and the archeologists and geologists even closer together. Of all the rewards of research, none is greater than that of meeting people in different fields and finding interests in common. It will be most refreshing and rewarding for the radiocarbon daters to go out and share, at least vicariously, in the great thrill of an archeological dig.

Accuracy of the Results

The many people who have contributed to the development of the radiocarbon dating technique (several of whom I have mentioned but many of whom I have been unable to mention) are largely responsible for whatever success it has had. We now have several thousand radiocarbon dates throughout the fields of archeology, geology, meteorology, oceanography, and other areas. From examination of the results it is possible to form an opinion as to the general reliability and general weaknesses of the method. I am sure that Arnold would agree with me in saying that it has lived up to our fondest hopes.

It was clear from the beginning that there would be difficulties about the samples. Anyone knows that it is possible to get dirt into solid matter which is lying in the ground, even if it is there only for a brief period, let alone many thousands or tens of thousands of years. The saving aspect of the situation, however, is that it is very much more difficult to mix molecules in such a way that they cannot be separated chemically, particularly in the case of substances such as charcoal and wood and cloth, and even, in certain instances, limestone and shale. One can separate and distinguish the contaminant from the original material and in this way disclose the real radiocarbon content. The researches of a number of people have validated the assumption that it is possible and that, indeed, it is not too difficult to obtain authentic samples in the field. In general, the samples may have to be inspected with some care under a relatively high-powered glass and then, possibly, treated with properly chosen chemicals. But all of these things can be done, with techniques that are no more difficult than those used by the average hospital technician, and a sample can be obtained which should give authentic radiocarbon dates. The dating technique itself is one which requires care, but which can be carried out by adequately trained personnel who are sufficiently serious about it. It is something like the discipline of surgery—cleanliness, care, seriousness, and practice. With these it is possible to obtain radiocarbon dates which are consistent and which may indeed help roll back the pages of history and reveal to mankind something more about his ancestors and thus, perhaps, about his future.

Note

1. Our whole research was supported generously by the Viking Fund of New York City (now the Axel Wenner-Gren Foundation), the U.S. Air Force, the Geological Society, the Guggenheim Foundation, and, of course, the University of Chicago, where most of it was done.

Bibliography

Am. J. Sci. Radiocarbon Suppl. **1** (1959); **2** (1960).
W. F. Libby, *Radiocarbon Dating* (Univ. of Chicago Press, Chicago, Ill., ed. 2, 1959)

Science in the News

Kennedy on Natural Resources: His Program Covers Same Ground as Ike's, but on a Larger Scale

The Kennedy message on natural resources placed heavy emphasis on the role of the scientific community. The message proposed comparatively little spending for the coming fiscal year (1962), beginning this July. A spokesman for the Administration said he considered an extra $100 million above Eisenhower's recommendations a reasonable guess. If Congress is cooperative, spending will surely be higher than this. But spending, in any case, will involve fairly small sums by the standard of the federal budget, and small also compared with what the program implies Kennedy would like to do in the years to follow.

Most of the recommendations for the coming year have to do with organizing a national attack on the problem of resources. Kennedy asked the National Academy of Sciences for a "thorough and broadly based study and evaluation of the present state of research." He said he wanted the Academy's recommendation for research programs affecting the "conservation, development, and use of natural resources, how they are formed, replenished, and may be substituted for, and giving particular attention to needs for basic research and to projects that will provide a better basis for natural resources planning and policy formulation." This study will take about a year and will cost about $1 million. Its full impact will not show up until the fiscal '64 budget, which must be presented to Congress in January '63. Meanwhile, Kennedy asked the Federal Council for Science and Technology to recommend what can be done more quickly "to strengthen the total government research effort relating to natural resources."

The message included the by now familiar emphasis on oceanography. (The Democratic platform and the State of the Union message also included specific references to this, a continuation of an effort begun under the Eisenhower Administration to draw attention to the field.) The problem has been that the science, or the group of sciences collectively known as oceanography, has had difficulty winning Congressional support partly because it lacks the glamor and the obvious connection with national security that space and atomic energy research have, partly because responsibility for the program is scattered throughout the dozen or so government agencies with an interest in one phase or another of oceanography.

Presentation to Congress

One result has been that there is no single Congressional committee in either house with the authority to ap-

propriate money for the whole program, and few of the committees have much interest in an area which is often apart from the major role of the agency asking for the money.

The most talked of example of this is the problem the Weather Bureau, which is part of the Department of Commerce, has had in getting even a comparatively small amount of money to do research on the effects of the ocean on the weather. The appropriations subcommittee with responsibility for the Department of Commerce has comparatively little interest to begin with in the Weather Bureau, and none at all in proposals of the Weather Bureau to do research in the oceans. When the committee begins looking for ways to cut the budget it is not surprising that it immediately questions the necessity of the Commerce Department supplying the Weather Bureau with several hundred thousand dollars to do research in the oceans.

A report on the problem appeared in *Science* (27 May 1960) and at the time there was talk of working out an arrangement for a single government office to present the whole program. Kennedy's natural resource message said something like this would be done, although it is not clear whether the effort can really be effective without changes in the law.

