

REVIEWS

Biometrika Tables for Statisticians, Volume 1. Edited by E. S. PEARSON and H. O. HARTLEY.

[Pp. xiv + 238. Cambridge: Published for the Biometrika Trustees at the University Press, 1954. 25s.]

VOLUMES I and II of *Tables for Statisticians and Biometricians* (T.S.B.) have for many years been an indispensable part of the equipment of the practising statistician, but the developments of statistical theory and practice since their first publication have now rendered many of the tables of limited usefulness. Furthermore, changes in technique have shown the need for other tables, and a glance through the volumes of *Biometrika* will show how new tables have been prepared to meet practical needs. A new edition of T.S.B. incorporating these changes has been long overdue and the volume under review, as part 1 of a new set of tables, fills this gap. Prof. E. S. Pearson and Dr H. O. Hartley, as joint authors, are to be congratulated on this new volume, which every worker in the field of statistics will wish to have readily to hand.

The value of a table is largely dependent on the confidence with which it can be used and, although we have grown accustomed to the high standard of *Biometrika* and could use this new volume with confidence, the provision in Appendix II of the origins of the tables and the names of the compilers gives complete confidence. Many of the tables have appeared in *Biometrika* and a few have been taken from outside sources; the remainder have been specially computed under the auspices of *Biometrika* to improve the utility of the volume.

The fifty-four tables (including some charts) are divided into six main sections and occupy about three-fifths of the book. The remaining two-fifths consists of an introduction, which details the nature of the problems for which the various tables are designed, together with many numerical illustrations showing the practical applications. Adequate references are given to original papers so that the text can be relieved of the theoretical derivation of formulae, all of which gives a very readable approach to the practical side of theoretical statistics. An interesting sidelight on the development of statistical practice is the economy in the use of significant figures in the examples as compared with the many decimal calculations which were a feature of the early years of the subject.

A proper appreciation of the scope of the tables can only be achieved by study of the book and no short review can hope to do proper justice. Similarly, to attempt to detail the circumstances in which the tables have applications would be equivalent to reproducing the first 100 pages of introduction. Accordingly, the reviewer has thought fit to give merely the broadest general outline of the contents of the various sections of the tables in the belief that nobody engaged on any appreciable amount of statistical work would fail to equip himself with a full knowledge of the scope of the tables and, in most cases, a copy of them.

Section 1 consists of tables of the Normal Probability Function of which the main section is the well-known table of the integral of $P(X)$ and ordinate $Z(X)$ to 7 decimal places in terms of the standardized deviate X , reproduced from vol. 1 of T.S.B. Other tables in this section consist of the inverses of Table I, i.e. X and Z in terms of P and Q and also a table for probit analysis.

Section II covers basic tables derived from the Normal Function and deals with the χ^2 , t and F distributions and tables and charts relating to the correlation coefficient.

Section III includes further tables relating to distributions derived from the Normal Function and covering more specific applications than the general scope of the tables in section II. There are tables relating to the mean deviation and the range, to extreme standardized deviates (measured from population and sample means) and to tests relating to heterogeneity of variance.

Section IV deals with tables based on certain discrete distributions, i.e. the Poisson and binomial.

Section V covers a miscellaneous group. The important table in this group is that of percentage points (upper and lower, 5, 2, 1 and $\frac{1}{2}$ %) of Pearson curves for given β_1 and β_2 . Other tables cover rank correlation, concordance and a table of orthogonal polynomials.

Section VI includes tables of functions useful in computational work, e.g. powers, sums of powers, squares, factorials, square roots, etc., of integers, natural logarithms and a short table of useful constants.

This very brief description will suffice to show how thoroughly the authors have covered the requirements of the statistician and a debt is due to them for collecting all the material in one convenient work. A material advantage of the division into sections is that location of a particular table is a much easier problem. A second volume is planned and will include some familiar tables from both volumes of T.S.B. as well as tables supplemental to those in this new volume I. The printing throughout is of the very high quality of the Cambridge University Press, the layout of the tables is good, and little has been lost by the reproduction of the tables in their original form. Finally, the price is such as to bring them within reach of all who want to do any practical statistical work.

R. E. B.

The Registrar General's Decennial Supplement, England and Wales, 1951, Occupational Mortality, Part I.

[Pp. iv + 75. London: H.M. Stationery Office, 1954. 7s. 6d.]

'SPEED is far more important than exact accuracy' said Sir Geoffrey Heyworth speaking of statistics in business in his 1949 presidential address to the Royal Statistical Society. The Registrar General has evidently been thinking along the same lines, and as a result has published this preliminary survey of occupational mortality just over three years after the census was taken. The results are based on an analysis of the deaths in the year 1950 compared with population figures from the 1 % sample of the 1951 census. The full investigation, which will this time cover five years' deaths (1949-53), will not be published until 1958 at the earliest.

This volume, like its predecessors, is entitled 'Occupational Mortality', but 'Social Class Mortality' would give a better indication of the contents, since, apart from a few particular occupational groups, figures are only given for the five social classes. The material now published will provide a happy hunting-ground for workers interested in many different aspects of social class mortality who have felt the lack of national figures during the twenty years since the previous investigation.

A few of the 1950 results for deaths from all causes are set out below and compared with the corresponding figures for 1930-32.

Social class	S.M.R.'s (ages 20-64)				Crude death-rates per 100,000 living Men aged 55-64		Percentage of all classes rate		
	Men		Married women (by husband's social class)				Infant mortality		Still- births
	1930-32	1950	1930-32	1950	1930-32	1950	1930-32	1950	1950
I. Professional	90	97	81	96	2237	2257	53	61	75
II. Intermediate	94	86	89	84	2347	1957	73	76	87
III. Skilled	97	102	99	101	2318	2343	94	96	99
IV. Partly skilled	102	94	103	104	2340	2105	108	115	109
V. Unskilled	111	118	113	117	2535	2523	125	139	117

The most significant feature of the new figures is that the nice tidy social-class gradient of 1930-32 for male mortality has gone, the Standardized Mortality Ratios (S.M.R.) for classes II and IV being out of step and less than that for class I. Part of this unevenness may be due to the larger standard error of S.M.R.'s based on only one year's deaths and on a 1% sample of the population. Also certain changes have been made in the occupational make-up of the social classes as compared with 1930-32, of which the largest are the transfer of some 225,000 accounting clerks from social class III to class II and of 132,000 gardeners from class III to class IV. No investigation of the effect of these changes has been made.

A comparison of the crude death-rates in age groups indicates the changes that have taken place in the level of the mortality experienced by each social class. The 1950 death-rates for men aged 55-64 (which age-group contained over half the deaths at ages 20-64) show no change since 1930-32 in classes I, III and V and a reduction only in classes II and IV. For younger age-groups mortality has decreased considerably in all social classes, but classes II and IV usually show the largest percentage reduction. The corresponding death rates for married women have decreased in all social classes with class II usually showing the largest percentage decrease and class I the smallest.

