

marking and tagging; age and growth; eggs and rearing of larvae; food and digestion rates; mortality; fishery management and particularly good chapters dealing with population numbers and ratio of mortality and production. The latter paper includes the most up to date mathematical formulae for the assessment of production and directs attention to the desirability of making separate assessments of the production of sexual products and the production of somatic tissue.

Two particular aspects of sampling fish populations recur in several chapters and demonstrate how much is still to be accomplished in basic work. The recognition of individual fish is deemed highly desirable for many experimental purposes and tagging of most species is still a very serious problem. The second aspect, selectivity of gear, is referred to time and again by different authors and it is important that users of this handbook are made aware of the very real limitations of some sampling methods when unbiased samples are required for ecological studies, and that vast opportunities remain for discovering and developing new methods of catching fish.

An important section of this book is the reference list of 34 pages listing some 700 papers in many languages. This will be especially useful for the worker with limited access to library facilities.

The editor and authors must be congratulated for the speed with which this book has been published—only one year from the date of the technical meeting at which it was planned. The book is written in English; is it too much to hope that in the not too distant future it may be available in other languages too? It is international in concept and deserves to be of international repute.

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should not be overlooked whenever, in practice, the deficiencies of subject bibliographies would make their use imperative—as, for example, in philosophy, where the current bibliographies are inadequate.

The book seems to go well beyond the needs of the “intelligent layman” and the “student, especially at undergraduate or senior college level” for whom it is intended. The author refers to 186 works, many in foreign languages and of earlier periods—an inventory of major sources that would seem more appropriate to the needs of subject librarians and research workers (though the omissions of guides to research, for example, would reduce its value to both). Additionally, the combination of narrative style and historical approach frequently obscures outstanding current sources: for example, in the chapter on dictionaries the importance of English and English is noted but not demonstrated. The alphabetical listing of sources at the end of the book, though valuable for identification, cannot remedy this limitation. Similarly, the form approach can result in the “loss” of an important work. For example, in the section on guides to the literature, Daniel and Louttit is not mentioned (having been classified under handbooks). History and form sometimes take precedence over function: in the section on current bibliographies in psychology the student will learn more about the development of bibliographies than the characteristics and uses of the various types.

It is, perhaps, unfair to mention such limitations in so short a review. Certainly it would be inexcusable to end without stating that this book will be extremely valuable in plugging a gap in subject bibliography.

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HOW TO FIND OUT

How to Find Out in Philosophy and Psychology

By D. H. Borchardt. (The Commonwealth and International Library of Science, Technology, Engineering and Liberal Studies: Library and Technical Information Division.) Pp. vii + 97. (Pergamon: Oxford, London and New York, 1968.) 20s.

THIS book, by the chief librarian of La Trobe University, Australia, aims to give a “broad introduction to the literary guides to philosophy and psychology”. Four of the six chapters (excluding the introduction) are about bibliographies, the other two cover dictionaries and encyclopaedias, societies and associations. It is not a select bibliography of these subjects, and those who come to it for some indication of the major texts, series, periodicals, and so forth, will be disappointed. Within the limited terms of reference it can scarcely be faulted on its basic content: the major guides are here, and the citations are up to date. The omission of the recent *International Encyclopaedia of the Social Sciences* makes the chapter on encyclopaedias defective—but, of course, this is no criticism of a work the preface of which is dated November 1966.

One could question the choice of topics in the chapter on “specialized fields”. Child psychology, tests, psychiatry and mental health, and psychoanalysis seem a somewhat arbitrary representation of the subfields of psychology; and if *Excerpta medica* is to be mentioned under psychiatry, why not *Index medicus*? I find the author’s note on his principles of selection here not altogether convincing. At the other end of the scale the omission of many general bibliographies—major national bibliographies, for example—might also be questioned. Naturally one cannot expect each title in a series such as this simply to repeat such sources, and the author does refer to the general guide, Dr Chandler’s *How to Find Out*. Nevertheless, such sources as the catalogues of the Library of Congress and the *British National Bibliography*

CORRESPONDENCE

Tobacco and Tobacco Smoke

SIR,—Although we normally accept the convention that authors should not comment on statements made by reviewers on their books, we feel, however, that if such statements contain errors of fact which might mislead the reader, corrections are in order (*Nature*, 219, 98; 1968).

Dr Passey refers to calculations on one of our experiments published in 1953, and to more recent studies, in terms of biological response when animals receive tobacco “tar”. We have repeatedly emphasized that to begin to compare experiments from one country with another or even one laboratory with another can only properly be done if at least the same dose has been applied. We know of no experiments done in the early part of the 1950s which permit such a comparison to our early study. In subsequent years, there has been a reduction in tumorigenic activity of tobacco “tars” which we have related to a marked change in the make-up of cigarettes (page 142). Our present results are quite similar to those reported by Day. As a matter of mathematics, when Dr Passey notes that Day reported only 3 per cent of malignant tumours of 7,875 mice, he included in this figure mice receiving a low “tar” dose (25 mg) and even the control animals which obviously received no “tars”. For example, among mice receiving 100 mg of stored condensate three times a week, 14.85 per cent developed carcinoma of the skin. Thus the actual percentage of malignant tumours in the study animals treated with “tar” roughly corresponds to the dose applied by us and is similar to our findings today (15 per cent; *Nat. Cancer Inst. Monogr.*, 28, 168; 1968).

