further strengthening United States science is so broad that government, industry, universities, foundations, and individuals all have essential roles to play." Congress will ask, when it reviews the new budget, whether the government has fully accepted its "essential role."

Improving High-School Education

During January the national concern about high-school education manifested itself in a number of significant ways. Of first importance was the release of James B. Conant's report, *The American High School Today*. With the support of a Carnegie Foundation grant administered by the Educational Testing Service, Conant made a close study of 55 high schools in 18 states that led to 21 specific recommendations. Conant says of his work, which is to continue for at least another year:

"I can sum up my conclusions in a few sentences. The number of small high schools must be drastically reduced through district reorganization. Aside from this important change, I believe no radical alteration in the basic pattern of American education is necessary in order to improve our public high schools. . . . I think one general criticism would be in order: the academically talented student, as a rule, is not being sufficiently challenged, does not work hard enough, and his or her program of academic subjects is not of sufficient range. . . . A correction of this situation in many instances will depend upon an altered attitude of the community quite as much as upon action by a school board or the school administrators."

Columbia Honors Program

New York City has recently demonstrated the effectiveness of the community interest to which Conant refers. This fall a science honors program was established at Columbia University's School of Engineering with the aid of $29,000 from the Hebrew Technical Institute of New York and $25,000 from the Fund for the Advancement of Education of the Ford Foundation. The first half of the program has just been completed, and an initial report indicates that it is a complete success. The professors responsible for the 158 students, 25 of whom are girls, describe the students' ability with unqualified enthusiasm.

Every Saturday morning the group hears lectures on such subjects as physical and chemical metallurgy, theory of vibrations and wave motions, symbolic logic, nuclear physics, protein chemistry, and population genetics. Laboratory work includes advanced projects in enzyme chemistry, chromatography, effects of radiation on soils, and animal behavior. Every week 50 students have lunch at the men's faculty club, where five students are seated with each faculty member.

John R. Dunning, dean of the engineering school, says that the program is intended "to make the best science available to the best minds and to set an example that all colleges and school systems can follow."

Nationwide Survey of Students

Another important event in public high-school education to be reported last month was the U.S. Office of Education's national student survey, a survey that would attempt to assess the quality and quantity of these "best minds." The project would include a program of tests that would cover aptitude, achievement, personality, interest, and biographical data. These tests, given to a 5-percent sampling of the nation's high-school students (500,000), would provide a representative picture of the entire high-school population. The Office of Education's Research Advisory Committee has already approved the planning phase of the project, for which $335,000 has been provided. However, final action on the plans will not be taken until the committee meets in mid-February. If the study is approved—and it would cost more than $1 million—work will begin on 1 March. In May, a 2-day series of 25 tests would be given to 1000 to 1500 pupils as a pilot study; the national testing would be done next January and February.

The survey has been planned cooperatively with the National Institute of Mental Health, the Office of Naval Research, and the National Science Foundation. The project would be conducted by the American Institute for Research, a nonprofit affiliate of the University of Pittsburgh, with John T. Flanagan, professor of psychology at Pittsburgh, as principal investigator, and John T. Dailey, research associate, as program director.

Stanford Conference

Still another effort to improve high-school education in the United States occurred 24–27 January, when 15 scholars, educators, and lay authorities gathered at Stanford University's Center for Advanced Study in the Behavioral Sciences for exploratory talks on how to strengthen the national public-school curriculum. The group—which included Conant and Graham DuShane, editor of *Science*—was under the cochairmanship of Ralph Tyler, director of the study center, and Paul R. Hanna, professor of child education at Stanford. The conference was supported by the Ford Foundation's Fund for the Advancement of Education. Three questions were considered.

1) How can we achieve a solution to the curriculum problem as viewed by the public and its legislators, by the scholars and scientists, and by the professional educators?

2) How can public-school curriculums adequately represent the national interest and at the same time the special needs of the local and state community?

3) What steps can be taken and what procedures should be followed toward development of a more adequate public-school curriculum?

