

# THE QUALITY OF EDUCATION IN PHYSICS

THE last five years have been boom years for research and have seen a bull market for physicists. Research in physics and its fruits are referred to daily in the press. Under the forced draft of military support, research budgets are many times their pre-war values and they are still mounting. This stimulus has been as wisely applied as the best of judgment could devise, and the debt of physics to the Office of Naval Research, the Atomic Energy Commission, and other government support is appreciatively acknowledged in nearly every scientific paper to appear. The increase in the number of these research contributions is almost equally impressive; in 1945 the *Physical Review* printed about 6000 pages and in 1950 nearly 13,000.

Under this impetus the number of physics students has increased by more than half in the same period of time. It is estimated that in the 1949-50 academic year 350 doctor's, 900 master's, and 3400 bachelor's degrees were awarded. In spite of this growth in numbers the demand for more physicists has outstripped the supply and is increasing at least temporarily at a greater rate. The figures from the Institute's Placement Service show that there are somewhat fewer registrants with it for jobs in 1951 than in 1950, but that fifty per cent more employers registered with the service and the number of job openings listed were five times as great in 1951 as in 1950. The jobs are good ones and it is the rule rather than the exception that the starting salary in industry for the recipient of a PhD is but little less than the salary of the professor under whom he worked.

These are stirring times for physicists, but what of the underlying health of the academic system that produces them and the quality of its product? There is a considerable spread between the circumstances of the large tax-supported university which can react rapidly to the demands of society and the smaller endowed institution which is caught between a dwindling income and rising costs. But in general the burden of training has fallen upon an academic group but little larger than it was five years ago which has found itself at the little end of the horn of plenty. The research facilities are in general much better than they used to be by virtue of the funds made available under research contracts for the acquisition of equipment. This is good for the acceleration of research output, but it is not a completely unmixed blessing in the educational process since it tends to dull somewhat the spur of resource and ingenuity. Funds, however, are not available from this or any other source for im-

proving the quantity or quality of instructional personnel. Though a professor's salary is small enough in all conscience, instructional budgets have been requiring the greatest economy; most institutions meet this inexorable demand with low-salaried assistant instructors who are themselves graduate students with the minimum of experience. This system further accelerates the rate of training and research output, but at the cost of an added burden on the professor who must supervise both the instructional and research activities of these very junior colleagues.

The professor's is an honorable and intellectually rewarding vocation, but it has been and still is a calling rather than a profession. Nowhere else except in the ministry are so many expected to accomplish so much of social significance for so little worldly reward. Most of the dedicated individuals who have taken up residence in the academic cloisters have done so with their eyes open and the educational process has for long been characterized by the impact of the unworldly scholar upon the youthful and impressionable students in his classes and laboratories.

But the professor's life is no longer what it used to be and this may be expected to have a profound effect both on his successors and his students. The social and economic forces to which he is subject have distorted his activities almost beyond recognition. He is caught up in the big business of research and finds himself the administrator of a training program under all the pressures of a production line. He is more concerned with the negotiation of contracts than with the solution of experimental difficulties; the telephone is more often in his hand than the voltmeter. He spends more of his time at his desk with his secretary than in the laboratory with his students. He is in demand for boards and committees which are charged with such important responsibilities that he cannot deny his services, but his attention is inevitably deflected from his primary obligations to teaching and research. He is a harried and harassed individual with little time for his professional interests and academic pursuits and none at all for that leisure of thought and speculation in which alone the seeds of real creativity can germinate.

A changing educational pattern is being brought about which if it persists will have a profound effect upon both teachers and students. In order to cope with the situation as it exists, the professor is forced to delegate those very functions of teaching and research which alone drew him into his chosen



career to his younger colleagues and even the students themselves. His successor on observing this will be a different type of man than he is himself. His students are not learning from his example and daily association what he learned from his predecessors of a past academic generation. Even the best student advances less quickly, and the great majority of students in the overflowing classes and laboratories are severely handicapped by the infrequency of personal contact with a skillful and mature scientist. The occasional genius will unaided recognize the crucial experiment or theoretical development by himself. But even he will have difficulty in selecting and employing the most appropriate technique and arriving at a significant and convincing conclusion without the guidance of an experienced investigator. The students who persevere are perforce learning self-reliance but the educational system is not serving them well.

The number of students receiving degrees is impressive but the quality of training has suffered. This tendency toward a dilution of the profession will react upon its standards and its standing. Much pure research of high quality is now being conducted in industrial and government laboratories where excellent salaries and congenial working con-

ditions are attracting many of the ablest young men. Our academic institutions can take great satisfaction in having contributed to the bringing about of this situation. But now comparably attractive opportunities must be provided in colleges and universities on a scale that will ensure an instructional staff of the highest quality and adequate in size for the job to be done. Unless this is brought about, the trend toward dilution and mediocrity will increase with inevitable repercussions on the scientific profession. The quality of the scientific manpower they employ is the measure of the potential of our industrial and defense laboratories. A second or third-rate scientist were better off in some other occupation. The quality of the nation's scientists and the significance of the programs upon which they are engaged are dependent upon the maintenance of the highest standards of educational performance by our colleges and universities. We must do more to strengthen our scientific training than we are at present and to bring about those conditions which will attract an adequate number of the most competent scientists and most inspiring investigators into academic employment.

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## NOTES AND COMMENTS

### Zucker's Article Protested

Most of the opinions expressed by A. Zucker in his article "A Physicist's Holiday" (*Physics Today*, January, 1951) seem to me and to most of my Italian colleagues very personal, and anyhow very different from ours. I do not wish to enter into all details, as that would need an article as long as his, which does not seem to me to be worth while. But the point which I feel obliged to answer is the opinion attributed to Italian physicists with regard to the constitution of a European laboratory. Such a proposal, put forward by the American delegation at the 1950 UNESCO assembly in Florence, was received with very great interest. I should almost say enthusiasm, by the great majority of Italian physicists, who in all meetings whether national or international held for this purpose have always been extremely desirous to contribute actively to the construction and the functioning of such an organization. No anxiety exists among Italian physicists, but on the contrary a lively desire to collaborate in this field of scientific activity, as in every other field, with their colleagues and friends of other countries, and in particular with the French, who on their part are not less interested and desirous to collaborate with us.

Other opinions of Mr. Zucker, such as the incapacity of Italian and French physicists to collaborate in "team work," are lacking in common sense and lead one to suspect that the author has never read the titles of the works published in these countries by physicists associated in most cases in

large groups. Some of Mr. Zucker's opinions seem to be due to his slight understanding of other languages and mentalities. For instance, in his reference to the opinion of Prof. Bolla, Mr. Zucker has confused the crowd of secondary and high school teachers with the physicists destined to do research. I do not think it is the case to discuss whether Italian physicists are "disgusting" or not. It is true that almost all Italian professors, including Prof. Bolla and myself, believe that much better physicists could be produced than we produce today, and we hope to succeed in this effort in the near future, but we do not think that those we produce now are so bad, at least if we compare them with those of other countries.

I hope that Mr. Zucker will soon be able to come to France and Italy (or to other European countries) and to remain and work for some time. I am sure, really sure, that all here will learn and appreciate his sureness and unbiased judgement, and he on his side will be able to realize that aside from matters of an external nature the physicists of these countries have as much interest in scientific research as do physicists of the U.S.A. and certainly not narrower views, in so far as concerns the relation among groups of scientists from politically different countries; and that they are always ready to find a good opportunity to have a drink, be it Coca-Cola, Cognac, or Frascati wine.

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