This procedure, of course, is the main reason why the surplus, if it develops, is never very much higher than the predicted surplus, while the deficit may be a great deal bigger than predicted. Budgets that are balanced when submitted often turn out to be unbalanced by the end of the year, while budgets that are unbalanced when submitted, like Kennedy's revision of Eisenhower's budget last year, never turn out to be balanced. Predicting a deficit implies that even under the most optimistic assumptions you could reasonably make, you still could not get a predicted surplus, which makes it highly unlikely a surplus will develop. Under the reverse situation, predicting a surplus, a deficit is usually easily possible, and sometimes highly probable.

Procedure

The Eisenhower Administration never offered so explicit an explanation of how it arrived at its basic budget decisions as the Kennedy approach outlined two paragraphs above. Eisenhower's budget explanations generally asserted that he had limited spending to what was "necessary rather than merely desirable," and left the impression that it was rather a happy coincidence that the level of necessary spending, combined with the predicted level of tax receipts, always led to a prediction, at the time the budget was submitted, that the budget would produce a surplus at the end of the year. In fact, the general approach was probably similar to Kennedy's, except that the more genuine desire actually to achieve a balanced budget, combined with a more genuine desire to hold down federal spending and with less enthusiasm for efforts to stimulate the economy through federal budget policies, led to less spending than Kennedy would have recommended under the same circumstances.

The Kennedy approach was explicitly endorsed last week by a report of the Council for Economic Development, an important private group made up primarily of prominent business executives of the liberal Republican persuasion and currently chaired by Theodore Yntema, head of the finance committee of the Ford Motor Company. According to the CED, "it should be the policy of the government to set its expenditure programs and tax rates so that they would yield a constant, moderate surplus under conditions of high employment," which, of course, is just what the Kennedy economic report says his Administration is doing. If the Administration's optimistic but not wholly unrealistic assumptions about the growth of the economy prove true the budget may produce a small surplus. If not, we will have another deficit, which is just what the Administration, and such groups as the CED, would want under those circumstances.

The difference between the Kennedy and Eisenhower approaches is quite small if viewed from Senator Goldwater's viewpoint, but it is a very important difference nonetheless. Even a small shift in direction, if consistently adhered to, leads to a very substantial shift in where you would be in a few years by following the alternative lines in policy.

Kennedy and Eisenhower alike have supported increasing federal spending for science and for education. Under Kennedy there is more readiness to see the federal role in these areas grow. But the much more important difference is simply that there is more money available for spending under Kennedy. If Kennedy, and groups like the CED, and economists generally, are correct, the altered approach to fiscal policy should lead to faster growth of the economy, producing more revenues for the government, further increasing the amount of money available for government programs beyond the difference in spending stemming directly from the larger budget Kennedy would approve over Eisenhower in a specific year, under specific conditions.

One of Eisenhower's last actions before leaving office was to approve a report of his Science Advisory Committee which, among other things, put the major responsibility for financing basic research and graduate education on the federal government. The report spoke of the need for more private and state support, but the major source of funds had to be, the report argued, the federal government. In line with this, Eisenhower's last budget recommended a sharp increase for the National Science Foundation. Kennedy's budget revision then added a further sharp increase on top of Eisenhower's proposal. Kennedy's further shift upwards represented a change in policy on spending rather than a change in policy on basic research.

The accompanying graph shows the growth in federal spending for research and development. The jump between 1956 and 1957 comes mainly from the rapid rise in spending on rockets and missiles, as this area reached the expensive advanced development stages. The drop in the rate of growth between 1961 and 1962 would have been considerably sharper if Eisenhower's proposed budget, rather than Kennedy's revision of that budget, had been followed. Kennedy's increases, last year and this year, have been mostly for space, but once again, the greatest single factor in deciding to accelerate the space program seems to have been that Kennedy believed the budget could stand the extra expense and Eisenhower had strong doubts. It is a lot easier to convince yourself that something isn't worth doing if you believe you couldn't afford to do it anyway.—H.M.

Science, Engineering Manpower: Uncertainties Cloud Nation's Future Needs

The Administration's science advisers will soon buckle down to providing the President with recommendations for increasing this nation's supply of scientists, engineers, and technicians.

The task, which has been assigned to the President's Science Advisory Committee, the Federal Council for Science and Technology, and the National Academy of Sciences, is being approached with considerable circumspection. As the President himself recently demonstrated—apparently inadvertently—the existing statistics are easily misread; at the same time the dimensions of the problem are highly uncertain and the remedy that comes readily to mind—a good dose of federal money—appears on close examination to be far from adequate.

While the size of enrollments is popularly regarded as the starting point for whatever manpower difficulties may exist, it would appear that the nation's utilization of its trained manpower may be of even greater significance. The National Science Foundation estimated in 1954 that 14 percent of the members of each graduating class in engineering were employed in other fields within a year after they left school. Though inducements to enter engineering may be one way to tackle the problem, inducements to stay in engineering may be a more direct solution.

