

days of rapid progress: it has been produced in less than seven months.

Prof. Lehninger begins with a succinct account of the historical development of the subject. He then deals with the structural aspects, and this is followed, in several chapters, by a discussion of the oxidative processes (citric acid cycle, fatty acid oxidation and ketone body oxidation and formation, the properties of the electron transport chain and the mechanism of oxidative phosphorylation, including the energetics of mitochondrial metabolism and the control and integration of the various metabolic processes). Other chapters deal with the active transport of ions by mitochondria and with energy-coupled changes of volume and structure. One chapter is devoted to the ultra-structure in which the author discusses the information relevant to bridging the gap between electron microscope and chemical investigations of the basic molecules, or molecule assemblies, which have to be fitted into the structure.

Particularly stimulating is the final chapter on the bio-genesis of mitochondria, a subject on which information is still very scanty. Various hypotheses are discussed and include the *de novo* synthesis of mitochondria from sub-microscopic precursors present in the cytoplasm, the formation from other membranous structures in the cell, and the growth and division of pre-existing mitochondria. Mitochondria certainly have the capacity to synthesize some of their protein from amino-acids. Other mitochondrial components are synthesized extramitochondrially and taken up 'ready made' by the growing (or adapting) mitochondria. But the source of the mitochondrial matrix—the outer cell membrane, the endoplasmic reticulum, the nuclear membrane, the nucleolus and Golgi apparatus have all been suspected—is still unknown.

The book integrates in a happy way the different kinds of mitochondrial investigations—biochemical, physiological and structural. No doubt it will find many friends among students at all levels.

HANS KREBS

TRAINING THE INDUSTRIAL WORKER

Training within the Organization

A Study of Company Policy and Procedures for the Systematic Training of Operators and Supervisors. By David King. Pp. xxii + 274. (London: Tavistock Publications (1959), Ltd., 1964.) 38s.

NOW that the State has taken over responsibility for the development of industrial training and has empowered Industrial Training Boards to extract a levy from companies for training purposes, the attention being directed by industry and commerce to training has shown a noticeable increase. Attention, however, is not enough and many industrial managements are finding that the training required of them is much more than the sit-by-him variety. The help of specialists is being increasingly sought and, where they can show a practical approach to methods of training which lead to demonstrable improvements in workers' efficiency, managements are more than ready to accept their recommendations.

Training within the Organization aims to provide a systematic approach to the training of operators and supervisors which, so far as it goes, could be most useful to those concerned with the training of operators. King first presents a case-study of a company in Norway which was faced with the need to improve the performance of women employed in garment making. He describes how the elements of jobs were differentiated by analytical methods, how a training sequence and programme were built up, how an instructor was selected and trained, and how the trained novitiates were introduced to the more austere conditions on the factory floor. In a neighbouring factory

a similar approach to the training of supervisors led to the setting-up of self-governing working groups.

In the second part of the book the author examines the process of learning and shows how it should be used in training. The third section establishes the place of operator training in the company organization and, in the fourth section, detailed procedures in the training of operators are explained. The author also includes a chapter indicating how the effectiveness of training can be reviewed.

All in all, the case for the systematic training of operators in manual skills is well presented and the book will meet only with the criticism that it contains little that is new and has not been more succinctly presented by others elsewhere. If Mr. King had ventured outside the now familiar training schemes for sewing machinists, garment folders or stocking linkers, his book would have gained wider support, but the narrowness of his approach detracts from the appeal of the book. The inference throughout the whole work is that all that is needed in training operators is improvement in dexterity and that the systematic approach to the inculcation of skills is the universal panacea. The cognitive aspects of an operator's job are almost entirely ignored, and in those jobs where knowledge is at least as important as systematic training to develop manual skills, dexterity could be but a small part of the overall training required. In a chemical plant, for example, or in oil refineries, the operators need not only to be highly skilled manually but also to be well aware of what is taking place in pots and vessels and when and how to read instruments so that manual skills can be properly used. Nor will an approach which is not difficult to introduce on inexpensive equipment like sewing machines offer much comfort to managers faced with the problem of training operators for capital equipment like rolling mills, or for jobs that can only be done by operators working in teams, particularly where complete new teams are seldom required.

Mr. King's exhaustive approach to the development and administration of company training schemes also leaves much to be desired. Rather than detailed procedures, managers and supervisors would welcome guidance about what are, for them, complicated differences between City and Guilds and National Certificate Courses; when and where to recommend operative, craftsman, Intermediate Certificate and full technological courses; differentiation between Higher National Certificates and Higher National Diplomas and what endorsements mean to Section 'C' examinations of the professional institutions. To suggest that operator training schemes can be developed without reference to accompanying educational courses is to take an unrealistic specialist view which implies that we have not progressed far from the concept of the employment of 'hands' in industry.

The attention directed to the training of supervisors is so scanty that it is difficult to understand why it was included.

T. H. HAWKINS

ECONOMICS OF EDUCATION

The Control of Education

By John Vaizey. Pp. 263. (London: Faber and Faber, 1963.) 30s.

THE Control of Education, the publishers claim, tells us "about education—its value, its cost, its control". In fact, it tells us little about these things but a great deal about Mr. Vaizey's opinions concerning them.

Mr. Vaizey has collected together a number of talks and papers which he has given at various times covering a variety of topics such as "Education and Economic Development"; "Manpower"; "A Policy for Higher Education"; "The Status of Teachers". There has been

very little editing. Since each essay is a unit in itself, it would have been helpful to be told when, and for whom, each had been written. As it is, we are left to grope along a series of dark corridors which turn out to be unconnected.

