the Ford Foundation staff was represented—with the feeling that Ford trustees were reluctant to discuss an independent RFF while the organization's future leadership is unknown. RFF staff members felt that the trustees are attracted to a merger because Brookings offers known leadership and an established organizational base. RFF staff see a possible way out of the circumstantial bind if the foundation would extend support for a couple of years so that a formula for RFF independence could be worked out.

Whatever is finally decided on the future of RFF, the Ford Foundation will obviously have a decisive word. In terms of funding, RFF has led "a charmed life," as Hitch puts it. By general assent the Ford protégé has also performed worthily. Now, however, at a time when foundations are suffering from shrinking portfolios, tax law pressures, and heavy new demands on resources, RFF faces a painful adjustment in common with many other nonprofits for whom, so to speak, King Midas has lost his touch.

—JOHN WALSH

Assumptions About R & D's Link to Economic Growth Questioned

The scientific community should not any longer assert that a simple increase in the funding of scientific research and development will lead automatically to economic benefits and growth. The chain of events is really more complex, and scientists need to face this.

Such was the consensus that emerged from discussions and debate at the third annual colloquium on Research and Development in the Federal Budget sponsored on 20 and 21 June in Washington by the AAAS. The well-worn assumption of economic gain was but one of many such shibboleths subjected to examination by the 350 congressional staff members, federal officials, and representatives of private industry and the academic community attending the meeting.

Most of the discussion focused on the relationship of government and industry research efforts to the economy and international economic competition—a topic that is beginning to capture a lot of attention in the Administration and in Congress. In a report* on the topic, former federal budget analyst Willis Shapley described several recent trends that prompted the concern:

• Overall research and development funded directly by private industry has increased steadily since 1967 in constant dollars (that is, even after considering the effects of inflation). But basic research funded by industry, after a big drop between 1967 and 1972, has been more or less unchanged since then. Thus, it seems that an ever-increasing share of research and development money has been going to applied research and product development.

• Overall research and development performed by private industry—including that funded by the federal government through procurements and that funded by industry itself—increased slightly between 1967 and 1977, in constant dollars, by $1.14 billion. The federal share, although stabilized at 35 percent for the last 4 years, is far lower than it was in 1967. Thus, industry must now bear a greater share of the responsibility, or burden, for overall research gains than it has in the past. Altogether, research and development performed by private industry will account for $33 billion of the $47 billion total this year; $21 billion will be funded directly by industry itself.

• Finally, there has been a recent decline in three measures of economic growth commonly thought to be affected by spending on research and development: the rate of growth of U.S. productivity relative to that of other countries; the proportion of U.S. patents held by U.S., as opposed to foreign, citizens; and the number of new venture capital companies promoting innovations. As William Carey, the executive officer of the AAAS, noted at a press conference, talk of economic problems, in light of sustained levels of research funding, prompts questions about the *vitality* of research and development efforts.

The message of the colloquium was not that funding of basic and applied research fails to alleviate these problems, but simply that the subject of how much the funding helps—how much it stimulates industrial innovation and how much it contributes to the sale of domestic products in foreign markets—is more complex and less certain than science policy specialists have assumed.

In order to resolve the uncertainties, several speakers said, additional analysis of the role of research in the economy is necessary. "How can we steer our R & D properly when we are flying blindly?" asked Russell Peterson, director of the Office of Technology Assessment. However, Peterson added that drawing a connection between research and economic growth could be dangerous, because it might fail to turn up solid evidence: "The move by the President in his 1979 budget to include more funds for basic research is encouraging, but the words used tying such research to economic benefits are disturbing. Unless we continue to support substantial basic research with no other objective in mind than the uninhibited search for knowledge, we will erode the very foundation of technological progress."

Thus, Peterson suggested, there are pitfalls both in documenting the economic value of basic research and in precluding economic value from a discussion of research worth. This ambivalence was reflected in remarks at the meeting about the current Administration study of problems relating to industrial innovation. The study, which is being directed by Jordan Baruch, Assistant Secretary of Commerce for Science and Technology, received both praise and criticism for its intentions from various members of the audience. A congressional staff member suggested that the study, which President Carter wants by 1 April, may not be exhaustive enough to establish satisfactorily the ties between research funding and innovation. On the other hand, Baruch noted in a speech that he "will be able to rest in peace" about it even if it just provokes discussion of innovation and research funding within a comprehensive framework.

By this, Baruch meant that it has become increasingly clear that a variety of governmental policies (and not just research funding alone) have an impact on innovation by providing barriers and incentives. Among the factors cited by in-

*Willis H. Shapley and Don I. Phillips, *Research & Development in the Federal Budget: FY 1979*, available from AAAS, 1515 Massachusetts Ave., NW, Washington, D.C. 20005 (price, $6).

