How Quickly Will Europe Close the Science Spending Gap?

Paris. On 12 and 13 January, the officials responsible for science policy in the 20 countries which belong to the Organization for Economic Cooperation and Development met for the second time under the aegis of Alexander King of Great Britain, OECD's director of science affairs, and his science directorate.

Fresh in the minds of the ministers were statistics from a report issued in December by King's directorate, which noted wide gaps between the scientific effort of Western Europe and that of its two great economic rivals, the United States and the Soviet Union.

Such gaps are constantly discussed in Western Europe, and comments in the United States that a misdeployment of U.S. scientific effort may seriously erode America's competitive position have no effect on current European discussion.

For, despite self-critical warnings in the United States, Europeans are practically unanimous in their conviction that the United States has a crucial lead in science and technology and that this lead is widening. Far from being comforted by comments that the heavy U.S. commitment to defense and space science has little to do with the civilian economy or with strength in international trade, Europeans are convinced that it is these very commitments that give America the key to vital industries of the future. Expression of such convictions goes far beyond the statements that Europe's science ministers, many of them holding newly created posts, might be expected to make in their drives to extract more funds from their skeptical and tight-fisted cabinet colleagues.

The Freeman Report

Additional fuel was given to such arguments by the December report, by Christopher Freeman of the British National Institute of Economic and Social Research and Alison Young of the OECD. The report was an effort typical of the OECD's science directorate, which gathers statistics, holds ministerial meetings, conducts surveys of the science policy problems of the individual countries and helps six Mediterranean nations work out their educational policies, all in the hope of stimulating more forceful scientific policy making in OECD countries.

The Freeman report brings up to date the picture presented in a report submitted to the first ministerial meeting, in October 1963. The first report discussed the situation in the late 1950's, while this one refers mainly to the picture of 1962. Thus, the report does not reflect the situation in 1964, which the OECD science directorate is using as an "international statistical year" in its effort to make a great improvement in the number and comparability of figures on science programs.

The gaps illustrated in the Freeman report are notable, even when allowance is made for the much greater American and Russian commitments to big science and big engineering. The United States spent 3.1 percent of its gross national product on research and development in 1962, whereas the average for Western Europe was 1.6 percent. The percentages are based on official rates of exchange, which the report acknowledges may exaggerate the difference. More decisive were figures on scientific and engineering manpower. In both the United States and the Soviet Union, well over 400,000 academically trained scientists and engineers were engaged in research and development, whereas the figure for Western Europe was hardly more than a third of this: 150,000. Furthermore, according to the report, the United States committed a far higher proportion of its scientists and engineers—about one-third—to research and development than did Western Europe, where the proportion was less than one-fifth.

It might be argued that such figures are misleading. Are not research costs higher in the United States? Perhaps, but American firms operating laboratories in Europe have found that scientists there generally employ more assistants. The Freeman report cited rough estimates that U.S. laboratories employ 1.7 supporting workers per qualified engineer or scientist; the European figure is 2.5.

A more important argument is that in Europe the smaller number of scientists and engineers are employed on projects of more direct importance to the civilian economy. But this argument must confront some stark figures —the best ones available—indicating that the deployment of scientists and engineers in Western Europe may not be as effective as is sometimes supposed. These are the figures on the balance between what various countries pay foreign patent-holders in license fees and what they receive from other countries (it will be recalled that nearly all nations—including the Soviet Union, since 1965—are parties to a world agreement to honor invention rights).

Such figures, of course, do not necessarily reflect the current state of research in the United States or Western Europe. Patents represent science in a package—a device or a process reasonably ready for use, on the shop floor. License fee payments in 1961 or 1962, then, indicate relative strengths at least 5 years earlier.

Furthermore, the purchase of the right to use a patent indicates a technically alert and forward-looking management, aware of the need to take advantage of the latest technology and prepared to do so. But it must also be remembered that such a policy can be pursued only so far. Ultimately, the price of the information may be so high that the company must sell out or go under.

In any case, the West European countries paid in 1961, as a group, to U.S. patent holders 5.6 times what they received from the U.S. The figure for Britain in 1961 was 5.1; for France in 1962, 4.8; and for Germany in 1963, 5.2. Evidently, several of the European nations had similar imbalances with respect to countries other than the U.S. (presumably with each other and with non-European countries). Both Germany and France paid out to foreign patent holders in general 2.7 times what they received.

These imbalances with respect to foreign patent-holders in general contrast strongly with the United States position. In 1956 the ratio of license-fee payments was about 6 to 1 in favor of the U.S. In 1961, when the sums involved were four times as great, the ratio had increased to 10 to 1.