The fundamental assumption (scarcely mentioned in the report) of the Registrar General's studies of occupational mortality is that the occupations recorded at the census and at death registration agree sufficiently well for comparison not to be misleading. A study of the 1950 Classification of Occupations shows that sometimes quite small and apparently unimportant differences in description can result in allocation to different social classes. For example, 'actuarial clerk' is in social class II but 'insurance clerk' in class III; 'accounts clerk' and 'ledger clerk' in class II but 'invoice clerk' in class III; 'insurance manager' and 'officer (insurance co.)' in class I but 'insurance official' in class III; 'chief accountant' in class II but any qualified accountant in class I; 'plumber's mate' in class IV but 'plumber and joiner's mate' in class V; 'railway-ticket inspector' in class II but 'railway-ticket collector' in class IV. Some of these distinctions were made for the first time in the 1950 classification, but this was not published until 1951, by which time occupations would already

have been recorded for deaths in 1950. Were the local registrars given advance information of the changes to be made in the code used to classify the occupations recorded by them? Even if it is justifiable to make fine distinctions in occupation, such as those just mentioned, when dealing with the census, we have doubts whether it is reasonable to attempt to do so for death registrations. Perhaps the point only applies to a small minority of cases and it seems doubtful whether this sort of thing is sufficient to explain the change in the male figures (although it could cause substantial errors in each investigation), particularly as the married women show some of the same features. For married women (who are classified by husband's occupation) a greater degree of correspondence may be expected between the husband's occupation given on the census form and that at registration of his wife's death, as often he would be the informant in both cases. It is understood that the Registrar General hopes to investigate, for a sample of deaths, how the occupation stated at death corresponds with that given at the census; this should provide valuable information about the reliability of the national studies of occupational mortality, for the effect of inconsistencies of this type is not altered by increasing the number of years examined from one to five.

The Registrar General does not attempt to explain the 1950 figures but prefers to accept them 'cautiously as indicative that a change may have occurred' since 1930-32 and to await publication of the full analysis, when the individual occupations making up each social class will be examined. Whatever the explanation one thing seems certain, that any relationship there may have been in 1930-32 between income and social class will now be somewhat different.

The social class distribution of mortality in 1950 from selected causes of death shows a number of differences from the 1930-32 results, but in any comparisons it must be remembered that between the two dates there have been changes in both the list of causes of death and the method of dealing with multiple causes of death which may or may not have had differential effects on social class mortality. It is interesting to find that the 1950 social class mortality gradient for coronary heart disease in men aged 20 to 64 is still downward from classes I to V and considerably less steep than in 1930-32 but, unexpectedly, the gradient for married women has changed direction and shows a slight but definite rise from classes I to V. Whether this sex difference has any significance must await the publication of the full investigation, but it may be noted that the figures for married women are based on only 2,529 deaths as compared with 13,417 for men.

Although infant mortality (i.e. in the first year of life) in 1950 was less than 50% of that in 1930-32, there has been little change in the proportionate social class gradient. For neonatal (under 4 weeks) mortality, which only decreased to about 60% of the 1930-32 level, there appears to be a tendency for the social-class gradient to increase. The stillbirth rate in 1950 showed a social-class gradient similar to that of neonatal mortality.

The present results are only a temporary substitute for the full tables but their publication now is very welcome and it is hoped that the preliminary volume will become a regular feature of the Registrar General's reports, unless, better still, the publication date of the full investigation can be brought forward. Perhaps this could be done if, like the Statistical Review, the basic data were published first, followed later by the commentary.

Approximate Valuation of Life Assurance and Annuity Contracts. By M. T. L. BIZLEY and A. E. LACEY.

[Pp. viii+108. Cambridge: Published for the Institute of Actuaries and the Faculty of Actuaries at the University Press, 1954. 17s. 6d.]

THIS is a text-book in the series published under the authority of the Institute of Actuaries and the Faculty of Actuaries for students preparing for the actuarial examinations. The subject is an interesting field for the mathematically inclined but its study does not lead to insight into actuarial as distinct from mathematical problems, and it has been given only limited importance in the examination syllabus and in the examinations themselves. In the course of reading recommended to students preparing for Part IV, Section C (1), of the Institute examinations this text-book is prescribed as one which should be read with a view to general appreciation rather than detailed knowledge. The authors, in their preface, rightly emphasize that the student, in order to obtain a real grasp of the subject, should actually make approximate valuations by the methods described and also endeavour to evolve other methods of his own. The working of practical examples is essential to a proper understanding of the subject and to success in the examinations but the full programme recommended by the authors is probably too ambitious and too consuming of time for the average examination candidate.

The foregoing comments apply to the subject itself and its place in the examination syllabus and are not meant in any way to decry the merits of the book. Granted that a text-book is required, it is difficult to see how the present work could be much improved. The treatment is systematic and the general plan is to group together methods of approximate valuation which have a similar line of approach. Thus one chapter covers the methods of Henry, Kenchington and Trachtenberg, where the valuation factor is expressed in the form of a polynomial and the constants in the polynomial are used in the valuation; another chapter deals with methods where the valuation factors are made to take the simple form of a straight line, or nearly so, and the approximate valuation is made without the calculation of constants. In another approach the data are valued in groups of fixed range by mean factors—for example, King's method—and in the methods of Perks one mean valuation factor is applied to the whole range of data. Somewhat similar to Perks's methods is the method of Elderton and Rowell for estimating the cost of changing the valuation basis. The remaining chapters deal mainly with approximations by retrospective methods, checks on the accuracy of the valuation and the approximate valuation of joint life and survivor annuities which do not lend themselves to the usual types of grouping.

The treatment of the subject is on the whole uncritical although the authors discuss the limitations of various methods when returns are to be made to the Board of Trade under the Fourth and Fifth Schedules of the U.K. Assurance Companies Acts. The student may well wonder how close an approximation is required for the different purposes of a published valuation, an interim valuation, a check or an estimate of the cost of a change in basis; he will also ask how much work is really saved, which apart from their value as an independent check is the only practical justification of these mathematical ingenuities.

As the authors themselves mention, modern calculating machines have reduced the need for approximations. The electronic computer may completely

supersede these methods but, on the other hand, there is the possibility that it may revive the use of algebraic expressions instead of tables of numerical values for actuarial functions.

Few actuaries would care to embark on an approximate valuation without considering afresh the development of the method to be used and for this purpose alone the book will have great value.

J. M. B.

A Report by the Government Actuary and the Actuary to the National Debt Commissioners on the Mortality Experience of Government Life Annuitants 1940-1950.

