ble for the country to open new horizons in science policy.

With the change of regimes in 1958, several new governmental civil science organizations were created, old ones were reformed, and budgets began a steady upward movement. A three-part structure based on the law of 1958 provides an interministerial committee for science and research, an advisory committee made up of a dozen members chosen for individual distinction in a variety of scientific and technical fields, including the social sciences, and a secretariat, the Délégation Générale à la Recherche Scientifique et Technique (DGRST).

In making policy for civil science the new apparatus has gained in effectiveness from its role in the budgeting process. Each ministry isolates its request for research funds from the rest of its budget, and these requests are assembled under the supervision of the science minister in the so-called "*enveloppe recherche*" or research block appropriation. It is reviewed by the advisory committee and the interministerial committee. The science minister then pleads the case for research before the Minister of Finance and the legislature, and the procedure is regarded as having given the science minister added leverage in influencing overall science policy.

The block appropriation, it must be noted, includes a relatively small part of total government expenditures on R & D. As in the United States and Britain, defense and nuclear research and development are by far the most costly items and are treated separately. The block appropriation is made up primarily of funds for support of basic research—of the CNRS budget and of funds for research in universities and government establishments. According to a highly informative 1966 OECD report* on France (one in a series of reviews of national science policy), the block appropriation in 1963 contained about 15.5 percent of government R & D funds. In 1965 the total research block appropriation amounted to something over 1 billion francs (about $200 million). Not included are funds for international scientific programs, which are controlled by the Ministry of Foreign Affairs, and appropriations for telecommunications research and for most of the research related to French foreign aid programs. It is significant that Peyrefitte's official title, Secretary of State for Scientific Research and Atomic and Space Questions, gives separate billing to atomic energy and space.

While the block appropriation has grown steadily, it has continued to con-

*Reviews of National Science Policy: France (Organization for Economic Cooperation and Development, Paris, 1966).

Hornig on Research Policy: Public Understanding

An extensive statement on the scientific and technical policies of the Johnson Administration was delivered on 26 April, in a speech to the American Physical Society, in Washington, by Donald F. Hornig, special assistant to the President and director of the Office of Science and Technology (OST). Copies of the complete text may be obtained by writing to OST, Executive Office Building, Washington, D.C. The following are excerpts from Hornig's address:

At the end of the World War II we awoke with a start to the realization that this country was not properly cultivating its scientific base, not only in physics but in other areas like health research. . . . There was a vacuum to be filled and we proceeded to fill it at a breath-taking pace. At times, in some fields, the doubling period was 2 or 3 years; over all, the doubling period was of the order of 4 to 5 years through much of the two decades following World War II. What has changed now is not that there are restraints to be imposed on science either by the Congress or by the Executive, but that the initial vacuum has largely been filled and a new situation has arisen which requires new thought.

When I say that the vacuum has been filled, I mean that we have built a strong, viable scientific establishment in this country. In a whole variety of fields, from particle physics to molecular biology, the quality of American science is second to none. . . .

The country need not be convinced any longer that we need strength in basic research. This is accepted by the Executive, by the Congress, and by the people of the country. . . . What is *not* accepted is the notion that every part of science should grow at some automatic and predetermined rate, 15 percent per year or any other number, as a consequence.

The simple fact is that science and technology, research and development, have changed from being frosting on the cake of defense expenditures, health expenditures, and so on, to being a significant national expenditure which must compete with other claimants on national resources. The question is not whether we should have basic research, whether we should have research and development, or even whether it should continue to grow—but rather in what ways and for what purposes it should be expanded. The answer to this question will have to be supplied not by me but by all of us.

What has happened seems plain enough to me. Not so long ago, science was "pure" and could be conducted by people who talked largely to each other; now the country has become convinced of its significance and has provided the resources which have enabled it to grow into an important national activity. By any standards, we provide a higher proportion of our very high national income to science than does any other society in the world. But now, instead of languishing in the wings, science is on front stage center; it is in the spotlight and the quality of its performance is reviewed by public critics in the popular press.

The goals of our scientific effort and the nature of our scientific effort are being examined not only within the scientific community but by various organs of my office and, more important still, by numerous committees of the Congress. There is every reason why they should do so, just as they do for every other important national activity. The heightened interest in this case undoubtedly

stitute a modest percentage of the science budget as compared with expenditures for defense, atomic energy, and, more recently, space research. An expanded role for civil science in promoting economic growth and modernization, however, may well result in a bigger slice of the science-budget pie.

