

RECOMMENDATIONS

NRC-AIP Conference on the Production of Physicists

Physics Committee

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THE present shortage of physicists and the anticipated worsening of this situation in the future must be the concern of all career physicists who acknowledge a responsibility to their profession and to the well-being of the nation. This must be a compelling, personal concern even though it is obvious that the situation has so many aspects, extending throughout the entire educational and research activities of the nation, that physicists acting alone cannot solve the problem.

The shortage, while evident in all activities and areas, is extremely critical in teaching, both in the secondary schools and in general physics courses in the colleges. From the many studies and reports which have been published in recent years, we know that this lack has been engendered primarily by the enormously increased research activity of the federal government and industry during the years following World War II. The great demand for qualified physicists has drawn off large numbers both from college and from secondary school teaching; and the situation has been further aggravated by the increasing transfer of those remaining in educational institutions to administrative posts. What is most disturbing is that the youths of our nation upon whom we must rely to staff the rapidly expanding opportunities in schools, industry, and government are staying away from physics in droves. Lack of qualified science teachers capable of inspiring their students with intellectual curiosity cannot be ignored as a principal reason for their rejection of careers in science.

The principal force responsible for the decline may well be financial; but there are others. First among these is the climate of opinion among the public generally, and especially among students, that the long discipline required to become a physicist or other scientist is not commensurate with the rewards, both financial and in prestige, in comparison with less demanding careers. Also, there is the depreciated recognition of the importance of the teacher by both the public and professional communities in which he, the teacher, must work. This effect is particularly marked in the secondary schools but is not entirely unknown

in some of our universities. Many of our graduate schools, in both science and education, must share the physicists' concern and need for further conscientious introspection.

There is evidence that the situation in physics is even more acute than in other technical branches, in part because the better organized chemists and engineers have been more active in facing up to the problem and working toward its relief. Their efforts in behalf of their respective fields tend further to drain off the manpower and support for physics, especially in the teaching area.

The solution of this problem of the shortage of physicists will obviously not be found in merely "viewing with alarm" or even in any single course of impetuous or desultory action, but will require the combined, thoughtful, and sustained efforts of professional physicists, industry, government, and education in an atmosphere of public understanding and alliance if the present trend is to be checked and reversed. The recommendations which follow are only those directed specifically to professional physicists for their immediate consideration and action. Here professional physicists are understood to include the membership of all those organizations affiliated with the American Institute of Physics, and especially the membership of the American Physical Society and the American Association of Physics Teachers.

Robert S. Shankland, *Chairman*

REPORT OF THE PHYSICS COMMITTEE

1. *Introductory College Physics*

The greatest possible effort should be devoted to improving the quality and effectiveness of introductory college physics courses and directing them to present needs and conditions. This effort is believed to be one of the most promising means of increasing the number of physics majors, for careers both in teaching and research. It is recommended that this

task be the prime responsibility of the American Association of Physics Teachers. In discharging this responsibility it is recommended that the AAPT make every effort to encourage and recruit the participation of professional physicists outside their own organization.

2. *Special Courses for Secondary School Physics Teachers*

Senior professional physicists should seek and accept a personal responsibility to participate in the special summer courses for selected secondary school physics teachers now in existence, and to assist in the establishment of additional physics courses suitable for the needs of science teachers.

3. *Texts for Secondary School and Elementary College Courses*

Professional physicists should become active, especially in an advisory capacity, in the planning and preparation of modern and adequate texts and laboratory manuals, and other essential publications. To this end the American Institute of Physics should assist in bringing together interested authors with professional physicists.

4. *Professional Society Participation*

It is recommended that the American Physical Society and the AAPT establish a joint group, drawn from their own membership and from the other member societies of the AIP, to work cooperatively with the currently active committees of the American Chemical Society, Engineering Societies, Mathematical Societies, American Association for the Advancement of Science, National Science Teachers Association, National Education Association, National Science Foundation, National Association of Manufacturers, etc., in formulating specific programs of assistance by professional physicists to attack the problem of increasing the effectiveness of high school education in mathematics and the physical sciences generally.

5. It is further recommended that to assure the accomplishment of these recommendations the National Research Council be urged to continue in every possible way a program that secures the cooperative effort among the several scientific societies and professional groups concerned.

Education Committee

Philip Johnson (*Chairman*), W. L. Duren, Jr., V. E. Eaton, R. E. Hopkins, Keith Johnson, R. B. Lindsay, R. C. Maul, and H. E. Wise.

