasy.

Chapters 18-20 are concerned with the effect of mutation and selection in large populations. On p. 273, where he is considering the increase in the average selective value in a population whose members are experiencing selection, the author makes a very serious error as the result of confusing genotypic with genetic variance. In what he claims is a simplified version of Fisher's fundamental theorem of natural selection, he asserts that the increase in the average selective value of the population per generation is equal to what is, in fact, the genotypic variance of the selective value. This is not said to be limited to random mating populations but that it is erroneous can be seen very readily in the case of a random mating population where, at equilibrium, the genetic variance of the selective value is zero and there is no change in the average selective value, although the genotypic variance will certainly be positive if there is differential genotypic selection. It was, presumably, this same confusion of genotypic and genetic variance which led Dobzhansky recently to ascribe " adaptive value " to selectively balanced polymorphism. On this particular point, Professor Li is apparently not quite convinced for he writes (p. 260) that balanced polymorphism " furnishes plasticity to a species and thus may be of great evolutionary significance ". Plasticity indeed is a very adaptable word and one to which no precise meaning has been given in this context.

The last three chapters of the book are concerned especially with populations of small or finite size. Whilst it is true that in a large random mating population with a fixed environment and constant genotypic selective values, gene frequency will change so that the average selective value for the population will come to be a maximum, the consequence of selection in this particular case should not be erected into a general principle of selection. Selection acts, in fact, on individuals and in some circumstances may lead to a decline in the average selective value of the population. This is not made clear in this book.

In the last few pages of his book, Professor Li writes about Sewall Wright's " adaptive peaks and valleys ". This is a very confused section. On page 347 Professor Li introduces Wright's " $\bar{W}$-surface " and then refers us to Dobzhansky's book, *Genetics and the Origin of Species* for an " excellent non-mathematical presentation of this whole concept ". It should be made clear that Dobzhansky does not, in fact, discuss this " $\bar{W}$-surface " anywhere in his book, although he does refer to the different " W-surface ", whose conception is also due to Wright. Wright's " peaks " and " valleys " have been criticised before but the confusion of genotypic and genic quantities on which they depend still needs emphasis, and an account such as that given by Professor Li will not help to clarify the position.

The reviewer has concentrated upon some weaknesses of this book because it is important that vague phrases should not be repeated nor further confusion introduced into the literature on population genetics. However, Professor Li's book contains much that is sound and it will certainly repay close study by any serious student of genetics or evolution.

J. H. BENNETT.

GENETICS IN THE ATOMIC AGE. By C. Auerbach. Edinburgh : Oliver and Boyd. 1956. Pp. 106. 8s. 6d. net.

An interesting attempt to popularise genetics, ingeniously illustrated.

WORLD POPULATION AND RESOURCES. P.E.P. (Political and Economic Planning) Report. Published by P.E.P., London. 1955. Pp. 339. 30s.

STANDING ROOM ONLY, THE CHALLENGE OF OVER-POPULATION. By Karl Sax. Boston : Beacon Press. 1955. Pp. 206. $3.

ADAPTIVE HUMAN FERTILITY. By Paul S. Henshaw. London : McGraw-Hill. 1955. Pp. 322. 41s. 6d.

These three books discuss the human population problem. The P.E.P. volume is the well-documented report of a research group. Dr Sax gives us a personal and political as well as scientific judgment based on valuable new evidence. Dr Henshaw is concerned more with education in physiology and birth control.