

human as well as the technical and economic problems with which they are confronted.

If indeed this problem were solved, there would probably be no lack among Ministers and members of Parliament, in the higher ranks of the Civil Service and on the boards and directorates of industry, of a sufficient number, not simply of scientists and technologists of proved administrative competence, but also of administrators capable of appreciating for themselves the importance of scientific and technical factors in a problem or situation. In such conditions, there would probably be little difficulty in working out effective policies for the expansion of technical education at all levels and for keeping educational policy in balance with the resources of Britain and with the demands for trained man-power of all kinds. The primary problem is that of communication, to which compartmentalism of all kinds—whether in the central government, in local government, or in educational institutions—excessive specialization and apathy are the greatest obstacles.

The Minister of Education is evidently determined to deal vigorously with apathy on the part of the public to the extent to which it hinders boys and girls from entering on careers in science and technology and full use being made of the facilities now being provided. Even in that task, he needs all the help that professional institutions and such bodies as the Parliamentary and Scientific Committee can give him; still more, he requires the full co-operation of the schools, the technical colleges and universities, government departments and industry in improving the facilities and making full use of the trained man-power that will be forthcoming. To deal with the neglect of industry and of public bodies to make sufficient use of scientists and technologists and to see that those now employed are used efficiently under appropriate conditions and supported adequately by technicians and craftsmen are more difficult tasks, which under present conditions appear to fall chiefly within the responsibility of the Lord President of the Council. There appears to be a field calling for greater effort and considerable inquiry, if not research; but the content of education in this age of nuclear power and automation also offers a large and urgent field for inquiry at all levels. This applies not merely to the education of the scientist and technologist, the craftsman or technician, but equally to the education of the ordinary citizen, whether he be employed in some unskilled job in office or factory, in agriculture or transport, or in some highly responsible administrative post.

Perhaps the most encouraging feature of the debate is the evidence that this problem of education is beginning to be approached as a whole and not piecemeal. Much, however, remains to be done before full understanding is established and relations between the different sections is sufficiently close to avoid waste and frustration while providing the flexibility upon which the Government rightly insists. There is welcome evidence that the professional institutions themselves are approaching the question of professional training at all levels with

fresh minds, for they, too, have an indispensable contribution to make. Above all, there are needed wise vision and clear thinking, the discarding of doctrinaire approaches and preconceived ideas, and the urgency and driving force which come when education is seen as the outstanding weapon for adapting ourselves to meet the challenge of change. The more that education is seen as a single problem and its significance is appreciated—not simply for particular developments like that of nuclear power, but also to the whole economy of Britain and the efficient use of our resources in industry, the public services, defence and welfare—the easier it should become to introduce whatever radical changes may be required in the organization of the education system itself, in that of the central government, or at local government level. There may well be dangers in the system of block grants to local government authorities recently announced, though Lord Hailsham has given emphatic re-assurances to the National Union of Teachers on that point; but at least the system involves a closer association and understanding on the part of the local elector with what is being done in the schools. Without such co-operation and understanding the Government's plans for the expansion of technical education and of university education are unlikely to succeed. Given that co-operation and understanding and goodwill, there should be little difficulty either in making the changes required in organization or institutions, or in the relationships of institutions and departments. Further, co-operation is essential in securing whatever further expansion may prove necessary, either in the universities, the technical colleges and colleges of technology, or in the schools themselves, and the acceptance of the sacrifices in other sectors of the economy that such expansion and the consequent diversion of resources in man-power and materials inevitably entail.

ENCYCLOPÆDIA OF CHEMICAL TECHNOLOGY

Encyclopedia of Chemical Technology

Edited by Raymond E. Kirk and Donald F. Othmer. Vol. 15: Waxes to Zymosterol. Index to Volumes 1-15. Pp. xiv+936. (New York: Interscience Encyclopedia, Inc. Distributed by Interscience Publishers, Inc.; London: Interscience Publishers, Ltd., 1956.) 30 dollars.

THIS is the last of the fifteen volumes of Kirk and Othmer's "Encyclopedia". The first volume was published in 1947 and the production schedule of six to seven months per volume has been closely maintained.

The original purpose of this encyclopædia, namely, to publish "a comprehensive treatment of the American Chemical Industry", has been more than accomplished, for the words "Chemical Technology" which define its scope have been taken to include a wide range of subjects including unit processes of chemical engineering, analytical methods, economic information as well as chemical and physical properties of many substances and industrial products.

This volume opens with an article on waxes of animal, vegetable and mineral origin. A vegetable wax such as carnauba, or an insect wax such as bees-wax, has a great variety of uses in many different industries, but from the section on economic aspects, their total production is small compared with that of the mineral waxes. The article states that medieval sealing wax was a wax, for it contained bees-wax. Modern sealing 'wax' is chiefly shellac and venice turpentine and not therefore a true wax. The article on wine reminds the European reader that this encyclopædia is essentially American. The output of French wines is about fifteen times as great as that of California, but the consumption in the United States is predominantly Californian wine, so there is good reason for the article being concerned particularly with wine production in California. The article, however, is well balanced and refers to methods of production of wine in many different countries.