Some of the content is clearly aimed at developing countries and has little relevance to Great Britain. Much of it concerns education in Britain, but is oddly out of date. Thus, although published in 1963, his chapter on the block grant was presumably written before the introduction of the block-grant system in 1959 and is printed without revision or apology. It repeats the fears expressed by those who then opposed the system and contains no reference to the fact that by 1963 Britain had access to experience of the system as it had been worked out over the first three years of operation. An examination of these years would have shown that Mr. Vaizey's fears prior to 1959 have not been realized; there is, therefore, little point in repeating them as economic laws in 1963.

Mr. Vaizey has earned a deserved reputation as a pioneer of the investigation of the economics of education. Perhaps he is writing too much too quickly. Certainly some of his expressed opinions—including those to which he seems to attach most importance—merit more examination and research than he gives them. It is a good debating point to say that it is the shortage of teachers that keeps the financial structure of education alive. But is it anything more than a debating point? It is true that to supply the service with the 100,000 additional teachers which it badly needs will cost an extra £300,000,000 a year. But does it follow, as Mr. Vaizey asserts, that had these teachers been available "the local taxation system and the general grant system would have come under intolerable strain some time ago"? The system is flexible. We already spend £800,000,000 more a year on education than we spent 10 years ago, with no visible signs of a breakdown. Even if there is a ceiling to the rate share of this increase (and we have no idea what it might be), nevertheless the ratio of grants to rates can be adjusted to take the strain.

This is a point which Mr. Vaizey ignores; he seems to cling to the idea that a higher proportion of government grant is inadvisable because it leads inevitably to diminution of local control. This belief that local independence can only be assured by a high degree of local fiscal autonomy used to be widespread, but local authorities themselves are now beginning to question its validity.

Mr. Vaizey, however, not only still holds to this view, he also believes that only a very large authority can pay its way and that the present structure of local government must, therefore, give way to a system of regionalization. This is another *non sequitur*. There is, no doubt, a minimum size of administrative unit necessary for economy and efficiency. But what is this size? And beyond the minimum, how true is it to say 'the larger the better'? These are some of the vital questions which the professional educational economists should be considering, but they must be answered on the basis of careful costing, not of pontifical pronouncement.

N. MORRIS

TOWARDS THE EDUCATION OF THE WHOLE MAN

South Kensington to Robbins

An Account of English Technical and Scientific Education since 1851. By Michael Argles. Pp. xiii + 178. (London: Longmans, Green and Co., Ltd., 1964.) 21s. net.

SOUTH Kensington to Robbins presents the history of scientific and technical education, against its social and economic background, since the Great Exhibition of 1851. In the light of recent developments, and because of the imminent massive expansion in the whole field of technology and technical education, it treats a subject which is interesting, important and timely. The author, the assistant librarian of the University of Lancaster, has

produced a first-rate book, which compresses a considerable amount of information into a small space. The documentation is exceptionally well done. He pays tribute to some important figures in the history of English scientific education whose value has never been properly assessed or who have been overlooked. Such men were Albert Prince Consort, Lionel Playfair, Joseph Whitworth, Quintin Hogg (Senior), Roscoe, Lord Percy, A. W. Hofmann and his students. The story of English technical and scientific education, until the Second World War, is both surprising and sad. England did not lack men with knowledge and vision, including some trained in Germany, knowing the position of science and technology there, who were eloquent in their plea for a rational position for the 'pure' and 'applied' sciences in education. In 1851, after the successful conclusion of the Great Exhibition, Playfair said, "Until our schools accept as a living faith that a study of God's works is more fitted to increase the resources of the nation than a study of the Amours of Jupiter or of Venus, our industrial colleagues will make no material headway against those of the Continent". Even the obviously better technical equipment of the Germans at the beginning of the First World War was no lesson to England, so far as education was concerned, and the Spens report of 1938, just before another great war, has to confess that there was "little development of Secondary Schools of quasi-vocational type for those who desired to enter industry and commerce at the age of sixteen".

We have been waiting for Robbins for a number of years and, now that it is with us, we are still waiting, to a large extent, for it in terms of a new Government. But a report, even when followed by the expenditure of large sums of money, does not necessarily secure either success or efficiency. *The Times* considered that "by concentrating on the demand for places, as they interpret it, the members of the Committee have paid too little attention to the difficulties in which the universities would find themselves. The change of scale, the influx of students of questionable academic bent, the thinner spread of first-rate teachers are bound to influence profoundly the nature and quality of British universities . . . the Robbins rate of expansion . . . is not proof against the criticism that it would work to dilute academic standards". The conscientious provincial university teacher struggling with the least apt quartile of his students—"the already tapped sources of untalent"—may well wonder where are the "great untapped sources of talent". It is fair to say that cogent rebuttals of the "more means worse" type of argument have been made.

The foreword to the book is by Charles F. Carter, the Vice-Chancellor of the University of Lancaster. It is a masterpiece in one paragraph. It should be read by every responsible citizen. "Education remains a mysterious process, we are sure neither of how to achieve results, nor of what results we want to achieve. Technical education, though it may seem to have the simple function of providing the developed skills needed by society, must now in reality prepare people to develop skills which have not yet been imagined, required by technical or commercial processes not yet conceived; and it must do this in a way which has regard to the universal need of general education. . . . What we have done has usually been too little and too late; we still have to learn to educate for the needs of the future and not for the needs already passing which we have just belatedly come to understand. There is still a great lack of research and experiment".

Many more teachers who understand and practise modern techniques of teaching, examining and the use of libraries will be required. The university lecture which is a mere transcription of the lecturer's notes into those of the students, without the matter going through the minds of any of them, is not good enough: it never was!

Technology is not enough. It is a means to an end. A better technology does not ease the problems of the starving millions unless it is applied with freedom and goodwill on all sides. It does not even ensure a greater