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Scientific Method in Bibliography.

THE printed chronicle of human endeavour in all civilised countries of the world, in many tongues and recorded in multifarious publications, has long been accumulating at a rate so great, that not merely is its co-ordination beyond the power of any single mind, but also no central institution has been able to analyse it, so that this priceless store of knowledge may be made available for further advance.

At an earlier period, the author of a scientific or technical paper may have cherished the fancy that, by publishing his work, he was giving it to the world. To-day we have learnt by experience that to print a magazine article may be merely adding padding to a volume on the library shelf, for, without an index to recorded information, it is likely to become inaccessible. Nearly every one of that comparatively small band of workers who are patiently seeking to extend the boundaries of knowledge, to discover new and better methods of manufacture, or to invent and improve apparatus and machinery, must have realised the continual duplication of effort, which acts as an ever-present check to progress.

The lack of an extensive index to information was felt during the War; then machinery was hastily invented and methods of manufacture quickly devised, while the records of better apparatus and processes were lying buried on the library shelves. It is agreed that in peace and war a comprehensive guide to recorded knowledge would be an asset of the greatest value that would lead at once to important scientific and technical developments, while without it untold time and energy are being wasted throughout the world by the useless repetition of research and invention.

Various attempts have been made from time to time to collect, classify, and distribute information. A large number of publications are, or have been, devoted to the bibliography of special subjects; perhaps the greatest of all was the International Catalogue of Scientific Literature. There are, besides, many bureaux, both English and foreign, of divers types, engaged in the preparation of indexes to particular classes of information. Yet, in spite of all this activity, not the semblance of the desired key to knowledge is available.

This deplorable failure, which is restricting progress and prolonging unnecessary discomfort and inconvenience, may be due in great part to the lack of that which it is the purpose of bibliographies to supply; that is, information. For want

of knowledge, bibliographical research is being undertaken everywhere, at home and abroad, without attention to the canons of bibliography or previous experience of its methods. Each abstracting or indexing body adopts a different system of classification and the abstracts or index slips are produced without regard to size, so that they cannot be mounted on cards and amalgamated with other bibliographies, and the information collected becomes hopelessly lost in thousands of separate parts. Moreover, every bureau indexes or abstracts papers that are done by, usually, a number of other bureaux, and only a fraction of the literature is covered.

The science of bibliography is not a subject of general study, and many scientific workers who realise the need of practical training in scientific method as well as knowledge of previous work appertaining to their special field of investigation, fail to understand that the same is true of bibliography. The would-be bibliographer must bring a scientific mind to the study of his task and must gain proficiency in bibliography by laborious practice. The indexing of scientific papers has also the added difficulty that the needs of scientific workers cannot be appreciated fully except by themselves. Thus an efficient index to scientific literature can scarcely be produced except by the application of a thorough knowledge of bibliographical science, wide experience in its application, and expert knowledge of the subjects indexed; that is to say, it is imperative that the scientific method be applied to bibliography.

Since the preparation of a complete index to published information involves the co-operation of many workers, it is necessary that a single system of classification should be chosen, which must be kept up-to-date by some central body. If, however, a definite classification were accepted and utilised by existing bibliographical undertakings, it would be possible to amalgamate their work into one series of cards which would go far towards the universal index desired. All information collected on a given subject would then fall together into one place to be available at need, and it would become apparent that identical information is being collected from the same periodicals by many different indexing agencies, and that information on a given subject is interesting to workers in many different branches of science or technology. By consultation, overlapping could be avoided, and energy, at present being wasted, could be used in indexing literature not dealt with hitherto.

The International Classification, described by Dr.
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S. C. Bradford elsewhere in this issue, is, ready to hand, such a scheme as is required for the preparation of a great index to recorded information, and no other suitable system is available. The general adoption of this code would make possible now the realisation of the index desired. Some thousands of bibliographies are in actual progress. At present their utility is very limited. But merely to number the bibliographical titles by the International Classification would make it possible to amalgamate them all into one index of the greatest value to mankind. The scheme has been utilised on the Continent as the basis of extensive bibliographies. The Classification is surely gaining ground and has received the support of the League of Nations. Recently, in Great Britain, the Optical Society has published an English translation of part of the Classification which has been used for the classification of the index to its *Transactions*. This can now be cut up, pasted on cards, and incorporated with other bibliographies numbered in accordance with the code.

When the International Catalogue of Scientific Literature came to an end, it was obvious that sooner or later the preparation of a comprehensive guide to scientific literature would have to be revived. The ideal solution to the problem has been suggested to be the building up of a National Science Library to take every important scientific periodical or publication together with a complete index to their contents, so that documentary research could be carried out in one building without waste of time journeying to different libraries.