[Pp. 14. London: H.M. Stationery Office, 1954. 6d.]

THE Report provides further interesting evidence of the trend of mortality rates among annuitants. Tables in the Report compare the experience of the decennium 1920-30 and the four quinquennia between 1930-50 with the period 1900-20 which formed the basis of the last full scale investigation. The rapid improvement in mortality rates during the period 1940-50 contrasts with the lack of improvement between 1920-40.

Comparison is also made between the experience of the Government annuitants in the period 1940-50 and that of the Life Office annuitants in the period 1941-48. There is close agreement between the rates in nearly all age groups. It is noteworthy that the Life Office annuitants also showed little improvement in mortality between 1920 and 1940—unlike the general population.

Graduation and projection were carried out by fitting curves to the mortality rates experienced in eight periods ranging from 1808-75 to 1945-50 (N.B. not generation curves). The formula found suitable for both male and female mortality rates was $\log q_x = 2a/(1 + b^{c-x})$. It was considered that the rates could be represented with sufficient accuracy by adopting the same values of b and c for all the experiences, although different values were required for the two sexes. Accordingly the secular trend of mortality was epitomized by the values of a . To quote the words of the Report 'The quantity a is the co-logarithm of q_x at age x ; the secular increase in a shown by the table above is therefore a measure, on a logarithmic scale, of the secular decline in the rate of mortality at that age.' The value of a for male lives increased more or less steadily from 1.101 in the period 1808-75 to 1.216 in the period 1945-50, the corresponding values for female lives being 1.054 and 1.252.

Projection into the future was carried out for each of the sexes by fitting a straight line to the values of a , excluding that for the earliest period. The value of a having thus been determined for any given year in the future, the corresponding rates of mortality appropriate to that year of experience can be determined from the formula. The Report includes a table giving the projected rates on this basis appropriate to quinquennial attained ages from 52 to 97 and quinquennial ages of purchase in 1955 from 50 to 80—in other words, the rates which it is assumed will be experienced in quinquennial calendar years from 1957 onwards. A comparison of these rates with those in the generation table published in the *a* (55) *Tables for Annuitants* shows that the former are throughout at a substantially higher level than the latter, the differences generally varying between 10 and 20% for female lives and between 10 and 15% for male lives. The existence of these differences, notwithstanding the close agreement between the experience rates in the decennium 1940-50, has arisen out of

the different methods of graduation and projection. For the Life Offices' table, graduated rates appropriate to the year of experience 1947 were obtained from the data for that year and neighbouring years and these rates were used as the starting point for the projected rates. The latter were calculated by using the rates of improvement derived from the experience of female annuitants over the period 1863-1948. In the Government table, the effect of fitting a straight line to the values of a was to assume, for projection purposes, higher rates of mortality in the period 1945-50 than were in fact experienced—in other words it was assumed that the rapid improvement in these years constituted a secondary fluctuation in the primary trend. Moreover, the rates of improvement experienced by Government annuitants are lower than those experienced by Life Office annuitants. These two factors operating in the same direction naturally bring out considerable differences in the projected rates.

No attempt has been made to construct a single entry table of mortality rates appropriate on the average to lives purchasing annuities in a given year as was done in the a (55) table. Such a table presumably would not serve any useful purpose. As on the occasion of the 1900-20 investigation, specimen annuity values were calculated from the double entry table of mortality rates and a suitable addition to the existing annuity values derived therefrom. The additions appropriate to annuities purchased in 1955 range from 3.7 to 5.2% for males and from 4.1 to 6.0% for females. The uniform addition of 6% which has been adopted provides some additional margin for improvement in mortality rates beyond the allowance inherent in the projected rates of mortality. J.L.A.

The Law of Life Assurance. By DAVID HOUSEMAN, A.I.A.

[Fourth Edition. Pp. xxiv + 257. London: Butterworth & Co. (Publishers) Ltd., 1954. 22s. 6d.]

A NEW edition of this well-known work has now arrived to take the place of the previous one which was published in 1949. In some places the text has been altered for the sake of clarity, and there are more paragraph titles in heavy type to facilitate reference. The general arrangement, however, remains the same.

The section dealing with Pension Funds has been enlarged to cover modern practice and conditions, and the devolution of estates under intestacies has been revised in accordance with the Intestates' Estates Act, 1952, while the scale of assignment stamp duties has also been brought up to date.

An additional section has been inserted to cover the Exchange Control Act, 1947, but the chief alteration in the whole book is in connexion with estate duty liability and, in particular, for policies effected under the Married Women's Property Act. The important Scottish cases of *Haldane's Trustees* and *Walker's Trustees v. Inland Revenue Commissioners* are cited, and the latest aggregation rules (Section 33, Finance Act, 1954) are discussed. They are also quoted in a new Appendix, No. 20. There is, however, one of these rules where authorities appear to differ over interpretation.

The case in point concerns policies under the Married Women's Property Act where at the date of death of the life assured the beneficiaries cannot be definitely identified. Mr Houseman states that all such policies are aggregated together (but not with any other property) and form a separate estate. On the other hand, G. Boughen Graham, LL.B., in *An Estate Duty Notebook*—another

recent publication—seems to indicate that these policies would bear estate duty at a rate applicable to the value of an estate obtained by aggregation of all policies in which the deceased never had an interest including those of identifiable beneficiaries. The matter is obviously not free from doubt, and it is to be hoped that the question will soon be settled by an authoritative ruling.

Dealing with policies under the same Act, Mr Houseman does not himself find it possible to be definite regarding the position of adopted children since the passing of the Adoption Act, 1950. One would think that it should be possible to include as an object of a Trust in a policy any child already adopted but not any child or children who might subsequently be adopted, unless the contrary intention appeared. It is believed that certain Life Offices are prepared to issue policies under the Married Women's Property Act for the benefit of existing adopted children, no doubt with adequate warning to the proposer that the responsibility is his.

E. K. R.

Impairment Study 1951.

[Pp. 300. Compiled and published by the Society of Actuaries, 1954]

AMERICAN actuaries have long been in advance of their British colleagues in investigating the mortality of impaired lives. As long ago as 1912 the American actuarial bodies published the *Medico-actuarial mortality investigation*, which contained a record of the experience under policies issued during the period 1885-1908. A further investigation, relating to the experience under policies issued from 1909 to 1927, was published in 1929 and was entitled *Medical impairment study*. Two smaller investigations, each limited to a few selected impairments, appeared in 1936 and 1938; and in 1939 the *Blood pressure study* was published in which mortality was analysed according to the systolic and diastolic readings recorded at entry into assurance.

