News and views

A Letter to the Editor

Physics Teaching in Secondary Schools

I have read the article on "The Role of the Secondary School in the Teaching of Science" by Dr. George R. Harrison (*Physics Today*, June 1952) and find that it presents a point of view which I can endorse completely. It is indeed encouraging to find men of science who have taken the time to become so well aware of the problems of public school education as has Dr. Harrison, and even more encouraging when they will express themselves so brilliantly on problems of education in a publication such as *Physics Today*, which reaches not only physicists but scientists and engineers in general.

I want to support the principal thesis expressed in Dr. Harrison's article by referring to the work of one of our Indiana physicists, Dr. K. Lark-Horovitz of Purdue University. He was influential in helping to bring about needed reforms in teacher certification in Indiana. His ideas, which were largely adopted by the Indiana State Commission on Teacher Certification more than ten years ago, have been expressed in reports of the Committee on the Teaching of Physics in the Secondary Schools which was organized by the American Association of Physics Teachers in the late 30's and by various reports of the AAAS Cooperative Committee on the Teaching of Science and Mathematics.

One of the reports of this latter committee was mentioned by Dr. Harrison in his reference to the Steelman report. The portion referred to is an appendix entitled "The Present Effectiveness of our Schools in the Training of Scientists", which was prepared by the AAAS Cooperative Committee at the request of the President's Scientific Research Board and which appears in *Manpower for Research*, volume four of *Science and Public Policy*, a report to the President by John R. Steelman, Chairman, The President's Scientific Research Board, October 11, 1947. This report was one of several prepared by the AAAS Cooperative Committee while under the chairmanship of Dr. K. Lark-Horovitz.

This 100-page document covers the matter of science and mathematics teaching at all grade levels from elementary school through the graduate school. It is my opinion that the far reaching recommendations which were made in this report have not been brought properly to the attention of the public.

Although it is always inadequate to pull statements out of context, I shall list below some of the recommendations which are considered vital to the improvement of science instruction at the secondary school level.

General Recommendation, for Immediate Action:

1. Establish in-service teacher training; (a) by workshops, maintained through grants-in-aid providing for teacher subsistence; (b) by provision of science and mathematics counselors throughout the country, one in each of the fields of mathematics, life science, and physical science per million of population.

General Recommendations for the Long Range Program:

1. Sponsor investigations of grade and age placement of concepts and ideas in the sciences and mathematics with a view to aiding teachers in curriculum planning.
2. Promote the design of and experimentation with testing instruments and guidance procedures which would lead to an early identification of talent.

Recommendations for the Improvement of Instruction in Science and Mathematics at the Secondary Level:

1. A complete appraisal should be made of science and mathematics teaching in secondary schools. This should include a survey of curriculum offerings, student enrollments, available laboratory and demonstration equipment, methods of instruction, the work week of the teacher, and the total preparation of teachers for their responsibility.
2. The secondary-school science curriculum should be reorganized so as to permit at least two years of science beyond general science for all students (e.g., general biological and general physical science) and at least three years of science for students with special talents.

Recommendations Relative to the Recruitment and Training of Secondary School Science and Mathematics Teachers:

1. Some teacher training institutions should provide at least one year of graduate work in which ample courses in science and mathematics are offered to meet the needs of the teacher instead of the research scientist.
2. A general increase in the level of teachers' salaries should be provided. The professional preparation required is such as to justify a mean salary of $5,000 per year of all teachers.
3. It is recommended that the preservice training of secondary school science and mathematics teachers: (a) provide for certification in closely related subjects within the broad area of science and mathematics; (b) allot approximately one-half the undergraduate program of study to preparation in the comprehensive teaching area; (c) include basic courses in biology, chemistry, mathematics, and physics for every teacher; (d) require 18 semester-hours as a minimum for certification in a particular subject; (e) provide for study beyond the basic courses in the comprehensive area of certification.

4. Professionalized subject matter courses should be provided in the sciences and mathematics. These courses should be planned cooperatively by the subject matter and education departments and taught in the subject matter department by an instructor experienced in secondary school teaching.