Hutchins' Comments

In contrast to Conant, Robert M. Hutchins, president of the Fund for the Republic, had some sharp words for American education when he received the Hillman Foundation Award for meritorious public services on 22 January. He said that every citizen must be educated to the limit of his capacity if this nation is to survive as a democracy in the nuclear age, that to preserve the democratic faith men must be sufficiently informed to take part in making decisions in a free society: "I don't mean trained, amused, exercised, accommodated or adjusted; I mean that his intellectual power must be developed."

He then went on to say that history would have trouble assessing American education in the 20th century.

"It will see a people, who say they are dedicated to education and who are the richest in the world, indifferent to education and unwilling to pay for it. It will see an educational system that delivers less education per dollar than almost any other saying that all it needs is more money. . . . History will smile sardonically at the spectacle of this great country's getting interested, slightly and temporarily, in education only because of the technical achievements of Russia, and then being able to act as a nation only by assimilating education to the 'cold war' and calling an educational bill a defense act."

Humphrey Explains Detection of Nuclear Weapon Testing

In a speech given 20 January to his colleagues, Senator Hubert H. Humphrey, Democrat from Minnesota, gave the sources of the new scientific data on nuclear test detection and related these data to the talks now in progress at Geneva. These negotiations stem in part from an agreement reached last summer by Soviet and Western scientists that a detection system was feasible. A White House announcement early last month cast some doubt on the bases for that agreement.

The senator, chairman of the Foreign Relations Subcommittee on Disarmament, served as congressional adviser to

the United States delegation at these talks prior to the opening of the new Congress. Excerpts from his speech follow.

"The Geneva negotiations have been making slow but, nevertheless, steady progress. Although it is still unclear as to whether the negotiations will succeed, and most of the difficult issues must still be discussed, agreement has been reached on four articles of a treaty."

Exaggerated Claims

"In the midst of these negotiations the White House issued a statement, on January 5, 1959, to the effect that new scientific data have appeared which indicate that 'it is more difficult to identify underground explosions than had previously been believed.' The White House announcement, which was made by the President's Science Advisory Committee, has resulted in some exaggerated statements and claims. On the one hand, some people charge that the new information is not genuine and that it has been put forth by those who do not want to see a ban on tests. One correspondent, for example, says, 'There is something fishy about the timing and the content of the White House announcement. Is this another underground triumph for Dr. Teller? . . . Are they (the scientists) jumping to conclusions they have long sought in order to block a test cessation they have always opposed?'

"On the other hand, there are claims that the new data make an agreement to ban tests under effective control impossible, and we should immediately call off the negotiations. To cite a case in point, a prominent magazine writes that the announcement means that 'the real minimum underground blast that could be fully detected was about 20 kilotons—about the size of the Nagasaki-Hiroshima bombs. . . . Should the U.S. trust to any stop-test agreement where the chances of deception are so great as to be a major risk of survival?' "

Data Are Not False

"The White House announcement is not the result of data trumped up by Dr. Teller or anyone else. It is true that Dr. Teller does not favor a ban on nuclear weapons tests but insofar as I am aware Dr. Teller had nothing to do with the gathering of the new material. He may be using it to try to persuade people that the test ban negotiations should be called off but he did not create the data.

"How, then, did the data originate?

"When the President, on August 22, 1958, indicated that the United States would stop testing October 31, 1958, pending the outcome of the political negotiations of a test ban treaty, the Atomic Energy Commission quickly planned several tests at the Nevada proving grounds during September and October. Four of these were underground tests. Two were below one kiloton, one was approximately 4.5 kilotons, and one was about 23 kilotons.

"During the month of November seismologists reported to the U.S. Government as to whether and how their seismographs picked up the four tests. This material was received by two groups. One was the U.S. Coast and Geodetic Survey and the other was the group responsible for detecting nuclear tests.

"The records of the seismologists were analyzed further by a special panel of scientists from various governmental agencies and from private institutions during the test ban conference recess, from December 16 to January 5. Although the study of what should and could be done to improve the control system had not been completed, the Science Advisory Committee decided to issue a general statement to the public. At the same time the United States made the data and an analysis of it available to the Soviet Union and the United Kingdom, the two other nations participating in the test ban negotiations. On January 16 the Defense Department released more detailed information to the press.