Impairment study 1951 presents the results of a new full-scale investigation into the experience of policies issued from 1935 to 1949 and traced through to policy anniversaries in 1950. Twenty-seven companies, representing 70% of the Ordinary life assurance in force in the United States and Canada, contributed data. The total number of policies coming under observation exceeded 725,000 and, of these, 18,317 were terminated by death. The average period of exposure was 6.2 years.

The investigation covered a wide range of impairments. There were nine main sections, of which the first five were devoted to diseases of the cardiovascular, nervous, respiratory, digestive and genito-urinary systems respectively. The sixth section related to 'female diseases and conditions'; the seventh to tumours; the eight to 'metabolic diseases' (arthritis, glycosuria, diabetes and goitre); and the ninth section was a miscellaneous group which included syphilis, non-pulmonary tuberculosis, poliomyelitis, osteomyelitis and deafness.

Within most of the impairment groups the data are subdivided into 'standard' and 'substandard' risks according as the policies concerned were issued at tabular rates or were surcharged. As offices differ in their treatment of various types of risk, this subdivision gives rise to difficulties of interpretation. There is no indication from the code descriptions of how the physical condition of a person classified as standard may differ from that of another person suffering from an identical impairment but classified as substandard. If for a given impairment the additional mortality is 20% for standard cases and 60% for

substandard cases, what does the extra 40 % measure? The answer is clearly that it measures the effect of the subjective judgment of American underwriters in allocating policies to the substandard class. This necessarily limits the value which people outside North America can derive from the statistics when seeking a guide to life underwriting in their own countries.

The results of the investigation take the form of ratios of actual to expected deaths. As a basis for computing the expected deaths a special table, called 'Basic Table 1935-50', was constructed from a parallel experience of first-class lives, i.e. it related to policies issued over the period 1935-49 and traced through to their anniversaries in 1950. Rates of mortality in the basic table are not given by attained age but by age at issue and duration, the ages at issue being combined in quinary groups and the durations in the following groups: 1-2, 3-5, 6-10 and 11-15. Owing to the nature of the investigation there were no data at durations higher than 15. This same scheme of grouping the data by quinary age-group at issue and by duration-group was employed in computing the exposed to risk for each individual impairment code. For presenting the results, however, the initial quinary age-groups were amalgamated into four broad age-groups, i.e. 15-29, 30-39, 40-49 and 50-64. Even so, in none of the impairment groups were the data sufficient to permit a two-variable analysis of the results. Consequently they are given separately for age-group at entry and for duration-group. Thus the extra mortality for a given impairment can be ascertained for ages at entry 40-49, say, for all durations combined; or it can be ascertained for durations 6-10, say, for all ages at entry combined. The virtual impossibility of obtaining sufficient data to enable a two-variable analysis to be carried out is an inherent difficulty in all research into the mortality of impaired lives.

The investigation covered male and female lives without differentiation. In the basic table, female lives were 18 % of the whole. In view of the substantial difference between male and female mortality, any marked variation in the proportion of female lives between the basic table and the data in a particular impairment group would damage the validity of the mortality ratios. The proportion of female lives is stated for every individual group and, even when specifically female impairments are ignored, it varies from 2 % to 62 %. Consequently it is necessary in examining the results to take note of the stated proportion of female lives and, if it is appreciably greater or less than the proportion in the basic experience, to make some allowance accordingly.

It is not possible in the course of a review to comment in detail upon the statistical results and the most that can be attempted is to mention a few of the more noteworthy features. Heart murmurs provided the greater part of the impairments in the cardiovascular group and here a significant factor was the presence or absence of hypertrophy. In one group, for example (apex murmur, systolic, constant, transmitted to the left, and/or mitral regurgitation), the following mortality ratios emerge:

	%
Without hypertrophy	215
With slight hypertrophy	290
With moderate hypertrophy	565

A most interesting result was obtained for policyholders reporting two or more deaths in family at ages under 60 from cardiovascular-renal disease. Cases in this category which were accepted at standard rates showed a mortality ratio

of 141 %. As this result is based upon 122,159 years of exposure and 731 deaths, it seems to provide definite evidence that a family history of cardiovascular-renal disease is an adverse feature from an underwriting point of view.

The results in the tuberculosis class provide an example showing how lack of information about the difference between standard and substandard cases complicates interpretation. For policyholders reporting one attack of pulmonary tuberculosis occurring between six and ten years prior to application, the mortality ratio is 112 % for standard cases and 149 % for substandard cases. It would appear from these figures that the difference between standard and substandard cases, the nature of which is undisclosed, has a much greater effect upon the emerging mortality than the tubercular impairment itself.

One result of general interest in the tuberculosis class is the changing age incidence of the additional mortality. In the 1929 investigation the percentage of special to normal mortality diminished sharply with increasing age. In the 1951 investigation, the percentages were nearly constant with age. This change corresponds to a similar development in Britain, where deaths from tuberculosis in young life have become a small fraction of their former number while at the same time tuberculosis has become relatively more prominent as a cause of death in later life.

In the duodenal and gastric ulcer classes, cases with operation had higher mortality than those without operation. As would be expected, the extra mortality diminished with increasing interval between last attack and date of application. On the whole, gastric ulcer showed somewhat higher mortality than duodenal ulcer. In neither class was there a consistent trend in the mortality ratios either with age at entry or with duration.

Included among the impairments studied were family history of cancer and family history of diabetes. In neither case was there any significant excess mortality. This result may be contrasted with the excess mortality which, as mentioned above, was found among policyholders whose family history included deaths at ages under 60 from cardiovascular-renal disease. It would be of considerable interest to have data for family histories which contain deaths from other major impairments. It may be that in the past too much attention has been paid to a family history of infectious or malignant disease, and too little to a family history of degenerative disease. Whether premium rates should vary according as the proposer comes of a short-lived or a long-lived stock is a question which could be debated at some length.

All deaths in the investigation were analysed by cause. Death rates from specific causes were derived from the data underlying the Basic Table 1935-50 and were used to compute expected deaths from these causes within the various impairment groups. Causes showing a marked excess of actual over expected deaths are set out beneath the statistics for each group. For example, the impairment group defined as 'duodenal ulcer, without operation, within 2 years of application, no haemorrhage' yielded 97 deaths altogether, with a mortality ratio of 125 %. These 97 deaths included 20 from malignant neoplasms (mortality ratio 162 %), 39 from circulatory diseases (142 %) and 13 from digestive diseases (255 %). It can be easily computed that the remaining 25 deaths from all other causes represent a mortality ratio of 76 %. Thus, although information about the causes of death among persons suffering from particular impairments is of unquestioned value, it may be dangerous to concentrate too much on the constituent elements in the rate of mortality. In the last analysis it is the total rate which matters.

