How and why to teach

THE EDUCATION OF A PHYSICIST. Conf. proc. (London, July 1965). Sanborn C. Brown, Norman Clarke, eds. 185 pp. MIT Press, Cambridge, 1966. $7.50

by Robert L. Weber

This attractive, expensive little book is a lively account of the International Conference on the Education of Professional Physicists held in London, 15–21 July 1965. We are told that the editors retired to a delightful and secluded sixteenth-century hotel in Sussex to write the book from tape recordings of the conference. It may seem that on some controversial matters Brown enjoyed taking the last word, as his role of editor permitted. But he has earned this privilege by producing, with Clarke, an informative and challenging book.

Discussions reported are organized in these sections: (a) first-degree courses, (b) special problem areas, (c) practical work, films and television, (d) technical universities and (e) relationship between government, industry and the university. The book ends with a page of resolutions adopted by the conference.

Better than the formal resolutions, quotation of some views expressed in the sections enumerated above may serve to give the flavor of the book.

Lord Beeching in the opening address: "At present, while declaring that vocational training is not the job of a university, they tend to train for one vocation, a vocation to pure research."

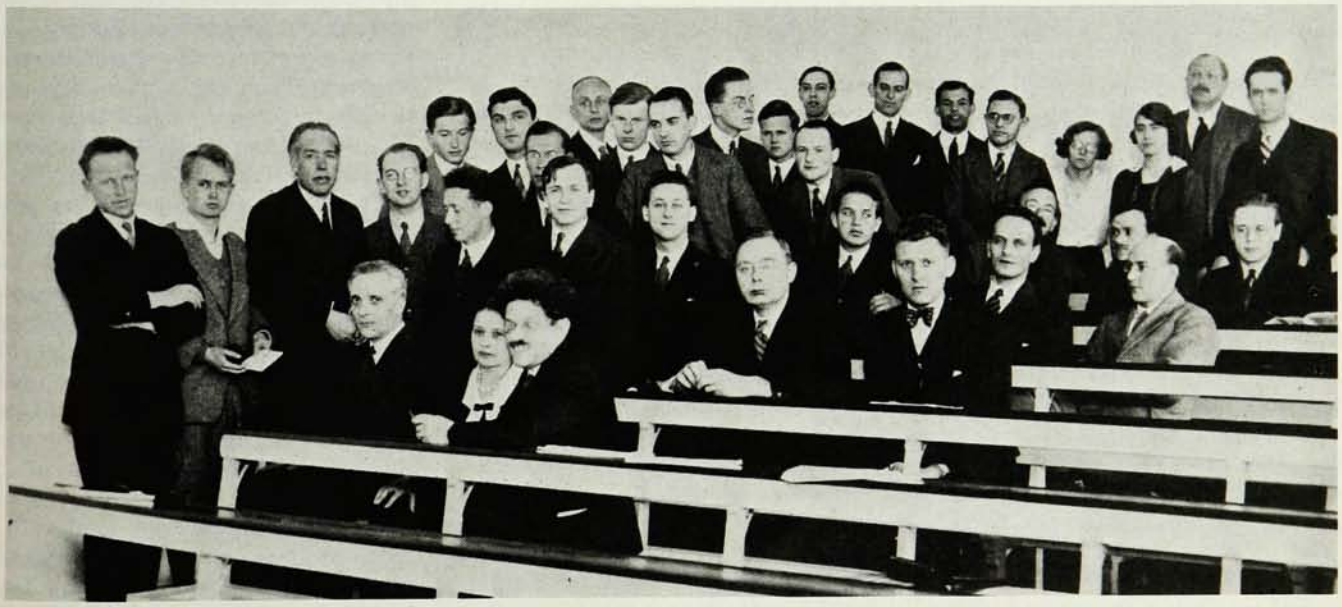
(a) A. B. Pippard (Cambridge University): "If we accept that our task is not to give the best professional training to the best students, but to pay particular attention to those who are going straight into industry, into government service, into physics all over the world with less than first-class degrees and first-class aptitudes, then we must do something about changing our courses."

W. Schaffer (University of Cape Town): "An unfortunate type of scholarship is the American Field Scholarship. . . . it is circulation rather than a one-way flow which should be encouraged."