The President reiterated his concern with the manpower problem last week at his press conference when he called

attention to the newly published National Science Foundation study, *Education and Professional Employment in the U.S.S.R.* A major point of that work, which was reported on in this space last week, is that the Soviets, through rigid control of their educational system, are taking fewer students into higher education than the United States, but are turning out three times as many engineers; in the sciences, if teachers are included in the totals, the Soviet output of graduates exceeds this country's by almost two to one.

The techniques that have produced these results for the Soviet Union cannot be transplanted to the American scene, for they simply boil down to telling vast numbers of students that they do not have to pursue higher education, but that if they want to do so they will have to become engineers or scientists. The task that thus faces the men charged with providing the President with recommendations is to find some means, within a context of free choice, to motivate considerably larger numbers of students to follow careers in science and engineering.

The question of how great a flow to stimulate is the first that requires an answer. Despite dramatic assertions on just what the nation's deficit in these fields will be in the next few years, there is vast uncertainty about how this country utilizes its highly specialized manpower and what its future needs will be. The dynamic nature of the contemporary American economy and the vast dislocations that would result, for example, if arms control or disarmament were achieved make it extremely difficult to foresee the needs with any reasonable degree of accuracy.

Uncertainties

Whatever is to be achieved, however, in increasing the output will have to be the result of a long-term program based on the fact that the production of scientists and engineers is a process that starts at least as far back as high school. Looming as a disturbing spectre in working out projections amid many uncertainties is the danger of stimulating overproduction in some fields, with unemployment as the payoff for long and arduous training. Not too many years ago, for example, geologists were in short supply and young men were assured of a profitable career if they chose that field. The profession is now experiencing substantial unemployment attributable to world-wide overproduction and political unrest in oil-rich nations abroad. Both have contributed to an unforeseen decline in oil exploration.

The most carefully prepared projections on the manpower needs of this decade are contained in a study prepared last year by the Bureau of Labor Statistics and published by the National Science Foundation, "The Long-Range Demand for Scientific and Technical Personnel." The study is replete with warnings of uncertainty—warnings which are almost invariably overlooked in public discussions and press reports on impending manpower shortages. But its conclusions, which are the best available, are that during this decade the annual deficit in engineering will total about 26,000. The projections for "science"—agriculture, biological sciences, forestry, mathematics, physical sciences, and general sciences—indicate that supply and demand may be fairly well balanced, but that shortages may develop in some specialized fields.

The problem of uncertainty in projecting the paths that will be followed by large numbers of people as they start out on their careers presents vast difficulties for any attempt to balance training with national needs. The NSF found in a study of 1951 science graduates that three-fourths of those with bachelor's degrees and about three-fifths of those with master's degrees were not working as scientists within a year after graduation. To provide for an estimated national requirement of 25,000 scientists annually in this decade, the NSF estimated, it would be necessary to have an average annual graduating class of more than 83,000. Current expectations are that science graduates annually will total 80,000, thus bringing the projected supply and demand fairly close. The NSF study notes, however, that in its projections, dropouts were estimated at 70 percent. If the percentage should fall to 60 percent, the study points out, an oversupply of scientists would result.

These overall projections apparently merit sizable revisions on the basis of the planned expansion alone of the National Aeronautics and Space Administration. The projections, prepared for NSF by the Bureau of Labor Statistics, were produced in 1960 on the basis of data available for no later than 1959. While attempts were made to account for the expansion of the nation's space establishment, NASA's growth, under the accelerated space effort instituted by the Kennedy Administration, was, of course, unforeseen. During the coming year, NASA plans to hire about 2000 scientists and engineers, about 8 percent to make up for attrition, the rest for general expansion; in coming years, it is expected to hire annually at least as many, with some estimates placing the total increase over 5 years at approximately 10,000.

Kennedy in Error

The specialists concerned with building a manpower program that to a large extent will have to be based on imponderables winced last week when the President undertook to tell the country about the plight that it faces. In announcing the manpower study at his press conference. Kennedy used the occasion for again telling the public that all is not well with its education system. The message is a useful one for him to deliver in view of the difficulties that are to be anticipated in Congress for his requests for additional funds for federal aid to education. What is disturbing, however, is that on a subject in which the quality of the overall information is sadly deficient, the President's misuse of statistics served only to alarm the public and contributed nothing but confusion to a subject of great public importance.

The President stated: "In 1951, our universities graduated 19,600 students in the physical sciences. In 1960, in spite of the substantial increase in our population during the last 10 years, and in spite of the fact that the demand for people of skill in this field has tremendously increased . . . the number had fallen from 19,600 to 17,100. In 1951, there were 22,500 studying in the biological sciences. In 1960, there were only 16,700. In the field of engineering, enrollment rose from 232,000 to 269,000 in the period 1951 to 1957. Since 1957, there has been a continual decline in enrollment. Last year, the figure was down to 240,000."