A noteworthy feature of *Impairment study 1951* is the similarity of the mortality ratios for many impairments with the corresponding ratios of the 1929 investigation. Such a result is by no means to be expected in view of the fundamental changes that have been taking place in mortality rates during the interval. Although death rates have fallen among the healthy, it does not necessarily follow that they will have fallen among sufferers from particular disabilities. Thus it would be quite possible for the mortality ratio for an impairment to increase merely because the mortality rates among persons exhibiting that impairment had remained constant or had not decreased to the same extent as the rates for healthy lives. In one major category—namely gastric and duodenal ulcer—increases in mortality ratios, as compared with the results of an interim study published in 1936, have in fact occurred. The authors of the 1951 study suggest that the relatively favourable ratios of 1936 may have led to more liberal underwriting and hence to a deterioration in the experience. However, the explanation suggested above may equally well be the cause of the observed increases.

In a prefatory note, entitled 'Interpretation of findings', the authors indicate that they are aware of many limitations in the data which necessarily qualify any conclusions drawn. In particular they refer to the heterogeneity which arises from inter-company variations in classification and in the degrees of strictness or leniency applied in underwriting. None will question the need for consistency and uniformity among offices when data are being assembled for a combined investigation. In North America, offices are widely separated geographically and this fact doubtless increases the difficulty of establishing uniform procedures. It is to be hoped that if an inter-office venture is attempted in this country, the concentration of offices in London, Edinburgh and two or three other cities will prove an advantage in this respect.

Certain other limitations are inherent in any investigation into the mortality of impaired lives. Over the period covered by the experience there have been substantial changes both in basic death rates and in the methods of treatment for various diseases. Thus the relationship between impaired and normal mortality has been continuously changing and the most that any investigation can do is to condense a variable experience over an extended period into an average. Furthermore, the data are of necessity weighted most heavily at the shortest durations. Consequently the analysis of mortality ratios by age at issue reflects the short duration experience far more strongly than the long duration experience. For durations over 15 there are no data at all, so that long-term effects cannot be studied.

Nevertheless, when all these limitations are borne in mind, *Impairment study 1951* is an important contribution to actuarial science and one in respect of which British actuaries should pay tribute to the industry and enterprise of their American colleagues. It is a very fine piece of book production—well bound, clearly printed and most handsomely set out. The underwriting department of every life office should certainly possess a copy.

R. D. C.

The Determinants and Consequences of Population Trends. United Nations Population Study, No. 17.

[Pp. xii+404. New York, 1953. 30s.]

As indicated by its subtitle, *A Summary of the Findings of Studies on the Relationships between Population Changes and Economic and Social Conditions*, this manual is a source-book; it lists some two thousand contributions, by almost

as many authors, on the subject of the general background to census and registration statistics. Comprehensive, thorough and copiously annotated, it constitutes something of an encyclopaedia for demographers and economists.

Besides the index of sources there is a text giving in effect a gigantic 'rapporteur's survey' of past and present writings in this field. Although the papers referred to are described as being only a sample, it is difficult to find much that has been omitted. The narrative is scrupulously objective, contrasting views being placed side by side and balance being further maintained by drawing illustrative examples from all parts of the world and by giving equal treatment to the impact of the environment on the population and the impact of the population on the environment. Soviet Russian theories are expounded alongside the tenets of the Western world. While this type of presentation is a worthwhile objective, one that needed to be aimed at, it must be admitted that, like most compendiums, this book makes heavy reading as a connected account; it is repetitive; its very balance makes it dull in comparison with stimulating individual contributions to the subject such as that of Bowen*; its selection of examples from different areas makes for diffuseness and spoils the continuity. Its impact will not, therefore, be as strong as it should be and, unfortunately, biased opinions and speculations may well attract more public attention.

The most interesting chapter in the short introductory section is that giving a history of population theories. There is virtue in a balanced approach here, for it enables space to be devoted to writers who are usually overlooked in favour of Malthus. Many of the old ideas are, however, of little value today and others are likely to be superseded as the result of modern research involving the collection of new types of data. Actuarial readers will probably be quite ready, therefore, to pass on to the next chapter, which is concerned with factors affecting mortality. This and its companion on fertility are very satisfactory as far as they go, but having regard to the extent of the knowledge and information available today their subjects might have been treated more fully, for instance with reference to causes of death; as the volume has been compiled to assist in the formulation of Government policy, one might have expected to see greater space devoted to the question of State efforts to encourage fertility, as in France during and since the 1939-45 War, with an account of the measures taken and an assessment of their effectiveness. In the chapter on migration, too, some reference to the effects of full employment on mobility, internal and external, would have helped to complete the story.

If the part of the book dealing with factors affecting population trends could have been expanded with advantage, it seems equally true that the part dealing with the effects of population trends on social and economic life could have been shortened. As is admitted in the text, production, consumption and labour supply are influenced by many things besides population changes, which may be relatively unimportant. The more comprehensive the account tries to be, the more incomplete the present state of our knowledge appears. Some of the relationships referred to are not a matter of general agreement, and many of them are almost impossible to quantify. New data need to be collected and fresh methods of analysis evolved. In drawing attention to the serious gaps in our equipment-list, the book gives a valuable pointer to new areas of research that await exploration.

P. R. C.

* *Population*, by Prof. I. Bowen; Cambridge University Press, 1954.

National Insurance Act, 1946—Report by the Government Actuary on the First Quinquennial Review.

[Pp. 30 plus Appendices 30—H.M. Stationery Office, 1954. 2s. 6d.]

THIS Report, which covers the period of 5½ years from July 1948 (when the National Insurance Act, 1946, came into operation) to March 1954, is the first of the quinquennial reviews under the Act which requires the Government Actuary to 'make a report to the Treasury on the financial condition of the National Insurance Fund and the adequacy or otherwise of the contributions payable under this Act to support the benefits payable thereunder'.

The Report outlines the present benefits and contributions under the Act, the main changes made since 1946, the fundamental financial principles of the system, income and expenditure of the Fund during the review period, changes in financial structure and basis of the contributions, determination of new actuarial contributions and estimates of numbers of future contributors and beneficiaries and of emerging cost. The Report also contains a valuable statistical appendix.

The general picture brought out by the review is well known. The working of the Fund has been more favourable—allowing for changes in benefits and contributions and some minor conditions made by subsequent legislation—than originally estimated. The most important factors were the very light unemployment actually experienced as compared with the 8½% assumed in 1946 on Government instructions, and the more favourable sickness experience than that allowed for. But the long-term trend is unchanged. The Fund will shortly fall into deficit, and the additional annual charge falling on the Exchequer will mount rapidly, reaching an estimated figure of £364 m. in 25 years' time.

While much of the method adopted is similar to that of the Report of the Government Actuary on the Financial Provisions of the National Insurance Bill, 1946,* there is one major difference in basis in that, for the first time, the Government Actuary has adopted forecast mortality to estimate the future numbers of contributors and beneficiaries, emerging cost, and contribution rates.