As the Science Library at South Kensington contains an exceptionally extensive collection of scientific periodical literature, it seemed desirable that its resources should be developed so as to ascertain the possibility of realising such an ideal library. An organised effort is being made to augment the fine collection of scientific journals and transactions in the Library so as to make it as complete as possible. This has been so successful that periodicals are being added at the rate of a thousand or more a year, and the Library now includes between six and seven thousand of the items in the World List. The continuation of this undertaking, if possible on a somewhat larger scale, should lead in a few years to the gathering in the Library of a nearly complete collection of scientific periodicals.

After very careful consideration, the International Classification has been adopted in the Science Library for indexing the titles of its books and more important papers. The Library

contains also sets of certain other bibliographies, as well as of some smaller undertakings based on the same system. All these are now being collected into one repertory, to which it will be possible to add any bibliographies that adopt this classification afterwards. The whole will be available for consultation in the Library together with the books, or from the index it should be possible to supply extracts by post at the cost of typing and postage.

The work of the past three years shows that the attainment of the first half of the ideal is possible. Its complete realisation would follow if it were possible for bibliographical undertakings generally to adopt the Decimal Classification of the Brussels Institute.

Atomic Structures.

(1) *The Progress of Atomic Theory*. By Dr. Albert C. Crehore. Pp. ii + 230. (London: Taylor and Francis, 1926.) 12s. 6d. net.

(2) *Die Welt der Atome : Zehn gemeinverständliche Vorträge*. Von Prof. Arthur Haas. Pp. xii + 130 + 3 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1926.) 4·80 gold marks.

(3) *La fisica dei corpuscoli*. Per G. Gianfranceschi. Terza edizione. Pp. viii + 267. (Roma: Università Gregoriana, 1926.) 18 lire.

(1) **T**HAT the Rutherford-Bohr atomic model, despite its remarkable success in explaining and correlating so many of the facts of physical and chemical science, is not yet universally accepted, is evident from a study of the first of these three books, the title of which will probably lead many who are unfamiliar with Dr. Crehore's writings to expect something quite different from what they will find. The book is really an account of the progress of the author's own particular atomic theory. Although we fancy that it will win few converts to his views, it is, nevertheless, not without interest.

Broadly speaking, Dr. Crehore believes, as so many of us would like to believe, that all atomic processes can be explained in terms of classical electrodynamics. It will probably be in the earlier chapters that the work will prove least convincing. Here the author describes the atomic models on which his subsequent calculations are based. We are told that the hydrogen atom consists of a nuclear charge of two units with two spheroidal electrons in contact with it, one on each side : similarly, the helium atom has a positive charge of four units, and on each side of this charge are

two electrons closely bound to it. From these two fundamental atoms Dr. Crehore proceeds to construct the more complex atoms by a suitable arrangement of hydrogens, heliums, and cementing electrons. His atoms are more or less close-packed assemblages the linear dimensions of which are of the order of 10^{-13} cm.

The difficulties presented by such atoms are manifold, but if once the reader gets past these early chapters and accepts, even if only for the sake of argument, the hypotheses, he will find the subsequent chapters more logical. Indeed, in the development of his theory, Dr. Crehore shows no small courage and considerable mathematical skill in dealing on classical lines with these unconventional atoms. Perhaps the most interesting problem he sets himself is to explain why it is that atoms so small as 10^{-13} cm. should build themselves into solids in which they are separated by distances some ten thousand times greater than this. For this problem he claims a solution in the case of hydrogen.

The origin of a spectrum line of wave-length λ involves, according to this theory, an excursion of an electron to a distance $0\cdot05\lambda$. This applies equally to the optical and X-ray regions. In considering the latter spectra, the author emphasises the fact that this excursion is small compared with atomic distances in the solid. It is of interest to note, however, that recent direct determinations of long wave-length X-radiations would involve excursions considerably greater than the distance of closest approach of neighbouring atoms.

In spite of a bold defence of these atoms, which includes an explanation, based on them, of gravitation, there are still many gaps which will have to be filled and many difficulties which must be overcome before the majority of physicists will consider that the theory has progressed sufficiently far to replace that which is more or less generally accepted.

(2) If a course of Dr. Crehore has shaken, ever so slightly, the reader's faith in the conventional atom of to-day, it should be easy to restore it by a study of the second of these books. Dr. Haas is well known as a writer with a very considerable gift for clear and concise exposition, and this latest work worthily upholds this reputation. It is based on a course of lectures intended for a non-specialist audience and covers practically the whole range of modern atomic physics. That is a great deal to expect of a relatively small volume, but the author has selected his material with excellent judgment and woven it together into a convincing