It is true that for some industries and some countries the imbalance is

Among the ministers responsible for science and technology who attended the OECD's meeting for science ministers in Paris, 12 and 13 January, were (left to right) Frank Cousins, minister of technology, United Kingdom; Anthony Crosland, secretary of state for education and science, United Kingdom; Carlo Arnaudi, minister for scientific and technological research, Italy; Alain Peyrefitte, minister-delegate charged with scientific research and with atomic and space questions, France, who was elected chairman of the conference; Gerhard Stoltenberg, federal minister for scientific research, Federal Republic of Germany; and Manuel Lora Tamayo, minister of national education, Spain.

less marked. For instance, chemical firms in Germany, whose chemical industry is one of the fastest-growing in the world, paid the Americans only 1.8 times what they received from the United States in 1963. It must be noted, however, that this appears to be the smallest imbalance indicated in the Freeman report, and yet the balance is still almost 2 to 1 in favor of the United States. In the fields of steel, machinery, and vehicles—three areas in which Germany has shown strength in both sales and invention—the ratio was 7 to 1 in favor of the United States, and in the field of electrical devices and machinery it was 15 to 1.

Such disparities are especially notable in view of the recent Westheimer report on the needs of chemical research in the United States (*Science*, 3 December 1965). A survey of recent chemical literature showed that just about as much complex equipment for physicochemical research was used in Great Britain, West Germany, and Japan as was used in the United States (although the United States had a clear lead in integration of computers with chemical research).

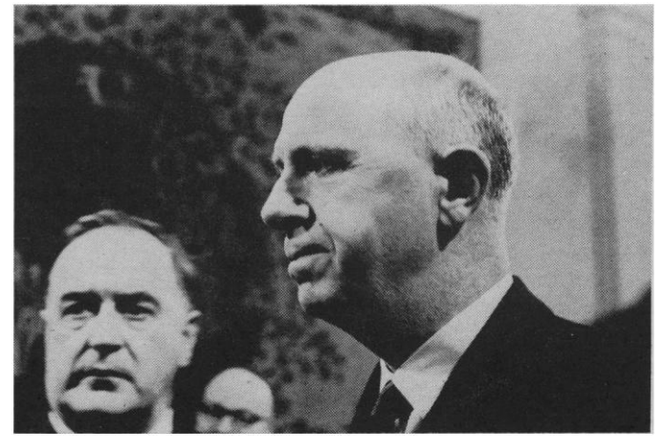
The figures of the OECD report illustrate the magnitude of the problems the science ministers who assembled in Paris will face in trying to stimulate Western Europe's scientific efforts.

Although the countries of Europe have tried a number of collaborative programs in such fields as space research, subatomic physics, and power-reactor development, such programs are difficult to start, and even more difficult to redirect in midstream, as Britain's Secretary for Education and Science, Anthony Crosland, noted when Donald Hornig, science advisor to President Johnson, urged Europe to stress still further the development of "centers of excellence."

Furthermore, the European countries have far to go in breaking down the many barriers to free movement of people and ideas. Among these barriers are rigid structures in universities, poor interchange between universities and industries, lack of equivalence between various countries' pay scales and university degrees, and lack of provision for travel and postdoctoral fellowships. Crosland said and Hornig agreed, that such deterrents to the development of excellent individual scientists were more important than money or institution-building.

American representatives at the meeting, however, reacted strongly to the constant talk about the great disparities between the U.S. and Western Europe. They sought vigorously to combat the notion of a technical giant (the United States) turning the Old World into a group of technological colonies.

J. Herbert Hollomon, Assistant Secretary of Commerce for science and technology, put the matter succinctly in a briefing for U.S. correspondents. Hollomon said that, if there are disparities, they are generally in fields which do not affect the civilian economy. The real test is economic growth, he said, and for most of the period since the war the European economies have been



(Left). Representing Sweden at the OECD science ministers' conference were Bror Rexed, chairman of the government's research advisory board (left), and R. Edenman, minister of education. (Right). In overall charge of conference arrangements was Alexander King of the OECD (left). Belgium was represented by P. Harmel, prime minister (right).

growing a good deal faster than the economy of the United States. Hence, he could not believe there was a widening gap. Furthermore, the American commitment to expensive defense and space science had been made in part to defend Western Europe and, to some extent, freed Western Europe from similar commitments.

Hornig stressed that U.S. officials benefited from the chance to hear, at the conference, about European and Canadian programs for stimulating more rapid adoption of new technology in industry.