THE Committee on Education, composed of college physics and mathematics professors together with other members whose professional concern lies in science teacher training and supervision and educational research, brought together diverse points of view. We were all disturbed by the apparent decreasing interest in physics at high school and early college levels. We were troubled by the large number of students with abilities necessary for success in college but who did not go to college. And we shared a sense of frustration in the difficulty of finding solutions that must override the draining-off of competent secondary school science teachers by more lucrative employment or by retirement and the drafting for military service of those men who have prepared for science teaching. It was felt that talented students in secondary schools must be identified. In many schools this means that a poorly-prepared science teacher must serve usefully in this identification since there will be no well-prepared science teacher available. Furthermore, this same poorly-prepared science teacher must somehow be helped to provide challenging educational experiences if the tal-

ented student is to reach his career potential. There was belief that gadgeteering of the science-fair type alone would not provide the intellectual diet necessary to sustain interest and motivate students towards the rigors of a career in physics. If these and related problems are to be solved, the committee became convinced that as a paramount condition for any real success the general public must be brought to a much better level of understanding and appreciation of the work of physicists.

Our discussion turned towards an effort to define the basic premises upon which our recommendations must be based. Our premises may be stated as follows:

1. There is a serious public relations problem facing physicists.
2. There are many high school students, some potential physicists, whose only contact with physical principles is in general science.
3. Certain circumstances that make improvement of physics teaching difficult are similar to those that make improvement of instruction in any area diffi-

cult, such as low salary, heavy teaching schedules, large classes, etc.

4. The effectiveness of science teachers can be improved.
5. Secondary school teachers, especially science teachers, are influential in the student's choice of a career. Once in college their college science teachers determine very largely whether the student will continue to seek a career in science.
6. Students with high probability of success in science can be recognized with reasonable accuracy at the secondary school level.
7. Able students may be found in all parts of the nation. Those living in remote areas or in homes where the values of college studies are minimized need special attention and help.

Members of the committee then faced the problem of suggesting what could be done and what should be done. At first, attention centered on specific ideas that could certainly be accomplished. Thought was also given to activities, already under way, that would be more effective if they could be extended and integrated. Both of these approaches failed to include other plans that members of the committee judged as highly desirable. Thus, while many separate and detailed recommendations were considered, it was decided to combine these into somewhat more general recommendations which should be no less effective when interpreted to fit individual circumstances or local situations. These were approved by the committee and, with minor changes, were endorsed by the entire conference membership.

Philip Johnson, *Chairman*

REPORT OF THE EDUCATION COMMITTEE

1. Opportunities that provide special instruction, fellowship opportunities, or other assistance to science teachers for the summer period should be made known to all secondary school teachers of science.
2. The National Science Teachers Association should take the initiative in collecting and publishing this information.
3. College science departments should encourage and work with appropriate agencies to make it possible for science teachers to include basic and special course work in science that may count as credit for professional advancement.
4. Professional societies, including the AIP, working through local sections should encourage and assist local scientists and educators in an organized joint effort to improve the status of the science teacher and in providing the working conditions and instructional aids that will increase the effectiveness of the science program.
5. School administrators and school boards should encourage science teachers to work with superior students as individuals and in small groups, often outside of the regular school day. These services and other evidences of superior teaching should be recognized by extra pay.
6. The AAPT, in its activities to improve physics teaching, should encourage scientists and educators to work with science teachers in preparing teaching aids and instructional suggestions that may be made readily available throughout the nation for the improvement of science teaching.
7. The results of the present conference should be brought to the attention of all scientists, educators, and science teachers and a continuing organization should be established to see that the recommendations result in action.
8. Since the schools must provide a continuous supply of competent new scientists, teachers who discover, encourage, and develop the latent talents of our youth must be attracted to the classrooms.

Government Committee

M. H. Trytten (*Chairman*), J. W. Buchta, Harry Kelly, W. C. Michels, Brian O'Brien, Alan T. Waterman, and Dael Wolfe.

THE Government Committee was composed largely of persons with experience in government activities. The committee was aware that this country is traditionally opposed to direct intervention by the fed-

eral government in education. The government has, nevertheless, played an important role in education activities. Through such acts as the Morrill Act establishing the land-grant college program, the Smith-

Hughes Act, and others, it has subsidized or supported areas of education and training of especial interest to the national welfare. The subsidization of individuals through such acts as the "G.I. Bill" has had a tremendous effect on education and its institutions.

The responsibility of the federal government for the national security, however, is a compelling and overriding responsibility and may lead the Congress to concern itself directly and intimately with fields in which the government has a stake. It is now generally understood that the relationship between the national security and an adequate supply of scientists and engineers is a close and vital one. These were the boundary conditions within which the committee felt it should seek its recommendations.