In the argument developed during the campaign, principally by Peyrefitte, the United States was used as both an example and a threat. American industry has devoted much more effort and money to research than French industry has, Peyrefitte noted, and heavy expenditures by the U.S. government on defense and space research, particularly in the private sector, have given the United States a long lead in vital high-technology industry. If France is to maintain independence of action in the economic as well as the military sphere, it is necessary for the French government to take action against what the French call, for short, "*le gap*."

Government action is, in fact, foreshadowed in the Fifth Plan (for 1966 through 1970), which was formulated during 1964 and 1965, well before the technology gap became a political soccer ball in Europe, around the beginning of 1966. Development of the science section of the Plan involved closer cooperation than had ever before existed between the Commissariat du Plan and DGRST and, reportedly, the collaboration of a large number of researchers and administrators from the universities and industry. Creation of a group of new organizations, devoted principally to the promotion of civilian technology, was announced in the last half of 1966; most of these are anticipated in the Plan.

A Centre National d'Exploitation des Océans (CNEXO) has been set up to coordinate present activities in oceanography and also to see that oceanographic research, where possible, yields industrial and commerical benefits. With about 100 laboratories, under eight or nine ministries, now operating in the field, the problem of rationalization resembles that in the United States, and CNEXO is looked upon as roughly the French equivalent of the new Marine Resources Council in the United States. While the law is somewhat vague, CNEXO will reportedly have authority to direct the use of equipment, particularly the use of research vessels.

Another new organization specifically created to link fundamental research and applications is the Agence Nationale pour la Valorisation de la Recherche (ANVAR). French officials are frank in saying that the details are far from settled, but that ANVAR will be essentially an information service designed to open channels between universities and industry and will seek ways to overcome prevailing habits and preju-

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arises because it is new and has not been so examined in the past. In short, if support is to continue to grow, it is no longer adequate to arrive at a subtle conviction of the needs within the scientific community or to communicate those needs to me and to the relevant agencies. The scientific community is going to have to learn to articulate its hopes, to describe the opportunities which are before us for practical advance, to express the excitement of the new intellectual thrusts—but to do these in terms which the American people, who are expected to pay the bill, will generally understand and have faith in. There is no alternative.

An excellent start has been made in the Pake Report, *Physics—A Survey and Outlook*, and in the Whitford Report, *Ground-Based Astronomy*. But the dialogue will have to be carried to the newspapers, to the schools, to the public and to the Congress, as well as to the Federal agencies and the Bureau of the Budget. It is not that we have entered a period of restraint—it is that science has matured, and to move ahead we must explain over and over again why and how. . . .

Now I would like to say a word about basic research in comparison with applied research and development. The facts are very simple. We are determined that the knowledge and understanding we have gained from science will be put to use to meet the needs of our people and the world as expeditiously as possible. . . . To this end the Federal Government supplies research and development funds where the results are technically feasible and economically or socially worthwhile.

But, because we are determined to make use of every bit of available knowledge whose application is feasible, economic, and useful, it does not follow in the slightest that this implies a decreased interest in basic research. The two activities are separate and usually done by different groups of people. On the one hand, there are people who feed the pool of knowledge and understanding into which we dip for our practical achievements and on the other hand there are people who recognize human needs and find new ways to meet them. Both are important, both demand creativity, imagination, enterprise, and talent, and both will go forward.

The President has put this very clearly in his recent message to the Congress transmitting the Annual Report of the National Science Foundation. After describing the practical benefits provided by scientific advance, he said:

> We know that we can continue this flow of benefits to mankind only if we have a large and constantly replenished pool of basic knowledge and understanding to draw upon. For the path between basic discovery and its application can be both long and uncertain. . . .

Unhappily, these points have not always been understood by government project officers, and there undoubtedly are unfortunate instances of efforts to mix the two and to warp basic research projects in the direction of application—or even to judge basic research projects not by the standards of scientific excellence but by the likelihood of practical advance. This we are trying to change. We are trying to get clear recognition that even when basic research is supported by a mission-oriented agency, its role is to build up the basic reservoir on which applications will rest rather than to define an application supporting the mission in each and every project. . . .