A number of important products fall within the scope of the letter 'W', including wine, wood, wool. The articles on both the latter are comprehensive. Under 'X', perhaps there are still unknown technologies, but the articles dealing with xanthene dyes, X-ray analysis and xylenes show that there is much that is known under the letter 'X'.

There is only one main article under 'Y', but that is a particularly up-to-date and useful one for reference purposes, mentioning work by Winge, by Lindgren and others on the genetics of yeast, etc. There are a number of other references under letter 'Y', which appear in other articles in the encyclopædia; for example, an account of yttrium is to be found in the article on the rare-earth metals. The clear referencing to other articles is a feature of the encyclopædia.

The last letter of the alphabet is responsible for articles on zein, zinc and zirconium. In the wet milling of corn, the germ, fibre and starch are separated from the ground steeped grain, leaving the gluten of the endosperm. This gluten is about 70 per cent zein, which is the alcohol-soluble protein. It is used as zein fibre in the textile industry, for paper coatings, etc. The articles on zinc, zinc alloys, and zinc compounds occupy fifty-six pages, which contain much useful reference material; for example, curves are given summarizing work at the Bureau of Mines on the thermodynamics of the reduction process. Reduction and purification of zinc-bearing materials can be accomplished in a single step to a greater extent than for most metals because it possesses a relatively low boiling-point. The isolation of zirconium, on the other hand, owing to its high melting point (1,830° C.), its avidity for atmospheric gases and reactivity with most refractories offers great difficulties. The article on zirconium states that the estimated production in the United States, primarily for naval atomic power installations, was 168 tons in 1954. Under zirconium compounds, the hydride takes a prominent place, being employed as a 'getter' in the electronics industry.

'Zymosterol' ends this very comprehensive encyclopædia, from which clear information is quickly obtained about almost any subject which is within the field of, or relates to, chemical technology. Zymosterol does not, however, end the volume, which carries on from p. 313 for a further 623 pages of subject-index, serving the whole fifteen volumes. It is a detailed index of 50,000 entries and will be a most useful addition to the whole set of volumes: for

example, there are 48 references to various volume^s and pages under 'detergents', only nine of which are in the special article on detergents. Thus, the index greatly extends the usefulness of the encyclopædia for reference purposes.

This encyclopædia is a fine achievement. It is costly, but the trouble which has been taken to present the information clearly is worth much. It should become available in any library designed to meet the need of technologists. There are nearly 14,000 pages of text and 800 special articles.

The information is particularly valuable in summarizing the state of chemical technology in the United States at the present time; the economic and other information relating to the different products is well presented. An encyclopædia, like a butterfly, however beautiful, is ephemeral. It is, therefore, satisfactory to note that there is to be rejuvenation. A supplement volume is in preparation, which will include subjects in which there have been developments of exceptional interest since the original articles appeared, bringing them up to date. It is expected that this supplement will be available at the end of this year.

ALFRED EGERTON

BERTRAND RUSSELL'S CONTRIBUTION

Logic and Knowledge

Essays 1901-1950. By Bertrand Russell. Edited by Prof. Robert Charles Marsh. Pp. xi+382. (London: George Allen and Unwin, Ltd., 1956.) 25s. net.

THIS volume may be recommended to those unacquainted with the leading ideas of our greatest living philosopher. The selection of essays is based both on their intrinsic importance and on their inaccessibility. There is a consequent bias to the first quarter of the century, which, however, comprises that part of his thinking which is most original and most likely to be enduring; not much is included of his philosophical speculations provoked by the modern developments of physics.

Lord Russell played a leading part on his own, and in due course in conjunction with Whitehead, in elaborating a system of formal logic from which "all pure mathematics can be deduced without any new undefined idea or unproved propositions" (p. 325). This deduction is surely a matter of stupendous significance in relation to the nature of human knowledge and of mathematical knowledge in particular. Yet, oddly enough, Russell has not devoted as much attention as one would expect to elucidating that significance; and no successor has appeared of sufficient philosophical calibre to do that work for him. His own interests took a different turn.

The system involves the construction of what may be called a new logical language. In recommending this, together with the 'theory of types' which it incorporates and which was Russell's most important single contribution, he lays much stress on its power to rescue us from those embarrassments which are caused in our ordinary language by the unsatisfactory status of such statements as "the present King of France is bald", and by the contradictions involved in such statements as "I always tell lies". *Prima facie* these embarrassments strike one as essentially trivial, and, although the escape from them by a