

Applied Mathematics

Mathematics for Physicists and Engineers. Organisation for Economic Cooperation and Development, Paris, 1961 (available from O.E.C.D. Regional Office, Washington, D.C.). 223 pp.

This tract is the report of an international seminar which was held in Paris in 1961; the seminar was organized in response to a French proposal that stemmed from concern about the content and pedagogical philosophy of the mathematics courses customarily taught to engineers. The proposal stated that "Mathematical studies for the sole purpose of learning this abstract science are not necessary for future research workers and engineers. There is reason to fear that the teaching of mathematics, which is naturally in the hands of mathematicians, is often allowed to go too far in this direction. It would, therefore, be extremely interesting to come to some understanding as to how much mathematical knowledge is indispensable for engineers and experimental scientists."

The participants (about 80 attended) represented nearly all the countries of western Europe, as well Greece, Turkey, and Yugoslavia, the United States, and Canada. Seminar papers, reproduced in this tract, were presented by H. O. Pollak (U.S.), M. Jacob (France), H. Wallman (Sweden), Mrs. L. J. Abercrombie (U.K.), M. Fallot (France), A. H. Douglas (U.K.), J. Fagot (France), H. D. Baehr (Germany), T. L. Cottrell (U.K.), H. J. G. Meyer (Netherlands), A. Kaufmann (France), P. Naslin (France). The range of viewpoints and the criticisms of the status quo, represented in these papers and in the associated discussion, were what one might expect from a similar conference of engineers, physicists, and applied mathematicians in the United States.

Working groups prepared coordinated reports entitled "Upper level secondary school mathematics," "Preparatory training in its pure sense," and "Professional training leading to the first diploma of higher education, as well as to post-graduate training."

The essence of the conference and its reports is contained in its conclusions and recommendations, of which the most significant are: (i) In the elementary teaching of mathematics one should not go into abstraction for itself, but one is required to start from the con-

crete, even for the introduction of a new teaching approach. (ii) At the "propedeutic" and more advanced levels, the introduction of mathematical topics should be motivated by their relevance to science and engineering and should progress from the special to the more general; after their introduction, the mathematical topics should be presented with mathematical rigor by mathematically competent persons. This necessity for rigor is more important at teacher levels; exercises (supervised and at home) should be drawn from physical and engineering applications; their major aim should be to deepen the understanding. (iii) The mathematical requirements of many categories of engineers, as well as physicists and physical chemists, are similar in kind, but the level to be attained may differ in particular cases. (iv) These requirements are vector field theory, linear algebra and matrices, complex variables, integral transforms, ordinary differential equations, partial differential equations, special functions, and probability and statistics. Throughout the foregoing, the quantitative aspects of mathematics should be stressed and the value of numerical methods recognized. (v) If, because of restricted time, a choice must be made between depth of understanding and breadth of coverage, the former should prevail.

I would like to hope that this reiteration of familiar theses will lend its share of weight in persuading the body of teaching mathematicians to re-recognize their pedagogical obligations to their scientific brethren.

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Education and Productivity

The Economics of Education. John Vaizey. Free Press (Macmillan), New York, 1962. 165 pp. \$4.

This brief book is largely a review of existing economic research on the contribution of education to productivity. It also directs some attention to the inputs of the education process—the alternative combinations of labor and capital from which choices of production techniques may be made—and to the problems of financing education.

Vaizey states in the introduction that he has "tried to apply economic anal-

ysis to education . . ." but it is not until he writes the conclusion, 138 pages later, that he admits to "tainting the pure milk of economics with a flavouring of the social purposes of public policy." Some readers may find that the mingling of value judgments with analysis makes the book more readable, but instructors may feel that this limits its usefulness in the classroom. And Vaizey hopes the book will find acceptance there.

There is much food for thought in this book, though we might wish that the analysis had been more acute. In a chapter entitled "The returns to education," Vaizey discusses what he sees as four approaches which have been used to measure returns. One employs aggregate-economic concepts. It attempts to discover how much economic growth is explainable by *quantitative* increases in labor and capital; it attributes the remaining, "unexplained," growth to other factors including *qualitative* changes in resources, of which education may be an important determinant.

The other three approaches view education as an investment analogous to construction of a machine. Vaizey calls them: (i) "Discounting of the additional earnings of the educated"; (ii) "Calculation of human capital"; and (iii) "Cost-benefit ratios." Without being precise, he seems to describe approach i as a means of evaluating the returns from, or the *benefits* of, investment in education, and ii as a means of evaluating the *costs* of resources devoted to education. Thus, iii encompasses i and ii, although Vaizey does not indicate this. If the profitability of education as an investment is one's focus, as it is for Vaizey in this chapter, and if his descriptions of the approaches are accurate, then iii is the only relevant approach; it is the only approach that compares the values of inputs and outputs. Yet, surprisingly, Vaizey "rate[s] the last *two* as most satisfactory" (p. 37, italics added). Actually, all of the economists mentioned by Vaizey as having worked with approaches i and ii have done so within a cost-benefit framework, so that there is really no significant difference between the three approaches. Vaizey's descriptions are simply incomplete.