(b) P. R. Thornton (University College of North Wales): "Two criticisms are made of PhD graduates. One is their unwillingness to tackle anything even verging on an application of physics, and the other is their lack of versatility. . . . we are in danger of replacing actual creative effort by the symbol of creative effort [published paper output] and the symbol is often not as good as it should be."

Bernard Friedman (University of California, Berkeley): The "need for more general concepts can be met only by the use of the more abstract mathematics. . . our previous emphasis on the teaching of detailed mathematical techniques should be discarded. We must, as in teaching all other sciences, emphasize concepts more than facts. We must teach linear spaces and linear operators instead of vectors and matrices. We must introduce the concepts of group and group representations. . . the theory of random variables as a basis for probability and its elaboration in the theory of Markoff processes must be considered as a fundamental part of a physicist's training."

(c) S. C. Brown: "M.I.T. believes very strongly that every teacher and professor should teach. We have no such thing as 'research professors.' . . . in my own research group, after the initial days of registration, I no longer know whether the men and women in my laboratory are undergraduates or graduates. The whole system is one of absorbing the students into the



EDUCATION OF SOME PHYSICISTS included having Niels Bohr as a teacher. A group at the Bohr institute in Copenhagen in 1932.

going research laboratories, and not prescribing any particular course of experimental work... because... you do not teach physics in practical work.... The only way you can do this is to throw away the routine experiments, throw away the laboratory manual..." (S. C. Brown coauthored the *Taylor Manual of Advanced Undergraduate Experiments in Physics*, sponsored by AAPT in 1959.)

E. Mendoza (University College of North Wales): "Contact with staff merely by mixing with their research group is haphazard. What we are trying to do is deliberately to teach how to design apparatus, how to be critical of apparatus, and how to organize a primary research project. ... It is a terrible criticism of us who teach science in the universities that graduates in English literature or history are found to have more logical and analytical minds than scientists."

(d) N. Clarke (Institute of Mathematics and its Applications, England): "The term 'sandwich course' is intended to indicate a course where periods of study in a university or college, extending over weeks or months, alternate with periods in industry or a government laboratory.... One of the requirements is that the student shall be engaged in industry on work which is relevant to his studies and which will help him to see the significance of them. A second essential requirement is that during the six months in industry the student shall be able to maintain appropriate contacts with the college.... A further feature.... is that the experimental work in the college, especially in the last year, has taken the form of projects. This is perhaps the feature more than any other in which the colleges have been pioneers in the United Kingdom."

(e) G. S. Bosworth (English Electric Co. Ltd.): "A physicist taking a post other than in a research laboratory will inevitably become a technologist. Unfortunately, the feeling seems to exist in the U.K. that technologists are second class scientists, if not second class citizens. The process of analysis is more highly regarded than the process of creation, but knowledge and understanding have little purpose if they are not used. Scientific knowledge can only be of lasting value if it is used in the constant struggle by mankind to dominate his environment. Man from the earliest times has been a technologist, and we in industry welcome especially the scientist who wishes to use his knowledge in creating the means whereby this can be accomplished."

All participants in the Conference are identified and a nine-page listing of their mailing addresses is given. It would have been helpful if addresses had also been given for sources of the films and film loops assembled by G. R. Noakes (pages 98–125).

Anyone interested in the education of physicists and the role of physics in society should find in this book some arresting new ideas and perhaps challenges to his present beliefs and practice.

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Robert L. Weber is the author of a number of physics textbooks. He is an associate professor at The Pennsylvania State University.

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Evolution of ideas

THE CONCEPTUAL DEVELOPMENT OF QUANTUM MECHANICS. By Max Jammer. 390 pp. McGraw-Hill, New York, 1966. $10.50

by Eugen Merzbacher

Most physicists who are active today studied quantum mechanics after World War II when it had already become a textbook subject, codified in terms of a set of consistent physical principles and mathematical techniques, and taught efficiently by a hardened pedagogic approach pioneered by Pauli (in his *Handbuch* article) and Dirac (in his *Principles of Quantum Mechanics*). We are fortunate that now an author of Max Jammer's ability and experience has provided us with a thorough and readable account of the genesis of the structure of quantum mechanics. The appearance of his *Conceptual Development of Quantum Mechanics* is an important publishing event in physics, and the book is a fitting addition to its publisher's distinguished green International Series in Pure and Applied Physics.

This is a study primarily of the evolution of ideas and knowledge that in the mid-twenties culminated in the formulation of quantum mechanics as we know it. As such it is a significant