

EDUCATION IN THE SCIENCES

During fiscal 1953, the Foundation pushed ahead on two important programs designed to increase the national supply of trained scientific manpower:

1. A Fellowship Program to provide predoctoral and postdoctoral training for a limited number of research scientists.
2. Encouragement of efforts to improve education in the various fields of science through the support of experimental conferences for college teachers of science.

FELLOWSHIP AWARDS FOR 1953-54

The Foundation conducted its second graduate fellowship program in the sciences during the year. A total of 557 fellowships were awarded for the academic year 1953-54 as compared with 624 for the previous year. At the same time the Foundation received more applications, about 3,300 as against 3,000 in the previous year.

Of the total number of fellowships awarded, 515 went to predoctoral candidates and 42 to postdoctoral candidates. Of the total 175 fellows were also recipients of last year's awards.

In view of the fact that the limitation upon funds precluded the possibility of making awards to all highly qualified applicants, the Foundation published an Honorable Mention List of 1,274 applicants. The circulation of this list among deans of graduate schools has resulted in better communication between departments and potential students in the award of fellowships from other sources and the placing of a number of applicants in teaching assistantships.

Continuing the policy of emphasizing the first year of graduate study, the Foundation awarded 180 fellowships to first year graduate students. A total of 166 awards was made to graduate students in the intermediate years, 169 to terminal year predoctoral students.

The largest group of fellowships (129) was awarded in chemistry, and the second largest in physics and astronomy (115). In other fields the numbers of awards were: engineering 63, mathematics 56, zoology

38, biochemistry 35, geosciences 26, botany 19, microbiology 18, geophysics 14, medical sciences 14, genetics 11, psychology and anthropology 10, agriculture 9.

Stipends for fellows in the first year of graduate study are \$1,400; those for the intermediate years are \$1,600; those for the terminal year of graduate study are \$1,800; postdoctoral fellows receive \$3,400. Additional allowances for dependents, tuition, and other normal expenses are provided.

Applicants for both new fellowships and renewals are evaluated at the same time by the same screening panels, and the awards are made irrespective of whether an applicant has previously held a National Science Foundation fellowship. Of the National Science Foundation fellows who applied for renewal, 44 percent were awarded fellowships for an additional year.

Fellowship awards are made on the basis of ability only and are distributed among candidates of substantially equal ability on a geographical basis. For the first 2 years there has been a good correspondence between college student population density and the geographical distribution of fellows.

The National Science Foundation Act specifies that fellows shall have free choice of selection among accredited institutions of higher learning.

Distribution by Field of Study

The Foundation has distributed fellowship awards among scientific fields in proportion to the number of qualified applicants in each field. No attempt has yet been made to award greater numbers of fellowships in fields where shortages appear to be acute. At present there are no sufficiently reliable data about existing or potential requirements for scientists to justify such action.

In 1952 the Foundation awarded 38 first year fellowships in physics and 43 in 1953. During the 1951-52 academic year the Office of Education estimates that there were in all about 1,860 first year graduate students in physics in the United States. Thus, the first-year fellowship holders in physics constituted only about 2 percent of the total number of all students in this category. The ratios in other scientific fields are similar.

Departmental Duties

The Foundation believes that experience in teaching and in other departmental duties contributes to graduate training. Requests from fellows to undertake definite duties in addition to normal work and

research will be approved provided the fellow, his scientific advisor, and the Foundation agree in advance that such duties are clearly and primarily needed for the student's education. A fellow who undertakes such additional duties may not accept remuneration for these services.

ATTRITION RATE IN SCHOOLS AND COLLEGES

If the Nation's scientific and technical manpower is to be maintained in adequate numbers and proficiency, there must be an adequate flow of students with aptitudes in these fields up through the secondary schools and colleges. The Commission on Human Resources and Advanced Training has analyzed the intelligence distribution of high school and college graduates in order to determine the fraction of the student population capable of completing advanced training.

The findings indicate that 89 percent of our young people having at least the average intelligence of college graduates finish high school in the United States. Of these 38 percent enter college, and 25 percent graduate from college. These figures make clear that a large loss of potential college graduates occurs between high school and college, and that a second substantial loss occurs during the college years.

In the same study estimates were made of the number of bachelor's degrees and doctor's degrees awarded for the 5-year period 1948-52 and for the estimated period 1953-57. For the earlier period the total number of individuals receiving bachelor's degrees in science, engineering, and agriculture totaled about 95,000 per year. The comparable estimate for 1953-57 is 66,800 per year, a decline of nearly 30 percent. For the earlier period the number of doctor's degrees granted in the same fields averaged about 4,660 per year, compared with an estimated 5,420 per year for the period 1953-57. Since a 3- to 4-year lag exists the decline in doctorate awards will not appear for several years, but after 1956 the number of doctor's degrees awarded will reflect the same downward trend noted above for bachelors degrees. This is further shown by statistics indicating that the total graduate enrollment at the first year level in all fields of science dropped from approximately 12,000 in 1951-52 to approximately 8,000 in 1952-53.