Dr Passey states also that the fact that the incidence of cancer of the oral cavity is relatively stable while cancer of the lung is increasing speaks against a direct carcinogenic action of tobacco smoke because the contact of tobacco smoke is greater in the oral cavity. For one thing, the incidence patterns of these two cancer sites cannot be

strictly compared with cigarette smoking, for oral cavity cancer has been shown to relate to cigar and pipe smoking as well as to tobacco chewing, the former two having a relatively small relationship to lung cancer. What has changed in the last 20–30 years is not so much the number of tobacco users as the number of cigarettes smoked. Perhaps more pertinent is the fact that the absorption of particulate matter of tobacco smoke for which carcinogenic activity has been demonstrated in animals is significantly greater in the lungs than within the oral cavity of man (page 91).

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Not the Mysticism but the Science of Numbers

SIR,—We have been stimulated, as was no doubt intended, by the recent editorial criticisms (*Nature*, 217, 793; 1968) of the papers of Professor Derek de Solla Price to reply, for misunderstanding of the trends and objectives of the so-called science of science is evident.

Science is indeed an immaterial cultural product of the intellects (and hands) of people but nevertheless has a clear concrete basis in the means of its generation, propagation and use. The situation that in producing science actual people produce actual documents and artefacts, expending real money, time and energy in the process, invites physical measurement. In recent years such measurements have been made with steadily increasing frequency and care.

At the time (1652) when John Graunt, Citizen of London, published his book "Natural and Political Observations . . . made upon the Bills of Mortality. With reference to the Government, Religion, Trade, Growth, Ayre, Diseases, and the several Changes of the said City", science was not yet one of the estates of the realm or John Graunt would have examined it. Today, however, the sheer volume of science, or R & D as it appears in the statistics, is, in terms of people engaged in it, in the USA for example, increasing towards 5 per cent while the proportion engaged in basic agriculture is falling towards 5 per cent. Science, in its material aspects, as a complex developing system involving people, information, materials and money, invites study in terms of statistics, cybernetics, systems analysis and other appropriate modern techniques.

This study is required not only "because the object for study is there" and represents an intellectual challenge to the understanding, but because science (if most broadly interpreted) consumes 2–3 per cent of our GNP and because we believe that the progress of science and of our material prosperity may be interconnected. We similarly believe on statistical grounds that lung cancer and cigarette smoking may be causally related. The relationship between science, technology and society can also be discussed in this way, although, of course, as in the biological case, all methods likely to show up the detailed mechanisms must also be tried.

The aim of the science of science is the construction of theoretical foundations for the organization, planning, management and prognosis of science. These foundations must be built from a solid corpus of observations and experiment which will satisfy the criteria of science that they could be repeated by any competent observer who takes the trouble to do so. It is possible that a broad theoretical understanding of the phenomena of science may not result, but it is nevertheless a legitimate hope that on the basis of scientific study the number of variables with which those planning science have to deal may at least be reduced. An experienced gardener gets to know at least some of the conditions essential for the development of his plants. But for what is Professor Price

criticized? Mainly for the attempts to introduce quantitative estimates into the study of a human activity. We suspect that the emotional response to this is similar to that greeting the demand for "one man, one vote" which is a crude attempt to quantize politics. At the same time the emotional response to the appearance of "The Double Helix", which shows that science is all too human, indicates that a probe from the opposite direction is also striking truth.

We ask the question directly: is it possible to characterize live scientists and real scientific institutions by quantitative indices which summarize information and illuminate key features of the system?

An attempt to describe the love affair of Romeo and Juliet in numerical terms might appear unpromising, but science is not entirely powerless in this matter. First, the drama (according to Shakespeare at least) has a structure developing in time through the stages: enunciation of the components; development of the conflict; the crisis; the resolution of the crisis and the description of the resulting steady state. Second, science has explicit information even on the processes of love, and poets neglect the findings of molecular biology, of ethology and of communication systems (such as those employing pheromones) at their peril. Studying love is admittedly difficult, but prowess at the intellectual activity of chess is easily quantized and the Grand Masters are found by counting points. Science is surely somewhere in between.

Science undoubtedly has aspects which can be measured statistically or modelled as systems and, if we do not try to measure them, then someone else will. We must point out that some hundreds of people are now engaged in activities on these lines, so that Price is not alone.

No one may know in advance the day of death of an editor of *Nature* but, following Graunt, the operation of insurance companies is based on the experimental measurement of the probability of just such occurrences.

The interesting preliminary correlations found by Price indicate that, as in the case of lung cancer, there is something worth detailed study.

We try to use statistics with responsibility. We find, for example, that in a sequence of 53 kings a run of four dying on the same day of the week is to be expected with a probability of 1 in 7 so that we do not need to attribute the deaths of the Georges to the malignity of Saturday. The genetics of porphyria has much more relevance.

Similarly in the study of science itself, statistics indicate that there may be things to be explained by detailed study of the actual mechanisms. Here, the work of the established historians of science, if they can be persuaded to bring their studies up to the science of the present day, provides the basic facts.

Needless to say, as in all branches of science, the science of science can only advance (in the way in which John Ziman describes in "Public knowledge") by the growth of a corpus of knowledge which after criticism is accepted by the scientific community. We think that already in the science of science there is a coherent body of accepted fact enough to define it as a respectable field of study. In this stage editorial blasts will not blow it away; new observations and alternative theories based on the existing facts are needed to disturb the structure which Professor Price has begun to set up.

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