These forecast mortality rates are used to build up estimates of future population. Table C in Appendix 6 shows the populations in 1964 and 1979 for each sex in quinary age-groups, and Table D analyses these figures further into bachelors, married men, and widowers and divorced men, and into spinsters, married women, and widows and divorced women. Having arrived at the population estimates, the next step was to derive estimates of the insured population. In the case of men it was assumed that for future years the same proportions of the total population in each age-group would be insured in each class as at 31 March 1954. In the case of women, allowance was made for the different proportions occupied according to marital status, based on the 1951 Census data. In the past 15 years vast changes have occurred in the proportions of women who are gainfully occupied. Equally large changes may occur in the future, and these estimates in regard to insured women may well be subject to the largest margin of error of any of the many intricate factors involved in the review.

As regards the mortality basis, the Report points out that mortality rates up to about age 50 have considerably declined, that for women between the ages of 50 and 75 there is still a downward trend apparent but not after that age, and that in the case of men there has been little or no recent change in the death rate

* Reviewed *J.I.A.* 73, 175.

for the age-group 55-64, while for later ages the tendency is towards an increase. Nevertheless, the estimates take account of the possibility of further advances in medical science and assume that the flattening of the secular curve may denote no more than a temporary phase. The death-rates by sex and age appropriate to 1954 are estimated on the basis of the latest available statistics and it is assumed that for the next 25 years death-rates will decline year by year in geometrical progression at the average rate experienced at each age during the first half of this century. Specimens of the rates so derived are shown in Appendix 6 for 1954 and 1979.

Among the other Tables shown in Appendix 6, perhaps those of most interest to actuaries are Table E, age distribution of wives per 1000 husbands in each age group (derived from the 1951 Census), Table L, rates of remarriage of widows, and Table M, rates of sickness.

As regards Table L, rates of remarriage of widows were derived from the experience in 1937 and 1938 under the Contributory Pensions Acts and the rates shown incorporate a 'select' period of 5 years from date of widowhood. In the Government Actuary's Report on the 1946 Bill, a Table was also shown of remarriage rates derived from the experience of the Contributory Pensions Acts for an earlier period and a select period of 15½ years was then adopted. It is therefore difficult to compare other than the ultimate rates from age 37½ onwards. These show a considerable increase in rates of remarriage up to age 57½.

As regards sickness rates, the actual sickness experienced has been less by some 15-20% than that allowed for in 1946. The new rates set out in Table M contain a margin of 10% over the recent experience and have been further adjusted in the case of self-employed persons—who show materially lighter sickness rates than those of employed persons—to allow for the fact that most self-employed persons have been insured only since 1948, and the recorded experience of this class does not therefore include a due proportion of long-term and chronic sickness.

The review is a major actuarial undertaking. Quite apart from the financial investigation of the working of the National Insurance Fund and its future prospects, the Report contains a mine of information of interest and value not only to actuaries but to demographers and social statisticians.

F. J. C. H.

National Insurance Bill, 1954. Report by the Government Actuary on the Financial Provisions of the Bill (Cmd. 9332).

[Pp. 8. H.M. Stationery Office, 1954. Price 4d.]

THIS Report summarizes the financial effect of the provisions of the National Insurance Bill, 1954, which was introduced early in December 1954 to raise benefits and contributions under the National Insurance Acts and the National Insurance (Industrial Injuries) Acts and received the Royal Assent before Christmas.

The actuarial basis of the estimates is that adopted in the Government Actuary's Report on the First Quinquennial Review of the National Insurance Scheme. No new actuarial considerations arise.

The Report sets out the new rates of benefit and contribution, and gives estimates of income and expenditure of the National Insurance Fund for various years up to 1979-80. From these it appears that the total expenditure of the

Fund is estimated to reach £1093 m. in 1979-80, as against an estimate of £917 m. at present benefit rates. In the same year the contributions of insured persons and employers are estimated to yield £531 m. as against £438 m. at present rates and the increase in the cost to the Exchequer is therefore estimated to be £83 m.

F. J. C. H.

Studies on Medical and Population Subjects, No. 8: Measurement of Morbidity. A Report of the Statistics Sub-Committee of the Registrar General's Advisory Committee on Medical Nomenclature and Statistics.

[Pp. iii+12. London: H.M. Stationery Office, 1954. 1s. 6d.]

THE Statistics Sub-Committee of the Registrar General's Advisory Committee on Medical Nomenclature and Statistics was appointed as a result of a request by the World Health Organization's Expert Committee on Health Statistics that the United Kingdom, together with certain other countries, should make preliminary reports on methods of measuring morbidity and on the terms by which morbidity rates and indices should be described. The Sub-Committee have now published their first report which is concerned with measurements relating primarily to events happening in limited periods of observation, that is measurements of the 'cross-section' of morbidity. The Sub-Committee indicate that they may later submit a further report dealing with 'longitudinal' studies relating to the long-term history of individuals.

The Report is divided into three sections. Section A, the Introduction, describes the scope of the Report and, in particular, stresses the difficulties of definition which beset the study of morbidity. Sickness itself cannot be precisely defined in general terms, but must be defined to suit particular circumstances, which will also condition the types of rates to be adopted. The Sub-Committee accept this limitation and aim at providing a framework of rates sufficiently flexible to be extended to meet most particular needs.

Section B of the Report sets out the framework of rates which have been evolved. In all, eleven rates are defined, the layout being the same in each case, namely title, general definition, short title and notes to assist in the use of the rate. To obtain generality, words in the definition which may vary according to the particular needs of an enquiry, are inserted in italics so that more suitable words may be substituted if necessary. For instance, the word 'sickness' may be replaced by 'sickness absence', 'inpatient care' etc. This method of approach is, in the reviewer's opinion, very necessary and should have the desirable effect in any analysis of morbidity of throwing emphasis on the particular meaning of sickness under review and so avoid confusion with non-similar statistics. A second general principle has been adopted in the use of two alternative basic units, namely the 'spell' of sickness and the sick person.