In spite of its limitations, *The Economics of Education* is a useful presentation of current thinking in the area, blended with Vaizey's ideas concerning education as a contributor to lofty so-

cial goals. Moreover, the noneconomist student may benefit from the frequent reminders that education is not immune to economic analysis: scarce resources are required, and, as a result, decisions about public expenditures should be made with an awareness of the costs and benefits of alternative allocations of funds.

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Russian Translation

Monogenetic Trematodes. Their systematics and phylogeny. Boris E. Bychowsky. Translated from the Russian by P. C. Oustinoff. W. J. Hargis, Ed. American Institute of Biological Sciences, Washington, D.C., 1961. 627 pp. Illus. Members, \$9; \$10.

This work is divided into three parts. Part 1 is concerned with the morphology, biology, and life cycles of monogenetic trematodes. Part 2 discusses and lists Monogenea and related hosts in a variety of ways. Part 3 treats the systematics and phylogeny of the Monogenea.

The chapter on morphology (in part 1) admirably summarizes scattered information but offers little that is new. The discussion on musculature is general to the point of being incomplete, and the information on the excretory system follows the traditional pattern for flatworms but does not mention that flame cells have not been demonstrated in many Monogenea. Contradictory statements are exemplified by "... at the time of development of the animal, the basic chitinous elements of armament are formed, not directly in the cuticle, but in the mass of parenchyma" (p. 37) versus "... in spite of the fact that the chitinous elements of the disc are incepted in the parenchyma, they are undoubtedly of cuticular origin..." (p. 424). The chapter on the biology of the Monogenea is very good. Chapter 3 and the supplement (part 1) are entitled in the table of contents (in order) "Embryology of monogenetic trematodes," and "Materials on embryology of monogenetic trematodes," but the corresponding chapter headings in the text are "Development of monogenetic trematodes" (p. 85), and "Data on the development of monogenetic trematodes" (p. 146). The chapter headings are more correct, for embryological studies are virtually nonexistent. Apparently the author meant postembryonic observations on developing larvae, which are discussed in chapter 3 and the supplement (part 1). These are extensive, sound, and contain much original information.

The discussion in part 2 is concerned with (i) the hosts of Monogenea, (ii) the occurrence of species, genera, and families of Monogenea on the species, genera, families, and orders of fishes, (iii) the occurrence of Monogenea on Amphibia and reptiles, (iv) general considerations concerning occurrence and specificity, and (v) Monogenea belonging to separate groups of hosts. This interesting section is encyclopedic in scope. However, some of the tables are misleading and very difficult to interpret.

Part 3, on the systematics and phylogeny of monogenetic trematodes, is extensive but fraught with inconsistencies and omissions. Substitution of the term Monogenoidea Bychowsky, 1937, for the established one, Monogenea Carus, 1863, as the designation of a class is unwarranted and violates a long-established usage of the suffix -oidea for superfamilies. This apparently was largely responsible for the recommendation (29A, 1961) that this suffix be recognized as such in the International Code of Zoological Nomenclature. The two subclasses, Oligonchoinea and Polyonchoinea, which were proposed by Bychowsky in 1937, are based on the number of haptor hooks in the larvae. Two serious difficulties are immediately suggested in this separation: (i) there is a greater difference in the number of larval hooks found within each subclass than the difference found between the subclasses; (ii) the life histories necessary for the assignment of species to these subclasses are known for representatives of less than one-half of the families of the Monogenea.

Unfortunately, Bychowsky did not list species of any genera, although he had the information at hand (p. 242). Further, he failed to provide keys, which are always invaluable, and he also avoided the use of established nomenclature for the Monogenea.

Mistakes, clumsy and inept usage, misspelled words, and the lack of strict adherence to the *International Rules of Zoological Nomenclature* are conspicuous. The participation of author, translator, and editor in the present produc-

tion makes difficult the assignment of errors. Awkward statements can be assigned to the translator and the difficulties inherent in the two languages. Inept and unconventional biological usage, misspelled words, careless mistakes, and some inconsistencies are the fault of the editor.

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New Methods and Techniques

Transplantation of Tissues and Cells. R. E. Billingham and Willys K. Silvers, Eds. Wistar Institute Press, Philadelphia, 1961. vi + 149 pp. Illus. \$7.50.

Transplantation of Tissues and Cells deserves a special place on the bookshelf of anyone interested in problems of tissue transplantation. As the editors point out, the book is designed to present, in detail, certain procedures and principles used in experimental transplantation of tissues and cells. It is particularly valuable because each author attempts to stress the problems encountered in learning new techniques. These problems are rarely mentioned in individual publications, but they often account for the great difficulty encountered in mastering new methods. The book contains chapters on various techniques of skin grafting in birds (Billingham) and mammals (Billingham; Steinmuller); in addition to these technical problems, it includes a discussion of the principles of skin transplantation (Billingham), a chapter on the immunogenetic aspects of tissue transplantation (Palm), and one on the method by which transplantation antigens can be extracted (Billingham).

Other chapters deal with the transplantation of endocrine tissues (Palm; Russell), the transplantation of tissues to the chorioallantois of chicks or to the cheekpouch of the hamster (Billingham), and an experimental procedure for establishing parabiosis between animals (Wilson). A detailed account is presented of the materials, methods, and possible problems involved when tissues are transplanted in diffusion chambers (Amos). Another section is devoted to the induction of acquired tolerance to tissue homografts and the transfer of transplantation immunity