Fragmented Program

What the administration has in mind is to prepare a booklet bringing together all the pieces of the oceanography program now scattered through the budget, in the hope that this will make the appropriations subcommittees aware of the full range of the program. The Federal Council on Science and Technology, an arm of the President's office, would press the individual agencies to support their share of the program, a necessity since one of the problems has been that although oceanography has to come to enjoy high national priority, the segments of the program within individual agencies may have a very low priority in the agency programs. The work of the Federal Council would be a continuation of an effort begun under Eisenhower.

Finally, the Administration would present the program to the full Appropriations Committee. The presentation to the full committee, like the pamphlet, would be aimed at giving members of the subcommittees responsible for parts of the program a picture of the program as a whole.

If such methods turn out to be effective they will probably be adopted for other programs, such as meteorology, which also are fragmented among a number of federal agencies. But a really effective solution of the problem may require changes in budget procedures, permitting a single agency to present the whole program to a single appropriations subcommittee, and then to assign funds for the parts of the program to the various departments.

Opposition to Reform

It would be hard to push such a reform through Congress, for any rearrangement of power over appropriations necessarily takes a little power away from some subcommittees and gives it to others. This makes it difficult to work out a reorganization, and the difficulty is compounded by the usually correct assumption that the drive behind the executive's pressure for reorganization is to make it easier for the Administration to get what it wants from Congress. This means that the relative power of the legislative branch is reduced and not only runs into Congress' disinclination to part with its prerogatives, but more importantly, arouses the opposition of conservatives in and out of Congress who, again usually correctly, feel that anything that makes Congress more efficient simply means more federal spending and a further expansion of federal powers.

In the face of such difficulties the Administration apparently does not intend to try for major reforms in budget procedures this year, when it already has its hands full trying to push through such things as the aid-to-education program. It is likely, though, that the attempt will be made during Kennedy's term. It would require a major effort by the President to arouse popular demand for reform, probably on the grounds that since present methods are inefficient, reforms would therefore save a great deal of money.

Resources Message

In general, the message on natural resources drew less public attention than any of the earlier ones: it contained neither a proposal so hotly debated as the aid for teachers' salaries of the education message or the medical insurance for the aged of the health message, nor did it deal, as did the messages on the economy and the gold situation, with a problem that has been regularly making headlines. The message, in fact, was designed no more to present a program to deal with a problem than to draw the public and Congress' attention to the fact that a problem exists.

"Our entire society," the message said, ". . . is dependent upon our water, our land, our forests, and our minerals. How we use these resources influences our health, security, economy, and well being. . . . If we fail to use these blessings prudently, we will be in trouble within a short time. In the resource field, predictions of future use have been consistently understated. But even under conservative projections, we face a future of critical shortages and handicaps. By the year 2,000, a United States population of 300 million—nearly doubled in 40 years—will need far greater supplies of farm products, timber, water, minerals, fuels, energy, and opportunities for outdoor recreation. Present projections tell us that our water use will double in the next 20 years; that we are harvesting our supply of high-grade timber more rapidly than the development of new growth; that too much of our fertile topsoil is being washed away; that our minerals are being exhausted at increasing rates; and that the Nation's remaining undeveloped areas of great natural beauty are being rapidly preempted for other uses."

The message offered several dozen proposals covering these problems, and Administration spokesmen said that draft legislation would be soon sent to Congress. But the general purpose was to "bring together in one message the widely scattered resource policies of the federal government." On a larger scale, its purpose was essentially the same as the proposal to present a unified program on oceanography: to make Congress and the public aware of the need for a coherent national policy to deal with all the interrelated areas dealing with resources, and so to lessen the chance of the parts of the program being lost amidst the sea of often conflicting or overlapping legislation Congress must deal with each session.

Environmental Health

A substantial share of the message was devoted to the problems of air and water pollution, which it said had already reached alarming proportions. The nation is spending $350 million a year on municipal waste treatment

works, a substantial sounding sum of money, but Kennedy said that nearly twice as much, $600 million a year, is necessary just to keep pace with the growing rate of pollution.

The message charged that industry is "lagging far behind" in its treatment of wastes. It asked, as did the Eisenhower budget message, for stronger federal powers to deal with "serious pollution situations of national significance." It said air pollution is not only a growing health menace but that it causes an estimated $7.5 billion a year damage to vegetation, livestock, metals, and other materials, and although a great deal of this lies beyond any control measures now feasible or even imagined, Kennedy recommended a major research effort to see what can be done to lessen the damage. He proposed a special unit to be organized by the Public Health Service to devote itself to the problem of air and water pollution, and recommended increases in the levels of federal grants to city and state governments for pollution control projects.

The Eisenhower budget message included proposals, although on a smaller scale, along much the same lines. The idea of presenting a unified oceanography program to Congress, a proposal an Administration spokesman pointed to when asked what there was in Kennedy's message that was really new, grows out of an effort begun by the old Administration. Nearly all of the problems Kennedy described in his special message were touched on in Eisenhower's final budget.