Interpretation of the figures is complicated by a number of factors, which prevent easy generalization. The decline in the number of graduates in science and engineering is in part due to the effects of the reduced birthrate in the United States during the 1930's. It also coincides with the termination of large-scale Federal support for education under the GI bill.

These factors may explain the situation, but the statistics themselves indicate that inadequate numbers of capable young persons are receiving advanced training in the sciences. They raise two questions: (1) how can the total college population, and hence the number of students majoring in science, be increased; and (2) how can the total number of graduate students in all fields of science be increased.

Corrective Measures

The possible solutions are numerous and complex and not all of the possibilities within the purview of the National Science Foundation. One solution which immediately suggests itself is a large-scale scholarship program which would assist students who now fail to enter college for economic reasons. Thus far, the Foundation has not asked Congress for funds to support a scholarship program.

Students do not enter college for many reasons other than lack of funds. Dr. Byron Hollinshead, in a recent book *Who Should Go To College*, points out that only 13 percent of the top quarter ability high school graduates fail to enter college because of inadequate finances. Approximately 30 percent of the graduates in the top group would probably—under any set of conditions—continue to leave school either to enter the work force or, in the case of girls, to be married and become homemakers.

The National Research Council reports that 46 percent of students who received doctor's degrees in the sciences from 1936 to 1945 received their undergraduate training at institutions which did not award the doctor's degree in any field of science. Over half of the 46 percent received their training in only 118 of the 900 4-year colleges which do not grant the doctor's degree. The potential capacity of many smaller schools for interesting students in science careers may not be fully realized.

There is reason to believe that the major difference between the colleges, whether large or small, which are productive of scientific talent and those which are not, lies in the ability of science teachers to inspire, as well as properly teach, potential scientists. Teachers in the productive colleges have shown an active interest in research and ability to convert this interest into better teaching programs. The Foundation is attempting to increase the supply of young scientists by improving the teaching of science.

INSTITUTES FOR COLLEGE SCIENCE TEACHERS

During the past year the Foundation sponsored four summer institutes to assist college science teachers in learning more about recent developments in their own and allied fields. These included:

1. Colloquium on College Physics, State University of Iowa, June 17-20, 1953.
2. Conference on College Mathematics, University of Colorado, June 15 through August 8, 1953.
3. Conference on College Biology, University of Oklahoma, June 15-19, 1953.
4. Institute for College Teachers of Physics, University of Minnesota, June 15 to July 18, 1953.

The 4 institutes were attended by a total of 250 teachers from small colleges. The participants came largely from the surrounding regional areas, although in the case of the mathematics conference at the University of Colorado all sections of the country were represented.

The Colloquium on College Physics, an annual event now in its 15th year, was developed by G. W. Stewart, head of the Physics Department (retired), State University of Iowa. The Colloquium consisted of a series of lectures by leading scientists, followed by discussion periods. A feature of the program was the exhibition of experimental teaching devices created by members of the Colloquium.

The purpose and organization of the Conference on College Biology at the University of Oklahoma were similar. Lectures were given throughout the week by specialists in several fields of modern biology, followed by audience participation and discussion.

The Conference on Collegiate Mathematics at the University of Colorado and the Institute for College Teachers of Physics at the University of Minnesota were of longer duration. At Colorado lectures were given daily throughout the conference by two outstanding mathematicians. These were supplemented by lectures from a series of visiting scientists who covered special phases of modern mathematics. A feature of this institute was the spontaneous organization, by members of the conference, of an informal group for discussion of problems of mutual interest, including curricula, methods of teaching, and new textbooks.

SCIENCE ACTIVITIES AT SECONDARY SCHOOL LEVEL

The need for effective science teaching at the secondary school level is also acute since it is at the high school age that many students begin to show an interest in careers in science. It is hoped that ways and means can be found through the science teachers at the secondary school level to identify and motivate toward science those students who should become scientists.

During the past year a grant from the Foundation was awarded to Science Service, Inc., for the support of Science Clubs of America. This aid has strengthened materially the programs of the science clubs and science fairs during the year. In 14 new areas local science fairs were held and their finalists were able to participate in the Fourth National Science Fair held at Oak Ridge, Tenn., in May 1953. In all the Fourth National Science Fair had exhibitors from 29 local fairs. During the coming year the grant will assist in promoting science fairs in about 20 additional localities. Part of the grant was used to finance the compilation and publication of a booklet, *Thousands of Science Projects*, prepared to give students and teachers ideas for science projects that can be undertaken. It is estimated that activities under the grant benefited over 300,000 members of Science Clubs of America.