The individual rates defined are divided into four groups relating in turn to inception, prevalence, duration and fatality. The choice of inception in preference to incidence is an improvement since this latter word has too vague a connotation. Two rates are defined, one relating to the number of spells which start during a period, the other to the number of persons who start at least one spell. Under the heading of prevalence four rates are given, the subdivisions being firstly between spells and persons and secondly between period and point rates, the period prevalence rate (spells), for instance, relating to spells current

at some time during the period of observation, the point prevalence rate (spells) relating to spells current at a given time. It will be apparent, as mentioned in the Report, that the point prevalence rate (spells) and the point prevalence rate (persons) are numerically equal for the same point of time. The third sector, duration, contains four rates which do not fall into the same logical subdivisions. The rates defined are the average duration of sickness per completed spell, the average duration of sickness per sick person, the average duration of sickness per person, the proportion of time sick. The first rate is unique in that it brings into consideration periods of time prior to the period of observation. At first sight this appears unfortunate, since in sickness studies data relating to earlier periods of observation are generally less reliable, and may even be unobtainable, in which event it will not be possible to make use of the earlier part of the period of observation. The use of spells which both begin and end in the period would bias the result, the use of spells beginning in the period would result in an unforeseeable period of follow-up. It is presumably for these reasons that the word 'completed' is not put in italics. There is, however, a further alternative, namely, to use a 'duration per spell' relating the total amount of sickness from spells starting both in and before the period to the number of new spells. This would give the best estimate possible of average duration from the data available in the period of observation and generally would not differ considerably from duration per completed spell.

In considering a framework of rates such as this it is helpful to look for algebraic relationships. There are some already. The average of the point prevalence rates throughout a period multiplied by the time unit gives the average duration of sickness per person which splits into the period prevalence rate (persons) multiplied by the duration per sick person. The modification suggested above would complete the set of relationships since the average duration of sickness per person would also split into the inception rate (spells) multiplied by the 'average duration per spell'.

In the reviewer's opinion a further small improvement can be made in the rates by leaving space in the titles and short titles for the unit of time over which the rates are to be measured and so describing them as 'weekly', 'monthly' or 'annual' rates. This might avoid confusion where the time period of the rate differs from the period of observation.

The last part of Section B describes a fatality ratio which relates the number of deaths from a disease during a period to the number of new cases during the period. There seems to be a lack of precision in this definition. It is thought that it might have been more useful to produce a rate by following up new cases for a given period and relating to them the deaths which result.

Section C describes briefly the various ways by which the rates proposed can be adopted for use in vastly different spheres of activity.

In general, it can be said that the Report takes a great step forward in the study of morbidity statistics, nearer to the desired end where actuary, doctor and medical statistician can talk in the same basic statistical language. The Registrar General states in his foreword that it is intended to try out experimentally the rates proposed. The experience thus gained should be invaluable in consolidating the efforts of the Sub-Committee.

K. G. M.

Catalogue de la Bibliothèque Internationale des Assurances de Louvain. By E. VAN DIEVOET.

[Pp. xv+447. Louvain: Assurances du Boerenbond Belge, 1954.]

THE foundation some years ago of the Bibliothèque Internationale des Assurances at Louvain was undertaken at the suggestion of Prof. E. Van Dievoet, of the Faculty of Law at Louvain, who is also President of the Assurances du Boerenbond Belge. In a preface to the catalogue now published Mgr E. Van Cauwenbergh, Librarian of the University of Louvain, pays tribute to Prof. Van Dievoet's work in establishing the library in co-operation with the university authorities and to the generosity of the Assurances du Boerenbond Belge in making possible the realization of the project, including the publication of the catalogue. We are told, in the same preface, that the publication of a catalogue was undertaken not only to assist users of the library to make full use of its resources, but also because the library appeared to be insufficiently known. For the purpose of drawing attention to the existence and merits of a library a printed catalogue is admirable, and Prof. Van Dievoet, who, in addition to his other work, has undertaken the difficult task of compilation, should feel that his efforts are well rewarded on these grounds alone. There is, however, another reason why a printed catalogue is for this library so useful as to be almost a necessity; this is that the books are not all housed under one roof, but are divided among the central library of the University of Louvain, the library of the Assurances du Boerenbond Belge, and the library of the Faculty of Law.

The library contains 9,000 books on the law, technique and organization of insurance business and related matters. It is thus almost the same size as the Institute library, but it covers in some respects a wider range since all classes of insurance are represented. Considering subjects of particular interest to actuaries, there are about 900 books allocated to *Mathématiques des assurances*, about 600 to *Assurances sur la vie*, and about 1,000 to *Assurances sociales*. Taking into account other smaller sections, it is likely that at least one-third of the books are of direct actuarial interest, in addition to a satisfactorily numerous collection of actuarial and statistical journals. Among the journals, *J.I.A.* appears from vol. xvi onwards, *T.F.A.* from vol. 1, and many other actuarial societies are represented.

Libraries are made for books, not books for libraries. Subject classification, which if successful is a great boon to the reader, is therefore the most difficult, perhaps, of the librarian's tasks. The difficulties are accentuated in a specialist library such as this, where one of the published systems—admirable for general use—may create more problems than it solves. For the Chartered Insurance Institute's library which in scope is similar to the Bibliothèque Internationale des Assurances, the librarian, Mr O. W. Pendleton, has found it necessary to devise a special classification, and a similar task is at present being undertaken at our own Institute library. It is not surprising to find, therefore, that for the catalogue under review Prof. Van Dievoet has constructed his own classification and it would ill become a reviewer without actual experience of the library itself to attempt to criticize it. He may, however, be permitted to applaud Prof. Van Dievoet's thesis that a classification is a working instrument which should be judged according to the use to which it is to be put rather than from the standpoint of pure logic.

The primary classification is into thirteen main groups, each divided into

sections and subsections. Thus X indicates *Mathématiques des assurances*, X. 3 the section *Actuariat*, and X. 3 d the subsection *Tables de mortalité, de commutation et autres tables*. In suitable regions of the classification (for example, IX *Assurances sociales*) the division is on a geographical basis, and reference to the entries under the various national headings show that the library may justly be described as international. Under each subject heading the entries are in alphabetical order of author, and in this respect a curious practice is followed when a book has no individual author. A word is chosen which may describe the nature of the work (e.g. 'Catalogue') or its subject (e.g. 'Alcohol', 'Blood') or may simply be the first word of the title, e.g. the A 1924-29 Tables are under the single word 'Continuous'. The annuitants' mortality tables, a (55), are however under 'Tables'; and as a word chosen for this purpose is used in the language of the title, this particular 'author' appears in three different spellings (four languages). The Institute practice of adopting an indication of source (e.g. name of a sponsoring body) where there is no individual author seems greatly to be preferred. Apart from this feature the entries are excellent, giving clearly the main items of bibliographical information, and show in which of the three buildings mentioned above the book is to be found. Certain books appear under more than one subject heading, and further assistance to the user is provided by giving general cross-references between subject headings that may be connected.

Following the main body of the catalogue is an alphabetical list of authors (in which the substitute words already referred to are printed in italics), giving the pages on which their works are to be found; and finally, the scheme of classification is set out.

Altogether, the catalogue is well arranged and clearly printed, and anyone who learns of the existence of the library through the catalogue will certainly be encouraged by it to seek a closer acquaintance. R.G.B.

How to Lie with Statistics. By DARRELL HUFF.

[Pp. 142. Victor Gollancz Ltd. London, 1954. 10s. 6d.]