It seemed important to diagnose the malady which the conference was brought together to deal with. It was the opinion of the committee that the present-day situation is the outgrowth of an unresolved problem resulting from rapid development of new social patterns. Four decades ago the high schools in the nation served mostly those who intended to go on to advanced education and training. The movement towards universality in secondary education swelled high school enrollments enormously following World War I. This situation created the necessity of re-designing secondary education to meet wholly new demands. The majority of high school students no longer were those who would go to college, but were instead the terminal students. The changes that were introduced, however, have fallen short of meeting the problem for the terminal student and, in the opinion of many, have weakened the training given to those who do intend to continue. This is grievously true in the sciences and engineering.

It was the opinion of the committee that this malady is a major problem facing the nation. Its first recommendation, therefore, emphasizes the need of taking immediate steps to strengthen secondary school training for those who intend to go on towards specialization.

It was the opinion of the committee that the efforts of the federal government can be effective in several other directions. The second recommendation thus calls for strengthening the teaching process by efforts to train additional scientists and teachers, to improve teachers who are already on the job, and otherwise aid, where appropriate, both individuals and their facilities.

A third direction is that of fact-finding with respect to the national resources in personnel and facilities so as to pinpoint the places where help can be most effectively given.

The fourth relates to the policies of the government for procurement of military manpower. There is here the possibility that the federal government in attempting to provide for national security on an orderly and equitable basis may jeopardize that same security by decreasing its own technological potential.

The fifth and final recommendation relates to the forthcoming President's conference on educational needs to be held at the end of November. The committee felt that this opportunity of focusing public attention on these problems should not be lost.

M. H. Trytten, *Chairman*

REPORT OF THE GOVERNMENT COMMITTEE

1. The committee believes that great progress has been made in serving the needs of the large population now in secondary schools. It commends this achievement. However, it urges that the U. S. Office of Education examine carefully the problem of serving effectively the needs of the nation through attention to that segment of our secondary school youth who have special talents and interests.

Secondary school programs should be organized to prepare these students for their role as citizens, giving adequate preparation for college careers which in quality and extent will exceed that of the larger non-college group. Their training and educational opportunities should match, utilize, and challenge their abilities.

The manner in which these objectives are achieved will no doubt depend in part on local circumstances, but a national agency could study the universality of opportunity for satisfactory college preparation training, evaluate programs and policies, and serve usefully as a guidance agency.

2. The conference commends those federal agencies which have assisted in the education of additional scientists and in the improvement of teachers, through fellowships, grants, summer institutes, and other measures. We urge that efforts in these directions be continued and expanded.
3. We recommend that the federal government collect information concerning the deficiencies in equipment and personnel which exist in the high schools and colleges and which often prevent the effective teaching of physics. This information should be made available to the public and consideration should be given to some federal help to states and localities if such need is indicated by the study. Special thought should be given to the restoration of policies which favor the distribution of surplus materials to educational institutions.
4. The federal government through its manpower policies and resulting actions can and does affect profoundly the processes of education and training. The conference recommends that the adverse effect of such policies and actions on the teaching population be given special attention by government, to the end

that the effect on the production of physicists be minimized.

5. The conference urges special efforts to have the

agenda of the President's conference on educational needs recognize the special problems of education for the more talented youth of the nation.

Industry Committee

W. W. Grigorieff (*Chairman*), R. H. Carleton, J. A. Hutcheson, R. W. McNamee, H. A. Meyerhoff, L. O. Olsen, and Wallace Waterfall.

FACED by a host of ideas for industry participation or support, the committee met often to discuss, praise, criticize, and evaluate throughout the three days of the conference. Its results are grouped in two categories: General, which emphasizes ideas suitable for local or individual company action, and Specific, which singles out those most promising programs which call for concerted action.

General Recommendations

The following suggestions can be adapted to any managerial taste or to any industrial pocketbook, and most, if not all, are actually being done on varying scales. The lists in each category can, no doubt, be extended and elaborated, and all must be adapted to specific situations.

Parts of the program can best be carried out by local companies within their own operating areas. Others would be conducted most effectively in collaboration with national, professional organizations and/or their regional sections. In view of the close collaboration with schools that would be called for in many of the suggested programs, it is imperative to coordinate with and through appropriate educational groups. For example, the NSTA has already undertaken parts of this program such as awards for students and teachers, encouraging summer employment for teachers in industry and university research, and the design and conduct of summer work conferences. Additional groups that might participate in the program are the AAAS Cooperative Committee, Engineering Manpower Commission and Scientific Manpower Commission, American Chemical Society, American Association of Physics Teachers, state associations of science teachers, and others.