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Physics Manpower Resources

Some Findings of the Scientific Register

Preliminary results of the survey of manpower resources in physics for the year 1951, conducted by the National Scientific Register with the cooperation of the American Institute of Physics, have been summarized by the U. S. Department of Labor, Bureau of Labor Statistics, and by the NSR. The Register is organized under the Office of Education of the Federal Security Agency. The data reported cover some 6600 physicists and give a statistical breakdown for the following categories: fields of specialization, age, military status, educational background, fields of employment, functions performed, and professional income.

Estimates of the total number of physicists in the United States have ranged from twelve to twenty thousand, approximately 3500 of whom are PhD's. Although the survey by the National Scientific Register included only fifty percent or less of the total number, it is significant that nearly three thousand of those questioned were PhD's, representing about four-fifths of all PhD's in physics in the United States. In addition, some 1300 graduate students, nearly one-fourth of all graduate students of physics in the early part of 1951, were included in the survey.

A few of those listed in the survey (8 percent) were working in fields other than physics at the time of the NSR study. Of those working in physics, 44 percent were employed in colleges and universities, which is probably a higher proportion, it is pointed out, than would be found among physicists who were not members of professional societies. The next largest group (31 percent) worked in manufacturing industries, particularly electrical machinery, professional and scientific equipment, and atomic energy installations. The Federal Government had 15 percent under direct employment, while only 3 percent worked for nonprofit organizations and only 2 percent for schools below the college level. Approximately half of the scientists questioned were doing research work and a third were teachers. Another 8 percent were in administration and management. A few (in each case less than 2 percent of the total) were working in consulting, design, inspection, production, technical sales, or technical writing.

Electronics, nuclear physics, and optics were the leading fields of specialization reported. The relative numbers listing these fields as those of their highest competence were: electronics, 18 percent; nuclear physics, 15 percent; optics, 14 percent. Another sizable group (15 percent) did not indicate an area of specialization. Among the graduate students who reported a specialty, by far the largest group was in nuclear physics.

A detailed report of the survey is in the process of being published, according to the National Scientific Register. It is also planned that articles dealing with other aspects of the survey will be published in this journal in the near future.

Circular Nomograph

For Atomic and Weight % Interconversion

The chart on the opposite page, a circular nomograph devised at the Battelle Institute to permit quick interconversion of atomic and weight percentages in binary systems, is the outgrowth of work originated by H. W. Russell and extended by R. W. Dayton and E. M. Simons of Battelle. Such conversions are often found necessary in physics, chemistry, and metallurgy, but while the calculations involved are quite simple, they can become tedious—especially when a large number of conversions must be made. In using the chart, the first step is to obtain the atomic weight ratio by noting where a straight line joining the points corresponding to elements A and B cuts the diametral scale. A second straight line through this point on the diametral scale then joins the corresponding weight and atomic percentages of element A. If, for example, it is desired to find the atomic percent of copper (element A) in a copper-lead alloy containing 75 weight percent copper, the atomic weight ratio is determined on the diametral scale by a line joining Cu on the left with Pb on the right. Joining this point to the 75 percent mark on the weight percent scale and extending the line to the atomic percent scale then gives an answer of 90.7 atomic percent copper.

The nomograph can also be used for determining the atomic composition of salts or the molecular concentrations in binary mixtures of any compounds of known molecular weight. In the latter case, one would simply compute the ratio of molecular weights, locate the proper point on the diametral scale, and then draw a line through this point to join corresponding weight and mole percentages. The chart may, in fact, be applied for any conversions which follow the same type of relationship as that between atomic and weight percent. Volume and weight percentages, for instance, can be interconverted by calling the center scale specific gravity ratio instead of atomic weight ratio.

Linear nomographs and charts for the solution of such problems have been described elsewhere in the literature. The circular nomograph, whose theory is presented by R. P. Douglass and D. P. Adams (*Elements of Nomography*, McGraw-Hill, 1947; pp. 148–149), can be read to about one-tenth of a division, which gives atomic or weight percentages within 0.1 percent in the vicinity of the centers of the scales. Copies of the nomograph measuring 11 by 17 inches may be obtained by writing to the Publications Office, Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio.