their discoveries into our way of life. I do not, in this instance, have the answer for this segment of industry, but if I have brought some of its traps and hazards to your attention, I shall have accomplished my aim.

Reference

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News of Science

Snyder Statement on Education Legislation

Laurence H. Snyder, chairman of the AAAS Board of Directors and retiring president of the Association, recently appeared before the Senate Committee on Labor and Public Welfare, which has been holding hearings on proposed legislation for additional Federal support for education, especially science and language education. For an analysis of the two major bills under consideration, S.3163 and S.3187, see Dael Wolfle's "Science Education Legislation for 1958" on page 389 of the 21 February issue of *Science*. Snyder's statement to the committee follows.

"As a representative of the American Association for the Advancement of Science, I welcome the opportunity to discuss with you some of the problems of improving science and education in the United States. These problems have for long been of concern to this committee. They have long been of concern to my Association also. As two rather widely separated examples, I might cite the fact that the presidential address of one of my predecessors a century ago was one of the first public statements of the need for a National Academy of Sciences, a proclamation that President Lincoln heeded a few years later in establishing the National Academy, and that a decade ago the American Association for the Advancement of Science prepared the material on science education that was included in the report of the President's Scientific Research Board in 1947—the report that is usually known as the Steelman Committee report.

"Three years ago the Association greatly increased its attention to the problems of improving education in science and mathematics. This we did because we agree completely with the authors of both S.3163 and S.3187 that the primary requirement in education today is to improve the quality of education, especially education in science and mathematics. We need more and better school buildings. We need to pay our teachers more adequate salaries. We need to overcome the handicaps that prevent some bright students from attending college. But above all, we need to offer education of higher quality to the students who will be the teachers, the statesmen, the scientists, and the leaders in business and other fields of tomorrow.

"Let me explain why we put such stress on quality. There are two reasons. The first lies within the educational system. During the past three quarters of a century, the population of the United States has increased threefold. During those same years the population of our schools has increased a hundredfold. The nation's teachers have done an excellent and devoted job of meeting this rapidly expanding load. But note what we ask them to do. We want them to take care of practically every child in the land from the age of five or six to the age of sixteen or older. We want them to help the retarded and handicapped child; to serve the needs of the average; and to develop the talents of the gifted. Seventy-five years ago, most of the students who graduated from high school went on to graduate from college. It was appropriate then for the high schools to concentrate on preparing their students for college. Now, under the weight of a majority of students who will not, and in many cases should not, go to college, the high schools can no longer concentrate on college preparation. In the course of these changes, some of the virtues of intellectual rigor, of preparation for more advanced work, and of high quality education for the students of highest ability have been submerged under the burden of other claims on educational facilities and teachers' time. In science and mathematics, the problem has been particularly acute because industry and government have been able to outbid the schools in recruiting college graduates with training in science and mathematics. Consequently, there have been some special difficulties in securing an adequate number of well-trained teachers of science and mathematics, and instruction in those vital subjects has suffered more than in other fields.

"The second reason for our emphasis on the importance of improving the quality of education comes from within science itself. Less than 15 years ago the first atomic bomb was exploded. During these 15 years man has learned of the tremendous potentialities of nuclear energy and has witnessed a number of other dramatic technological developments. Atomic fission and fusion, satellites and space exploration are important in themselves, but in a larger sense they are merely symbols of a scientific revolution that we are entering. We are on the verge of vastly greater power over the forces of nature than we have ever held in the past. The evidence is already dramatically evident: compare the power of atomic fusion with the power of TNT, or the speed and range of Explorer with the speed and range of an airplane. Throughout the sciences discovery is accelerating. Astronomy, astrophysics, geology, and geophysics are greatly expanding our knowledge of the world, and of the universe. Chemistry is creating new marvels. In genetics, in pharmacology, in biochemistry, in neurophysiology, we are conducting experiments that were inconceivable five or ten years ago. We are getting close enough to some of the secrets of living matter so that scientists of all fields understand, and many agree with, Vannevar Bush's statement last month that if he were starting his career now he would be a biologist.

"We may be frightened or gladdened by this scientific revolution and its consequences. But like it or not, we cannot escape; we cannot stop the rush of scientific developments of which I speak.

The discoveries are being made in this country, in England and Europe, in the Soviet Union, and soon we will have to add China and other countries to this list. We cannot hide from this scientific revolution. There is no place to hide.

"The only conceivable thing we can do is to prepare ourselves as intelligently as we can to take full advantage of the rush of future developments. To do this we must maintain our own scientific status with respect to the rest of the world and we must improve the quality of our educational system so that our citizens of tomorrow will be able to contribute to and realize the benefits of this scientific revolution. In this improvement of education, one of the goals is to educate future scientists. But of at least equal importance is to educate our future statesmen, lawyers, business leaders, and men and women of other professions so that they will have a better understanding of science and will be better prepared to deal wisely with the benefits, the problems, and the dangers of rapid scientific advance.

"This point I want to emphasize as objectively and as powerfully as I can. As an indication of the importance we attach to it, the American Association for the Advancement of Science is holding a special conference of leading scientists from all parts of the country and from all fields of science. The background of that conference is the realization on the part of scientists of the urgency of preparing ourselves for the revolutionary developments ahead. The purpose of the conference is to consider the actions we should take now to strengthen science and education in the United States.

"The American Association for the Advancement of Science is a particularly appropriate organization to hold such a meeting because of its central position among the scientific organizations of the country. In our 110 years we have fostered the development of many of the leading scientific societies of the United States, and those societies—as well as others that have been established independently—are our close friends and formal affiliates. The AAAS has, therefore, not only its own individual members, who number about 55,000 men and women from all fields of science, but also has 279 affiliated societies that cover all fields of science. No one pretends to speak for all of the scientists of the country—some of whom are rather complete individualists—but our conference next month will come as close to doing that as an association can.

"I hope that you will forgive me for taking so long to get to the specific provisions of the legislation now before you. I have taken that time for two reasons: to tell you how vitally important it is in the judgment of scientists to improve the quality of education; and to explain the background of our own thinking concerning the several provisions of the bills under consideration."

Consultants. "We consider the provisions for improving teaching and education to be the most important feature of the legislative proposals being considered in these hearings. We take particular interest in the proposed arrangements for the employment of science and mathematics supervisors in S.3163 and science, mathematics, and language consultants in S.3187. Two years ago we [the AAAS Science Teaching Improvement Program] installed science and mathematics consultants in the geographic areas around the University of Nebraska, the University of Oregon, Pennsylvania State University, and the University of Texas. In each place there is a science consultant and a mathematics consultant. Each is an experienced and expert teacher. Each has a telephone and an automobile, and each spends most of his time in working, on an individual basis, with approximately 50 less experienced teachers in his region. He helps them with teaching problems, with subject matter problems, and with the problems of increasing their own competence and knowledge.

"This system works. Both teachers and superintendents testify to its effectiveness. We are convinced that adding a good consultant to 50 classroom teachers contributes much more to the improvement of teaching than does the addition of one more classroom teacher. We are pleased that a grant from the Carnegie Corporation enabled us to try out this system of science and mathematics consultants, and pleased to have the value of such consultants recognized in the two bills.

"As between S.3163 and S.3187, there is one aspect in which we prefer the latter. That is the matter of title; "consultant" describes the function better than does "supervisor," for a major benefit of the consultants' work comes from their getting out and consulting with classroom teachers, on the job, in their own classes, with their individual problems. Titles do not always accurately describe functions, but we are a little afraid that supervisors may spend too much time in the state capitol making rules and keeping records and answering correspondence.

"This brings up a related point. In the four states where we established consultants, we did so with full cooperation of the state departments of education, but the state university and not the state department of education is the consultant's home base. There are two important advantages in this arrangement. First, the consultant is in close touch with his scientific colleagues on the campus and is therefore a more up-to-date and better scientific representative to the teachers he serves than he would be without those regular campus contacts. Second, he helps to bring about liaison between school and college. He works with high school teachers, but he works under the direction of a committee of university scientists and educators. This arrangement brings scientists and educators closer together on the campus and brings both closer to high school problems, and this is all to the good.

"There is nothing in either S.3163 or S.3187 that would prevent the kind of relation I have described. Neither is there anything to encourage it. It is probably inappropriate to spell out any particular plan, but I hope that the states will be encouraged to base their science, mathematics, and language consultants in the appropriate subject matter department at a university wherever that arrangement is possible."

Teacher education grants; higher salaries. "Turning now to the provisions of S.3187 that provide for summer school attendance and extension course enrollment on the part of teachers, and the provisions of S.3163 that provide matching grants to states that can be used to employ additional science and mathematics teachers or to augment the salaries of such teachers, it seems to me that both represent substitutes for what is ultimately desirable. Ultimately—and the sooner the better—we should break the existing, fairly rigid salary schedules so that teachers of high merit are paid high salaries and teachers of ordinary merit are paid ordinary salaries.

"S.3163 would make a start in this direction by authorizing higher salaries for science and mathematics teachers who meet certain minimum requirements. This is not fair to the good teachers of English or History or Foreign Languages. Yet I support it because of the urgent necessity of getting better qualified science and mathematics teachers and because I fear that only by providing higher salaries for the abler teachers in some fields can we get started on the necessary changes of custom and attitude that will lead to substantial increases for the ablest teachers in all fields. Let me urge, however, that the provisions of Section 223 (b) (2) be so stated or interpreted that the required qualifications be set at a truly desirable level rather than an emergency minimum level. More will be accomplished in raising the status of teaching and setting a desirable goal for able prospective teachers by increasing substantially the salaries of the best 10 or 20 per cent of teachers than by giving minimum increases to all.

"The provisions of S.3187 are even more of a substitute for the ultimately

necessary increase in teachers' salaries and adoption of a salary scale that is based on merit and that exhibits a much wider range between top and bottom salaries than now exists. There are some clearly desirable aspects of the S.3187 provisions: it is desirable for many teachers in all fields to increase their subject matter competence, and it is good to have the opportunity open to teachers in all fields. The subsidized attendance at summer schools for advanced study is clearly preferable to having teachers eke out their salaries by summer work that is unrelated to their teaching. All these things are good, yet as between paying teachers to go to school and giving the better ones higher pay for doing a good job of teaching, I personally prefer the latter proposal."

Testing and guidance. "On another proposal for improving the quality of education, I can be brief. That is the provision for strengthening the testing, counseling, and guidance program of the nation's schools and improving the quality of counseling personnel. I know enough about the situation to know that these improvements are highly desirable, for here is one way in which we can help to overcome the difficulties of having the same school have to teach students of widely divergent interests, abilities, and later educational and career plans. When such a diversity of responsibilities falls on the shoulders of a single teacher, it is not surprising that much of her teaching is pitched at the level of the average student, and much of her individual attention devoted to the students who are having the most difficulty. Under these circumstances, the abler students are too frequently left to shift for themselves. A guidance counselor can help the abler student very materially in this situation; by paying individual attention to his abilities and interests, the counselor can help him to get into the most appropriate courses, help him to plan the education that will best develop his abilities, and, in general, give him a boost that he may not get from his teachers or his parents. I am not an expert in the field of counseling, however, and hesitate to recommend the provisions of one bill over those of the other, although the longer time scale of S.3187 seems preferable, for it will take some years to train sufficient well-qualified counselors and to realize the benefits of an improved guidance program."

Graduate fellowships. "Similarly, I can be brief in commenting on provisions for graduate fellowships. This is an important provision of both S.3163 and S.3187, for as Secretary Folsom told you, the need for college faculty members is increasing in all fields, and the educational preparation of newly appointed faculty members is declining. In view of the fact that the National Science Foundation already has an excellent program of fellowships in the sciences, under which the Fellows can enroll in any university that accepts them, I urge consideration of the provisions of S.3163, for those provisions will, I believe, contribute more effectively to the building up of additional graduate education opportunities of high quality all over the nation than will the fellowship plans of S.3187. Whichever of these systems is adopted, I strongly urge retention of the proposal, in both bills, to make fellowships available to students in all fields of advanced study."

Foreign languages. "The teaching of foreign languages is outside my area of competence, so I will not try to choose between the two bills. But let me commend the authors of both for recognizing the importance of giving our students better facility in languages other than English. In terms of the literature they must read, the meetings they attend, and the colleagues with whom they can profitably discuss their work, scientists constitute one of the most international professional groups in the world. Yet too many of them are unable to carry on a conversation in any language other than English."

Scholarships. "I have left the topic of scholarships to the last, for there are several quite different things I want to say on that topic. There are three principal reasons for granting scholarships. One is to attract students into a field in which there might otherwise be a shortage. A second is to aid needy students to secure an education. The third is to encourage and reward scholarship of high quality. Each of these points should be considered in deciding upon the nature of a desirable scholarship program.

"First, the use of scholarships to attract students into fields in which there might otherwise be shortages. We need talent in science, mathematics, and engineering. But we also need talent in many other fields. Consequently, I endorse the statements in both S.3163 and S.3187 that students who expect to specialize in any field of study will be eligible for scholarships. But I would go farther than either bill does in this respect; I recommend that the emphasis on science and mathematics be stricken out of the scholarship provisions entirely. Where a special need is evident, it is appropriate to give specialized fellowships at the graduate level. In the high school, it is proper now to give special attention to the teaching of science and mathematics, not because those subjects are more important than, say, English, but because it is important to redress some of the imbalances that we have allowed to develop. But in offering a scholarship to a boy or girl who is about to graduate from high school, let us not try to purchase interests that have not developed naturally and that may not be permanent. The Board of Directors of the American Association for the Advancement of Science has discussed this problem in some detail and is firmly on record as recommending that scholarships be awarded on the basis of merit, without consideration of the proposed field of specialization. I might add that the Educational Advisory Board of the National Academy of Sciences, the Engineering Manpower Commission, and the Scientific Manpower Commission have adopted exactly this same position.

"The second use of scholarships is to aid needy students to secure an education. It is true that there are bright boys and girls who are good students, who would like to go to college, but who cannot afford to do so. But it is also true that their number is usually overestimated. The percentage of high school graduates who enter college has been rising in recent years, and most of the statistics that are quoted on this point are out of date. There are no thoroughly good, nationwide statistics on this matter, but recent studies by the Office of Education, the Educational Testing Service, and one or two states indicate that of the top 10 per cent of high school graduates, about 80 to 90 per cent enter college, and that of the top quarter of high school graduates, two thirds or more enter college.

"What of the others? Some go into technical training institutions. Some of the girls take training as nurses and others marry. And an important fraction do not want to go to college. It is still true that some need partial help and others need full support, but there are already scholarships available from other sources, and the number of students who would go to college if one of these bills becomes law but who would not in the absence of such legislation is not large. Consequently, it seems to me that there are other and more effective ways to use a Federal scholarship program.

"It is appropriate in this connection, however, to consider the student loan provisions of S.3187. I hope that these provisions will be adopted so that the United States can give a substantial student loan arrangement a really good try. It is frequently said that loan funds go begging on many campuses now, and while this is true, this is not the whole story. Some of the available loan funds provide only relatively small loans that must be repaid quickly. They are useful in tiding a student over a temporary difficulty, but are not useful in financing an education. There has never been as generous and as widely available an opportunity to borrow money for educational expenses as is proposed in S.3187. That may be one of the principal reasons why student loans have never become popular in the United States.

"I would also like to support the forgiveness feature of the loan program for

recipients who later become teachers. Again, this is a substitute for the ultimately desirable goal of paying teachers salaries commensurate with their abilities and worth. But it is unrealistic to expect immediate adoption of such a salary scale. In the meantime, the opportunity to cancel 20 per cent of the total loan for each year spent in teaching should aid the schools greatly in securing additional teachers.

"The third function of a scholarship program is to encourage and reward scholarship of high quality. This is the function that should be given greatest emphasis. A scholarship of $500 or $1000 a year for four years is a substantial award. A national scholarship program is a sign of national interest in academic excellence. Both the winners and those who compete but fail to win will be more likely to go to college because of their heightened interest and application. In order to make the program most effective in improving scholarship and raising educational standards, I suggest that scholarship winners be selected on the basis of a national examination that emphasizes the fields of subject matter knowledge that are of most importance as a basis for good college work. Administration of these examinations can be local and there can be state quotas, but the national character of the examinations will enhance their prestige and motivational value.

"Senator Pastore has introduced a bill, S.1021, that proposes to offer scholarships to students who make sufficiently high scores on an examination covering high school mathematics. In earlier testimony, Professor I. I. Rabi has endorsed this idea. It is an excellent idea, for it would place clear emphasis upon the universal importance of a sound knowledge of mathematics whatever the field of specialization the student later entered. The idea can well be extended, however, so that scholarship winners would be selected on the basis of an examination covering mathematics, English, and perhaps a modern foreign language and science. Such subjects as these are the core of a good background for college work. They are the subjects we want to emphasize in the education of bright students. A scholarship program that placed such clear stress on these fundamental fields of knowledge would motivate students to do well in their high school work, would offer tangible proof to teachers, students, and parents of the importance attached to the basic college preparatory subjects in the high school programs of bright students, and would leave the students completely free to choose their own fields of specialization after they entered college. Here is a method by which a scholarship program can both motivate individual students to do well in their work, and at the same time encourage teachers, school administrators, and school boards to provide high quality instruction in the subjects that are of greatest value to bright students.

"In conclusion, I would like to commend the wording of the statement of purposes of S.3187. I refer particularly to the words, '. . . assure the intellectual preeminence of the United States. . . .' This is a noble objective. I hope that we mean it, and that we enact legislation that will asure the intellectual preeminence of the United States."

A Security Case in Britain

A British scientist suspended from his position on security risk charges has won his appeal against dismissal and has returned to work. According to a recent Reuters dispatch from London, "Mr. Z" was suspended 4 days before Christmas because he was judged to be "susceptible to Communist pressure." A special investigation officer had reported, after a routine interview to which all civil servants engaged on secret work are periodically subjected, that Mr. Z had "extreme pro-Russian sympathies." Listed against him were the following statements he made to the investigating officer's questions: that what was being done in Hungary by the Russians was no worse than the British government was doing in Cyprus; that there was no more repression in Russia than in other countries; and that Russia was living "in a world opposed to her."

Mr. Z, who was on full pay during his suspension, appealed to the three advisers appointed by the Prime Minister to hear appeals against security dismissal cases. It is reported that he denied that he was pro-Russian and pointed out that he had merely expressed his views freely and honestly in answer to the questions put to him.

Atmosphere Entry Simulator

A new laboratory device capable of simulating the extremely high temperatures and thermal stresses encountered by missiles and space craft flying at great speeds in the earth's atmosphere is announced in the annual report of the National Advisory Committee for Aeronautics. The NACA calculates that a model only 0.36 inches in diameter and weighing 0.005 pound can simulate the reentry flight of a full-scale 4000-mile range missile of diameter 3 feet and weight 5000 pounds.

The atmosphere entry simulator was designed by Alfred J. Eggers, Jr., of the NACA Ames Aeronautical Laboratory, Moffett Field, Calif. Another Ames scientist, H. Julian Allen, conceived the principle of blunt shaping of missile nose cones as a means of minimizing the heating factor.

The main element of the simulator is a trumpet-shaped nozzle through which air at supersonic speed undergoes changes in density from one end of a 20-foot passage to the other. The missile model is launched from a high velocity gun against the air stream. While flying through the nozzle test chamber, the model encounters air of increasing density, thus duplicating the flight course of a full-scale missile. The simulator can provide a variation in density over a range of 100,000 feet. It is used at altitudes up to a maximum of 200,000 feet.

A pilot model of the simulator is in use at the Ames Laboratory and a larger version is nearing completion. The NACA reports that the new reentry simulator will be in operation later this year for use on problems related to missile and space craft research.

News Briefs

At a ceremony last month at Bonn University, the German Council of Arts and Sciences (*Wissenschaftsrat*) was officially established. According to an agreement made between the Federal Government and the states, this council is to coordinate all West German plans for the advancement of the arts and sciences, to draw up a program of matters to be given attention, and to submit recommendations about how available funds are to be used.

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The United States will operate four scientific stations in Antarctica in 1959. Rear Admiral George Dufek announced recently that the South Pole, Byrd, Hallett, and McMurdo Sound stations had been selected for further operations at the conclusion of the International Geophysical Year. Three bases will be discontinued: Little America, Ellsworth, and Wilkes. Little America, however, will be used as a weather-reporting station, and its snow runway will be maintained as an emergency landing strip for flights to the McMurdo Sound and Byrd stations.

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The story of Archimedes, Greek mathematician, physicist, and inventor who discovered the underlying principle of specific gravity, will be seen on Telephone Time's *Man of Principle* over ABC-TV on 25 March at 9:30 P.M. EST and PST (8:30 P.M. other time zones).

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The National Merit Scholarship Corporation has announced that future Merit Scholarship competitions will begin with the testing of high school juniors rather than seniors. Thus, the 1958–59 program will begin this spring with a nationwide