"I cite these events to show that the data presented are genuine and not something that has been invented by those who wish to scuttle the test ban negotiations. However, this does not mean that the data prove that detection of nuclear tests has now become so difficult that, to quote again from a prominent periodical, 'the chances of deception are so great as to be a major risk to survival' because 'the real minimum underground blast that could be fully detected was about 20 kilotons.' This conclusion not only is invalid. It is factually incorrect and completely misleading."

What the Data Showed

"The analysis by the panel of scientists seemed to indicate that the control system as devised by the Geneva Conference of Experts, and which was based on scientific evidence available at the time, would have a more difficult job to distinguish between nuclear explosions and earthquakes than had previously been realized. The new data also showed that 'seismic signals produced by explosions are smaller than had been anticipated and that there are consequently about twice as many natural earthquakes equivalent to an underground explosion of a given yield as had been estimated by the Geneva Conference of Experts.'

"It is important to stress that the new information does not bear so much on the detection of nuclear tests as it bears on the identification of earthquakes which must be made so that they can be distinguished from nuclear explosions and thus eliminated by the control organization as suspicious events. Signals received at control posts which cannot clearly be identified as earthquakes must be subject to on the spot inspection, according to the Geneva technical agreement on detecting tests."

Improvements Possible

"The significance of the new data and what can be done about it are subject to varying interpretations. Some view the information in such a pessimistic light that they advocate suspending only atmospheric tests but continuing underground tests. Others are more optimistic and believe that improvements can be made so that the risk to the United States of entering into a test ban agreement will not be significantly increased. In fact, the new data on underground explosions prompted further research and study of detection methods. Already new methods have been found.

"I understand that there are several promising techniques to improve the capabilities without increasing the size of the system recommended at Geneva. These include: building better instruments, devising ways to blot out background noise, placing seismographs deep in the earth, substantially increasing the number of seismographs at each control post over the number provided for in the Geneva report, utilization of additional methods to distinguish earthquake signals from nuclear explosions other than the determination of first motion, and use of unmanned seismographs to augment the Geneva system. Another obvious improvement is to increase the number of manned control posts. The President's Science Advisory Committee is continuing to study how the control system might be improved. I hope and urge that its report be made public."

Basis of the Geneva Conclusions

"To view the new data in perspective, it is worthwhile to recall the basis of the conclusions of the Geneva Conference of Experts regarding the detection of underground nuclear tests. The Geneva conclusions are based on the following premises: that if five or more seismographic stations at various directions from the source of an underground event are able, not only to detect the event, but to determine the direction of the first motion on the seismogram—that is, whether the first motion is compressional (line on seismogram goes upward) or dilatational (downward first motion on seismogram—that then some 90 percent of the earthquakes can be eliminated as not being nuclear explosions or suspicious events. Whether the five stations can determine first motion depends somewhat on the distance of the seismograph from the source of the event (at certain distances the direction of first motion is difficult to determine) and on the amplitude, i.e. strength, of the signal. Deter-

mination of first motion also depends on whether the seismographic station is at a site which is relatively free of noise from other factors. If the size of the wiggle on the seismogram showing the direction of the first motion is quite small, and if there is substantial background noise at the seismographic station, then the direction of the first motion might be extremely difficult to determine correctly. Signals that cannot be definitely determined as coming from earthquakes, according to the Geneva conclusions, must be subject to on the spot inspection.

"The scientists at Geneva also thought that if five seismographic stations recorded some compressional waves as first motions and some dilatational or rarefaction first motions that this was a definite sign of an earthquake, and, therefore, probably need not be investigated. However, if all or most of the seismographic stations recorded the direction of the first motion as compressional then this was to be regarded as suspicious evidence that a nuclear test has occurred. An investigation would then be permissible. According to the report of the panel of scientists who studied the results of the recent underground tests, the new data do not change this conclusion.