Despite this wide difference between European and American views of technological competition across the Atlantic, Hornig did speak of ways in which the United States might offer direct technical benefits to Europe in collaborative programs. He announced that he had told the European science ministers, in a general way, that the U.S. might have specific technical help to offer if there were progress toward the following political goals: (i) international monetary reform; (ii) further European economic integration; and (iii) progress on the so-called "Kennedy round" of tariff negotiations between the United States and Europe. He told reporters that he could not elaborate now on what form the aid might take, but gave as an example the recent American offer to West Germany of an expanded program of collaboration on space exploration. (Right after the conference, Hornig flew off to Germany to discuss this proposal with the new German science minister, Gerhard Stoltenberg, and other officials.)

Spending on Science

At the Paris meeting there was less discussion of the size of scientific budgets, but it is clear to most European scientists that budgets must expand greatly if there is to be reasonable support of good projects and if Europe is to compete technologically with the United States.

There is more agonizing over budgets for science in Western Europe than in the United States, even though the U.S might seem to have come closer than Europe to the real limits of spending on science. At the Paris conference, as elsewhere, the Europeans talked a great deal of "priorities," and the American representatives, while admitting the importance of this problem, tended to stress the value of large commitments of money and men to science. The Americans seemed confident that they could afford to support most of the good ideas and the good men. The Europeans were much less sure. This is a fundamental difference of attitude, and it affects profoundly the way the European nations carry out their announced determination to spend more on science.

Germany, for example, wants to raise her private and public spending on research and development from today's 2 percent to 3 percent by 1970. These goals were announced early in 1965 (*Science*, 2 April 1965), and reiterated at Christmastime by science minister Stoltenberg.

In 1965, private and public sources apparently spent about $2 billion for research and development. Stoltenberg said the German goal was the spending of more than $12 billion from all sources on R & D in the 4 years from 1966 to 1969. This annual average of $3 billion would be 50 percent above the 1965 level.

But sharp restrictions on spending by Germany's central government, which accounts for less than a third of West German spending on R & D, had to be imposed in the austerity budget of January 1966. Each of the main areas of the science ministry—atomic energy, space research, general research support—got extra appropriations of $25 million, far less than planned. Hence, Stoltenberg, who joined the Erhard cabinet after last September's elections, was not able to make much of a start toward his goals in 1966.

In France, the announced goal is the spending of 2.5 percent of the gross national product on research and development by the end of the 5-year Fifth Plan, which begins this year. Although the belt was let out somewhat for the 1966 budget year, after 2 years of austerity, the spending on buildings and equipment for civilian research and development other than atomic energy and space will be $96 million, only about 12 percent of the $780 million envisaged for the Fifth Plan.

This modest start makes many observers skeptical about the Fifth Plan goals, which call for more than double the annual spending of the Fourth Plan.

Nonetheless, the Fifth Plan goals are ambitious, and even if they are only partly fulfilled, they will represent a great expansion in French scientific effort. The number of "researchers" in France is expected to double between 1963 and 1970. The government plans to make $120 million available to industry to support the exploitation of inventions. National research institutes will be created for oceanography, geology, automation and information, nuclear and high-energy physics, and social and economic development. On space research, a total outlay of $400 million is planned, including $65 million for the rocket-launching base in Guiana.

Even more important are operating funds, especially for the basic research laboratories supported by the National Center of Scientific Research (CNRS). After a cutback in 1965, the government is again allowing the appointment of large numbers of new scientists and technicians in government laboratories. The budget for operations in civilian, non-atomic, non-space research was $148 million in 1965, and will be $164 million in 1966.

A similarly modest increase in spending in the face of ambitious goals can be seen in Italy, where the atomic energy development agency CNEN is supposed to have $240 million to spend in the 5 years 1965 to 1969. This is an average of $48 million a year, but in 1965 (a time of slow recovery from recession in Italy and of administrative disorientation in CNEN), the agency received only $37 million. During 1966, CNEN is likely to get only $42 million, although the government might release $8 million now held in reserve.

Figures like these show that the ministers who met in Paris faced the conflicting pressures of budgetary shortages and the serious economic consequences of past inadequate support of research.

Loss of Scientific Manpower

Adding urgency to their efforts is the continuing net loss of researchers to the U.S. Comparison of National Science Foundation figures on immigration with European figures indicates that the U.S. takes about 5 percent of Europe's yearly output of scientists and engineers. The reverse migration of American postdoctoral researchers, although important, is less permanent. Moreover it is likely that America is getting more than 5 percent of Europe's best researchers, for the better-trained young researchers are the best-informed about research going on in America. This loss of scientific manpower to the U.S is likely to continue for some time, despite the expansion of science budgets in the countries of Western Europe.

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