PROPERLY read, this book will combine entertainment with aids to clearer thinking for considerable numbers of people. The complexity of modern life has led to an increased reliance on statistical appreciations of situations of various kinds. Apart from the fact that reduction of a real situation to figures may produce a false appearance of simplicity there is the danger that the figures themselves, through incompetence or dishonesty, may be misleading. We are all familiar with the use of statistical 'evidence' in support of advertisers' claims for their products. The book contains some well-known examples of this type of statistical crime ranging from the 'carefully' chosen sample to the exaggerated difference (e.g. 'the highest $\bar{X}$ of any comparable product'), and the artfully constructed diagram.

Although intended primarily for the layman, parts of the book will prove valuable to the statistician. In particular may be mentioned the chapter on 'Post Hoc rides again'—a discussion of more or less subtle spurious correlations. The chapter on 'The semi-attached figure' contains some interesting remarks on sample surveys. There is here, unfortunately, a fertile field for the dishonest use of the weighted question (e.g. 'are you satisfied with the present govern-

ment?' or 'do you support the government?'). There is a further and subtler method of weighting which is not described in the book, though it might well be. This is to arrange that a question on a controversial point, to which 'No' is required as an answer, shall follow three or four questions which will probably be answered 'Yes'.

Summing up, one must qualify the opening sentence of this review by the comment that unless the book is carefully read the impression that will be left will be a vague distrust of all statistics. If the author intended to instruct as well as amuse, a short summary of correct types of analysis and presentation at the end of each chapter would have been a valuable addition to the book.

N.L.J.

Design for Decision. By IRVIN D. J. BROSS.

[Pp. viii + 276. New York: The Macmillan Company, 1953. \$4.25.]

THIS book is about 'statistical decision', and much of it is so good that it is a pity to have to cavil at certain parts of it. From Chapter 6 onwards there is little to complain about. In fact, any statistical student should find these later chapters a great help as background reading. Whether they would provide much understanding for the layman, to whom the book is presumably addressed, is, however, another matter. The parts played in statistical decision by the prior probabilities, the data, the model, the value scale, the criterion for decision (minimax is deservedly played down) are all clearly brought out.

The explanation of the part played by symbolic models (Chapter 10) and the description of the Neyman-Pearson theory of testing hypotheses (Chapter 13) are particularly clear and helpful. It is a pity, perhaps, that in denying (p. 225) the 'fairly widespread belief' that 'current statistical methods' condemn 'a research worker to make mistakes 5 % of the time' the author should have overlooked the colour lent to this view by his own remarks on p. 100! The statisticians really have only themselves to blame for so obstinately neglecting the prior probabilities. It is the recognition of the part played by the prior probabilities that makes the theory of statistical decision so important, although it would be more graceful on the part of the exponents of the theory if they would give some acknowledgment to those who have always stressed the importance of Bayes in statistical inference. The hidden prior probabilities in the Fisher and Neyman-Pearson systems are specifically recognized on p. 83, but there is no reference to Sir Harold Jeffreys who first pointed out their presence. This would not matter if names were generally omitted, but there is a fairly extensive list of 'further reading' and no reference anywhere to Jeffreys, who surely should get some credit for the rehabilitation of Bayes's theorem and for bringing out the importance of posterior probability distributions. In fact, in view of the admitted reaction against the Wald minimax criterion (p. 113) one wonders why the emphasis is so much on Wald's approach. The fusion of the prior probabilities and the value scale in Lindley's system is, of course, another matter altogether and one with which the reviewer is not in sympathy, if only because the appropriate prior probabilities are often specifiable when the value scale has to be arbitrarily fixed (and *vice versa*).

One of the troubles about putting this book into the hands of unsophisticated students is that they may not be sufficiently immunized against the virus of

American pragmatism which is the basic philosophy of the book and which is 'sold' with all the zeal of American salesmanship. Pragmatism's place, like that of the idea of frequency, is at the application stage, not at the foundations. Anyway, no philosophy is so well-grounded, so widely accepted, that it ought to be pumped into scientific students as the one true gospel. Surely a liberal outlook and a free inquiring mind are essential to the modern scientist.

The main trouble, however, about this book lies in the confused treatment of the subject of probability. No harm will come to the reader who has a clear grip of his own attitude to probability, and the novice will be unable to make head or tail of it anyway. To the impressionable student, however, there is considerable danger if he is unable himself to sense the confusion. What can we make, for example, of the three statements (i) 'a sample is... a subset... of a population' (p. 183), (ii) 'The simplest sort of population is a finite collection of individuals such as a deck of cards' (p. 183) and (iii) 'If I flip a coin ten times the results... can be regarded as a sample of possible tosses of the coin' (p. 186)? In (ii) there are 52 alternatives and probability comes in only when we add the notion of 'random sample'—or 'equally likely'. In (iii) there are only two alternatives, but the author goes on to say that 'this latter population is not finite since there is no limit to the number of coin tosses'. He is thus thinking in terms of some unknowable, hypothetical, infinite succession of potential tosses, and again it is only by virtue either of the notion of 'random sampling' which the word 'toss' usually carries with it or of a random selection from this succession that probability comes into this example. This confusion between the set of alternatives or reference class approach and the infinite set of hypothetical potential trials is the besetting sin of the frequentist.

In Chapter 3 there is a complete misunderstanding of the principle of insufficient reason. The author pokes fun at this principle by applying it where there is very ample reason for not assuming 'equally likely'. For example, on p. 63 he says that a person using the principle for betting on horses would 'lose his shirt'. In fact, this system would be perfectly valid if and only if the horse backed were selected either at random or in complete ignorance and the odds given were $(n-1)$ to 1 for n runners. It is easy to ridicule anything by misusing it! A similar misuse appears on p. 50 in connexion with dice-throwing. Actually, the principle of insufficient reason is involved whenever equal probabilities are used in games of chance because there never can be *sufficient* reason. Insufficient reason does not necessarily mean complete ignorance, although the modern users of Bayes's theorem (which statistical decision is stated (p. 84) to have 'restored to its central place in the theory of probability') seem to fail to realize that the measure of the information embodied in any application of the theorem (e.g. the m and n in the expression $p^m (1-p)^n$) presupposes a starting-point, a zero, for nil information. That is why a suitable indifference rule to express the limiting position of complete ignorance is essential.

There are a number of other fundamental points in this book that could be questioned, but there are also many things worthy of approval such as the following: (i) 'For more than a century actuarial studies represented the main, and perhaps the only, fruitful application of probability theory to human affairs' (p. 42); (ii) 'In the real world, there is no such thing as a completely repeatable event' (p. 61); and (iii) '... in some scientific circles the word "subjective" is a form of profanity when applied to a scientific paper' (p. 152).