"The number of stations recommended by the Geneva Conference of Experts was based on identifying about 90 percent of the earthquakes equivalent to a nuclear explosion of five kilotons and thus eliminating them as suspicious events. The capability of the control system devised at Geneva to identify underground events of less than five kilotons would depend on: 'a) the small fraction of earthquakes that can be identified on the basis of data obtained from the posts alone; b) the fraction of earthquakes that can be identified with the aid of supplementary data obtained from existing seismic stations; and c) the fraction of events still left unidentified which could be suspected of being nuclear explosions and for which the international control organ carries out inspection. . .'

"The control organization would also have a capability to deter a potential violator so long as there existed the right of spot checking the source of signals which appeared suspicious. In other words, the right of inspection would exist even though it would not be practical to investigate the source of every signal that could not be identified as coming from an earthquake."

Number of Earthquakes Still Uncertain

"In deciding the number of earthquakes that would need to be identified and, therefore, eliminated from inspection control the Conference of Experts was somewhat vague. The reason for this vagueness in part stems from a difference of view between the Western and Soviet scientists as to how many earthquakes of a given size occur each year. The difference of opinion over this matter appears to be not unusual. Seismologists and geologists have not heretofore been concerned with small earthquakes and have, therefore, not concentrated on devising seismographs or seismographic sites to record them. They have been primarily concerned with the larger earthquakes which could be a danger to cities and populations.

"The number of earthquakes that occur each year of various sizes, therefore, is at present a mathematical calculation or an extrapolation downward of what has been known about the number of large earthquakes. The number of earthquakes is not yet determined as a result of close and persistent scientific observation. For this reason, a great deal more research must be done before scientists have reliable knowledge in this field.

"The new data presented to the President's Science Advisory Committee indicate that since an underground test might give off a weaker signal than previously believed by Western and Soviet scientists, that therefore, the control system will have more earthquake signals to cope with and thus have more of a burden placed upon it than had previously been thought. And, to repeat, the fact that some nuclear explosions give off weaker signals makes the determination of the direction of the first motion more difficult. But again to repeat, many of the scientists who have studied these results feel that through improvements in scientific instruments and further research, the capabilities of the control system can be increased. In fact, the President's Science Advisory Committee has so indicated."

Implications

"The new data do not indicate that nuclear tests will definitely be more difficult to detect. Actually, the data appear to indicate that in some respects it may be easier to detect nuclear tests than the Conference of Experts at Geneva had concluded. This is so because the Geneva conference thought that the determination of the direction of the first motion was about the only way that earthquakes could be distinguished from nuclear explosions. The new data appear to show that surface waves from a nuclear explosion are weaker than those from earthquakes of a comparable size and that, therefore, analysis of surface waves may be used to distinguish between the two.

"In addition the Geneva Conference thought that at certain distances, from about 620 miles to 1240 miles from the source of an event, seismic signals would be very weak. The new data indicate that stations in this 'shadow zone' as it is called pick up signals somewhat stronger than had been estimated. The size of the zone is now considered somewhat larger; the signals are delayed, and determination of first motion is not usually considered possible, but the strength of the signals is greater."

Rockefeller Institute Press

The Rockefeller Institute and the Oxford University Press in New York have jointly announced the establishment of the Rockefeller Institute Press to publish books on science and related subjects. Editorial responsibility for the books will rest primarily with the institute, while Oxford will be chiefly responsible for design, printing, and distribution. It is expected that the first books will be issued in the fall of 1959. While many of the books and monographs will be the work of institute faculty members, works by other scholars will also be published.

In announcing the new press, Detlev W. Bronk, president of the institute, said:

"The functions of a university include not only the advancement of knowledge and its communication to a new generation of scholars but also the dissemination of new knowledge far and wide. It is appropriate, therefore, that The Rockefeller Institute, having become a graduate university of science in 1954, should now follow the example of its sister institutions throughout the world in establishing a university press.

"Among the objectives of the press will be to provide an additional and needed outlet for scientific books of highest quality, carefully selected for their excellence. Further, during this time of rapidly increasing scientific knowledge paralleled by ever-mounting costs of publication, The Rockefeller Institute Press, because of its nonprofit nature, will make possible the publication of books at costs which will enable the

Charles I. Campbell