Book Reviews

The Organisation of Science in England. D. S. L. Cardwell, Heinemann, London, 1957, ix + 204 pp. 18s.

At a time when many nations are giving increased attention to the development of an adequate supply of well-trained applied scientists, Cardwell has supplied a well-documented and highly relevant case history of the development of a class of professional scientists in England. The telling of this story provides an opportunity for analyzing the developments of education in applied science in England, and for comparing those developments with parallel ones on the Continent.

Formal training in applied science was late in getting started in England. The Ecole Polytechnique was established nearly a century before anything comparable existed in England, and the great technological schools of Germany and Switzerland were frequently cited models in efforts to improve science education in England. There were, however, antecedents to the great growth of science at Cambridge, the founding of Imperial College, and the development of other now prominent centers of technological education. Cardwell gives some of the antecedent and parallel developments from the 18th century into the 20th: the Mechanics Institutes, the changing character of the universities, the origin and course of development of the Cambridge Natural Science Tripos, the founding of University and Kings Colleges in London and the University of London, and other significant events such as the impact of the Great Exhibition of 1851 and the later establishment of the Exhibition Fellowships.

These individual histories are used to document two major themes which run throughout the book. One is the argument that to have a flourishing scientific industry requires the existence of a class of professional scientists, and that to have a class of professional scientists requires both an educational system designed to train them and an adequate number of positions in which their vocation can be practiced. An organized system of technical education provides the solution to this apparent circle. It offers professional training. It also provides jobs for those who have been trained. Only after a sufficient number of teaching positions become available can industry begin to employ scientists, either by taking some from teaching posts or by engaging new graduates.

This is the major theme of the book, and it provides the framework for considering individual developments and comparing English with Continental experience. For example, when the International Exhibition of 1862 was held in London, there was much enthusiasm over Perkins' recent discovery of mauve. The official handbook of the exhibition promised, ". . . we shall soon become the great colour exporting country. . . ." The promise failed of fulfillment. Seventeen years later, Germany had 17 color works to England's five, and was producing coal tar colors of over four times the value of those manufactured in England. True enough, England was exporting, but primarily coal and coal tar rather than the finished dyes. Germany's leap ahead was attributed to the existence of a group of professional chemists, something England did not have.

The second recurring theme is the still fresh problem of the merits of specialization in education. Cardwell gives the arguments, pro and con, of many of the leading British scientists of the past century, and shows the relations between these arguments and the developing aspects of technological education. It is on this topic that the author closes. The achievement of professional science he recognizes as a desirable advance in social organization, but the high degree of specialization that now characterizes English education, even in the later secondary years, may well, he contends, hinder the progress of science itself by increasing the difficulty of communication and cross-fertilization among the interdependent branches of science.

Appropriately, the publisher classifies this work in the field of sociology. It is a thoughtful, useful contribution to the sociology of science.

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The Hypercircle in Mathematical Physics. A method for the approximate solution of boundary value problems. J. L. Synge. Cambridge University Press, Cambridge, 1957 (order from Cambridge University Press, New York). x + 424 pp. Illus. $13.50.

One of the more beautiful *objets d'art* in mathematics is surely that of Hilbert space. Here geometry and analysis meet and enrich each other. It comes as somewhat of a shock to realize, under J. L. Synge's prodding, that one of the possible avenues wherein geometry could help in analysis has simply not been used. The chain—Euclidean concept to Hilbert space to analysis—has not been exploited. To be sure, the concept of distance has traveled this road. But the concepts of the plane, the sphere, the circle, and so on, have not.

This book undertakes to remedy this situation. Various geometrical constructs with which we are familiar in three-dimensional space are generalized to the infinite number of dimensions of Hilbert space. The insight, which comes from having a geometrical understanding, automatically suggests theorems and their proofs. In particular, an application to problems of boundary values suggests itself. In these geometrical terms, a boundary-value problem resolves itself into finding the intersection between the subspace composed of functions which satisfy the differential equation involved and the subspace composed of functions which satisfy the boundary conditions. For example, in electrostatics, upper and lower bounds to the capacity can be found, and a method of successive approximations can be set up.

The book is a model of clarity. The author starts slowly, reviews often, and gives many examples. One should not, however, think that it reads like a novel. The reader has to do some work too! Applications are made mostly to the Laplace equation, although the biharmonic equation, as well as the equations of acoustics, electromagnetism, and elasticity, is treated.

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Handbuch der Physik. vol. 32, *Structural Research.* S. Flügge, Ed. Springer, Berlin, 1957. 663 pp. Illus. $27.50.

Perhaps no other volume of the new *Encyclopedia of Physics* shows the changes which have taken place in physical research so clearly as does the volume on structural research. Even in the second edition (1933), the classical article by P. P. Ewald was barely 200