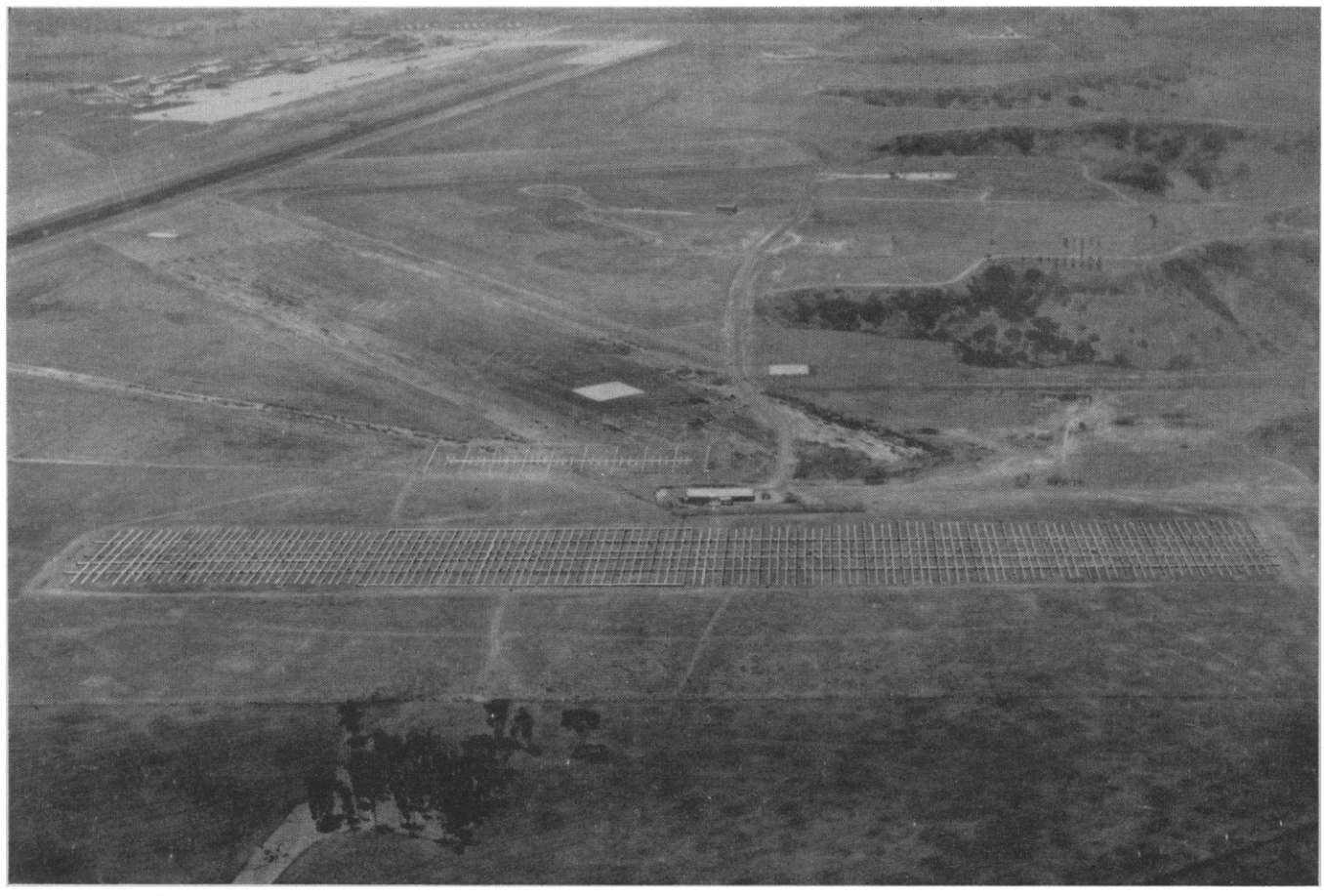
How then, the spokesman was asked at a background briefing for the press, did the Administration see its policies as compared to Eisenhower's. "The previous Administration," he said, "recognized problems, but then only did enough to be able to say they were doing something; this Administration is really addressing itself to the problem." The Eisenhower view was that his Administration was indeed addressing the problem but at the same time was preserving a "sound balance" in the role of the federal government by restricting the programs to what seemed "necessary rather than merely desirable."—H.M.

News Notes

"The Dark Fence": Radar Screen Detects Orbiting Objects

The Navy has announced that the so-called "dark fence" will be completed later this year. It has been in partial operation for some months.

The screen will be created by a 500,000-watt transmitter (three smaller transmitters are now in operation) emitting a broad, thin radio curtain across the continent from southern California to Georgia. Reflections of objects in near space are picked up by gigantic receiver arrays, such as that illustrated. Data are fed into computers, and the orbits can be calculated. The system makes it possible to detect and track nonradiating satellites passing over this country. Navy officials said that even in its present partially completed form the system has detected and tracked a piece of wire 15 feet long orbiting at a height of 400 miles. The wire was debris from U.S. satellite.



Receiving antenna of the "dark fence" satellite detecting system, near San Diego, Calif. [U.S. Navy]