A comparison of the President's figures with figures published by the U.S. Office of Education shows that while Kennedy's intentions may have been sound, his statistics were not. The figures he cited for 1951 in the physical and biological sciences are actually the figures for 1950, when many World War II veterans, who produced peak postwar enrollments, reached gradua-

tion. In few fields—mathematics is one of the notable exceptions—has the annual award of degrees surpassed the figures for 1950. Had the President used 1955 as the base year for the biological sciences, a comparison would show that degrees conferred in 1960 had increased from 12,800 to 16,700; had he used 1954 as the base year for the physical sciences, a comparison would show an increase from 10,900 to 17,100.

The President's figures for engineering enrollments contributed generously to the confusion. Contrary to what he reported, engineering enrollments rose from 146,900 in 1951 to 268,700 in 1957; enrollment in 1961 totaled 232,100, but the number of degrees awarded last year was 37,800, a slight drop from the previous year, but the third highest total since 1951.

It should be noted that while engineering is experiencing a drop in enrollments, mathematics is a rapidly expanding field of study; it produced almost twice as many graduates in 1960 as in 1950 (11,400 to 6,300); in the physical sciences, growth has also been rapid, and the 1960 total of graduates was 17,100, compared with 19,600 in the peak year of 1950.

The picture presented by the President was also rendered misleading by his failure to note that the population of 18-year-olds—from which the great majority of college students are drawn—actually dipped slightly between 1950 and 1957, but still produced steady increases in all fields but engineering.

(An inquiry into what led the President to err in the presentation of the statistical information revealed that the information was requested by a White House aide shortly before the press conference got underway and apparently was hurriedly delivered to Kennedy, who used it without time for checking or reflection.)

Manpower Utilization

In the opinion of a number of manpower specialists, the failure of the engineering profession to match the growth of other fields is the result of "image" problems. The title "engineer," it has been noted, is loosely protected in this country, with the result that janitors are "building engineers" and repairmen pass themselves off as "engineers" of one sort or another. In addition, the nomenclature employed by the press assigns the title "scientist" to great numbers of professionals who are engineers in training and practice. Many "space scientists" are, purely and simply, engineers, but a young man contemplating a career is led to the impression that engineering is one of the lower orders of professional endeavor. The engineering profession is naturally aware of its public relations plight, and can be expected as the situation continues to invest some effort and money into public relations aimed at elevating the profession's public image.

One of the problems which will be reviewed in the study ordered by Kennedy is the utilization of scientific and engineering personnel, working for some of the larger firms doing business with the government. The impression is widespread that many of these firms engage in "hoarding" of highly trained specialists so that they will be on hand as evidence that a company is qualified to carry out a government contract. In addition, a review will probably be made of the sticky problem of bidding on government contracts. While Congress pressures the Executive to throw open more contracts to bidding, the agencies letting the contracts are aware that a vast amount of engineering and scientific effort goes into the preparation of bids. The outcome is that the effort pays off for one company, but is time and talent down the drain for the others.

Another subject that may be scrutinized is the advertising for scientists and engineers which many companies purchase in considerable volume. The suggestion has been made that some of these advertisements are inspired more by a desire to impress the public than to hire help. Notice that a firm needs a large number of scientists and engineers can have a beneficial effect on its stock-market position. The truth is hard to pin down, but there are cases where it would appear that corporate image building has been extended to the help-wanted ads, producing distortion in the manpower picture.

The general manpower review ordered by the President is expected to get underway within the next few weeks. Among those responsible for carrying it out there is an awareness that no quick answers are in the offing and that a great deal of careful number gathering will be necessary before the problem can be viewed with reasonable clarity.—D.S.G.

Announcements

A new **section on statistics** (section U) was established by the AAAS during its 1961 annual meeting in Denver. Although statistics, as a methodology, has long been a part of AAAS activities, affiliated statistical organizations were necessarily associated with the section on mathematics (A) or the section on social and economic sciences (K). The new section will serve to correlate these organizations and help intensify the contributions of persons engaged in statistical work.

The committee's principal administrative body, chaired by a vice-president of the AAAS, will consist of representatives of the participating associations; four members, chosen at large; and a secretary, chosen by the Board of Directors. Morris B. Ullman, of the Bureau of the Budget's Office of Statistical Standards, has been appointed secretary for the current term.

Individual AAAS members who wish to be identified with the new section are requested to write the association. (Membership Department, AAAS, 1515 Massachusetts Ave., NW, Washington 5, D.C.)

A popular survey of the **measurement of time** will be presented over the NBC-TV network on Monday evening, 5 February, as part of the Bell System Science Series. The hour-long program, "About Time," will cover the evolution of the calendar, development of clocks, built-in timing mechanisms of plants and animals, techniques of precision timing, reconstruction of geological time, and relativity.

Bibliographic and documentation services in **biotoxicology and natural products chemistry** are available through the World Life Research Institute. Services include exhaustive literature searches, continuing current and generic searches, and literature procurement. (B. W. Halstead, WLRI, Colton, Calif.)

The National Institutes of Health's Office of International Research has established a branch in Paris to represent U.S. Public Health Service interests in **European medical research.** Duties of the new office, headed by Charles P. Huttrer, former assistant chief of the NIH Grants and Training