What Industry Can Do

For Students

1. In High Schools

- (a) provide materials for student club use
- (b) provide materials, money, and leadership (if needed) for nonschool clubs
- (c) offer competitive college scholarships

- (d) provide funds to be used for prizes (such as books, apparatus, sets, etc.), trips to science conferences, etc.
- (e) provide counseling services

2. In Colleges

- (a) provide undergraduate scholarships, with as much emphasis on prospective teachers as researchers
- (b) provide funds for attendance at scientific meetings, both student and professional

For Science Teachers

1. In High Schools

- (a) provide funds for regular attendance at science and science-teacher meetings
- (b) provide opportunities for plant inspections by high school classes
- (c) provide movies, lectures, and other classroom props
- (d) provide summer employment for science teachers
- (e) subsidize or co-sponsor workshops, summer attendance at graduate schools, etc.
- (f) establish awards for excellence in science teaching

2. In Colleges

- (a) continue or expand present programs but add
- (b) awards of recognition, including fellowships for good teachers, especially in teachers colleges

For High Schools

- 1. equip, in toto or in part, school laboratories both in new and old schools
- 2. supplement existing equipment with specific items
- 3. provide detailed information on job opportunities in local industry for high school graduates and for those who continue to college (e. g. Evansville program)
- 4. counsel, formally or informally, with school authorities on mutual needs and problems
- 5. cooperate with local societies in preceding and related activities

For Colleges

1. continue and expand existing activities, with more stress on need for teachers and help for teachers colleges

For the General Profession

1. support a program to publicize physics, not merely as a profession but as a vital part of modern life

W. W. Grigorieff, *Chairman*

REPORT OF THE INDUSTRY COMMITTEE

*Specific Recommendations**College Science Scholarships*

The following proposal was made for the primary purpose of directing into science careers qualified high school graduates who for various reasons do not now enter college:

1. A program of testing high school students for aptitudes, intelligence, and capacity in science and mathematics shall be instituted. The minimum program should involve testing in the senior year, but for the purposes of guidance earlier tests would be desirable. It is expected that only a small number of applicants will satisfy the rigorous requirements of the program.
2. Those who qualify with the highest ratings will be offered attractive scholarships supported by industry; these scholarships should include provision for tuition, books, supplies, and partial subsistence allowances.
3. The conference accepted the foregoing in principle and appointed a committee of R. W. McNamee as chairman, J. A. Hutcheson, and C. G. Suits to determine the following:
 - (a) The number of scholarships which can be supported by industry
 - (b) The appropriate agency to administer the program

Summer Employment of High School Science Teachers

It is recommended that industry be approached with the following plan:

1. A central national clearing house or agency should be set up to receive applications from those high school science teachers who wish to obtain summer employment in industry to the end that they will be thereby given an opportunity to learn at first hand of the application and progress of their science in industry.
2. The agency will also be given by individual industries a list of the number and kind of high school science teachers they are willing to employ during the summer.
3. The agency will then provide each industry with a list of candidates for each available opening.

4. Each industry will then indicate to the central agency the names of the high school teachers they wish to employ, and, when possible, a list of alternate choices for each opening.
5. The central agency will finally advise each industry of the names of the individual teachers who will be available for summer employment.
6. Each industry will then offer summer employment to the high school science teacher chosen.

Note: Certain uniform operational policies will have to be determined including pay, allowance for travel, type of work, agreement on nonhiring by industry, etc. These should be worked out between a joint committee of industry and the central agency.

Industrial Support of Summer Study Programs for High School Science Teachers

The initiative of a number of companies in inaugurating and supporting summer institutes for science teachers is highly commended. It is recommended that these comparatively substantial fellowship programs be continued and expanded. It is desirable that more industrial concerns undertake the support of programs at additional academic institutions. There are also a number of more modest programs for the improvement of science teachers which are struggling for existence. These would be tremendously vitalized by modest industrial support. This support could take the form of grants for distribution of scholarships by the institutions operating such programs or by scholarships awarded by local industry for teachers in the local community to attend summer programs.

Physics and Public Relations

Increased support of physics education programs requires a better public understanding of what physics and physicists contribute to a better life. Much of what the public knows or believes about physicists is derived from newspaper headlines. They read about the atomic bombs, the dangers due to radioactive material and the alleged subversive tendencies of prominent physicists. Why should the public support further training of men who may be bringing the world to the brink of self-destruction?

Physics needs a sensible program to identify physics and physicists with the technological advances toward a better and more pleasant life. Such a program is beyond the means of the professional societies in physics and might be interpreted as self-seeking.

The chemical industry has done much to improve the public appreciation of the chemists. The Advertising Council is doing a good job for engineering. There is no physics industry as such but there are many large industries based on physics—communications, television, electrical appliances, and others—which could help, through their current advertising programs, to correct the "bad press" which physics now has. The aid of these industries should be solicited.