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dustry spokesmen at the meeting were government regulations, patent policies, tax requirements, and investment restrictions. (A new law that requires pension fund trustees to invest only in so-called safe undertakings was the object of much criticism.)

Considering the lack of agreement about the questions, dissension over the solutions to these problems was understandable. Markley Roberts, a staff economist for the AFL-CIO, suggested that large multinational corporations, which dominate industry research efforts, stop exporting technology to potentially competitive nations. Representative J. J. Pickle (D–Tex.), a member of the House Ways and Means Committee, said that tax credits for research and development should be increased and the tax on capital gains reduced. Another observation was offered by Edward David, president of the Exxon Research & Engineering Company. Noting a recent $240 million agreement for long-term cooperative research signed by his own company and the Department of Energy, David suggested that such arrangements serve to stimulate industry interest in innovation.—R. JEFFREY SMITH

Science in Europe/ British May Use Telephones, TV's, to Tap Data Bank

On 1 June a new information service with some revolutionary implications went into operation in Britain. Through the regular telephone network it provides access to a computer-based information system, using an ordinary TV set as the display terminal. It may be the biggest thing to happen to communications since the invention of radio; or it may be about to rival the Ford Edsel as a marketing disaster. The silence you hear is the sound of breath being held.

The service is called Prestel and has been devised and brought to market by the British Post Office, in collaboration with the electronics industry, the TV manufacturers, and the British Broadcasting Corporation (BBC). While it might be unfair to imply that the Post Office has been responsible for no innovations since the penny post way back in the 19th century, it does not have the image of a go-getting organization. Yet there seems no doubt that with Prestel it has come up with an idea which, if it catches on, could bring enormous changes in the office, the home, education, newspapers, and in the way information is exchanged and used.

The concept is simple. Using an ordinary telephone, a Prestel user dials a central computer packed with information on a wide range of topics, from financial data to consumer reports and mail-order catalogs. When the connection is made an index page appears on his TV screen, and by pressing buttons on a hand-held keyboard, the user can find his way into the data bank, which can hold up to 250,000 "pages" of information. (Each page holds about 150 words.) It costs him 3 pence (just over 5 cents) for the basic call, plus another 1 to 2 pence for every page he consults. The charges appear automatically on his quarterly telephone bill.

In this transaction the Post Office merely acts as the carrier, giving the user access to information supplied by more than 100 "information providers." These include the Stock Exchange, Reuters, the Consumer Association, local newspapers, chains of shops, the Meteorological Office, travel agents, the Sports Council, the motoring associations, as well as totally new "electronic publishing" companies which have been set up to exploit the new medium. The information providers can put their own price on each page of information they supply; some pages, like weather reports, or advertisements, would be free, while others, like financial information, would cost whatever their providers think they are worth. How many pages, and which ones, each subscriber has consulted is automatically recorded by the Post Office, and is billed accordingly. From the revenue received the Post Office subtracts the cost of running the service, takes its own profit, and sends the rest to the information providers. A provider whose information proves useless—and is therefore seldom consulted—will earn nothing from the system. A provider whose information is widely consulted will do very nicely; the system thus puts a premium on the success of each provider in attracting users.

On 1 June the system went live for the first time, although only in a limited way to the first few hundred users who are acting as a test market. The system should be nationwide by the beginning of 1979, although it now looks as if it will slip a few months and likely come on stream some time in the spring of 1979.

Prestel is, in fact, just one of a range of information systems which have been in development in Britain for the past decade, and are known by the generic title of "teletext." The simplest are systems for broadcasting short news items or simple information, using two spare lines from the 625-line TV signal. These two lines fall outside the area of the TV screen, so play no part in carrying the normal TV picture. Instead, they are used for carrying up to 800 pages of written information in a format similar to Prestel. The information transmitted includes such things as news reports, sports results, and gardening tips. The user selects the page he wants with a hand-held keyboard.

This system was developed by the BBC and the Independent Broadcasting Authority (the organization responsible for the control of commercial TV and radio in Britain). It is now available, under the name Ceefax for the BBC version and Oracle for the commercial channel. The information it supplies is free once the user has bought a specially adapted TV set. Unlike Prestel, the Ceefax and Oracle systems broadcast their information and are not, therefore, interactive systems. They are also limited in capacity by the fact that they have only two lines in the TV signal to use as carriers. But they are ideally suited for the provision of news and seem likely to dominate that end of the market. So far, there are not very many users; those there are find the system particularly useful when they get home at night and want to be brought quickly up to date with the news.

Prestel is a system with wider possibilities. There are no limitations on the amount of information it can store, and since it is an interactive system it can do things Ceefax and Oracle cannot.

For example, Mills and Allen Communications Ltd., one of the new electronic publishing companies which act as information providers for Prestel, has designed a page for the Save the Children Fund, a British charity. The page is an advertisement urging the Prestel user to

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