TECHNOLOGY POLICY

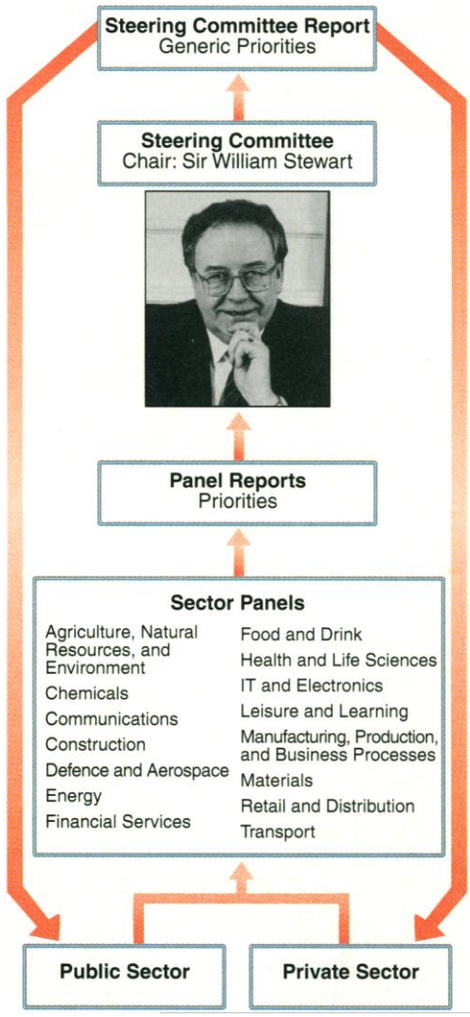
U.K. Tries to Set Priorities With the Benefit of Foresight

LONDON—Like their colleagues around the globe, scientists in the United Kingdom are being admonished by their paymasters to pursue research in line with national goals, work more with industry, and contribute more directly to the wealth of the nation. But the British government, at least, is backing its clarion call with an unprecedented series of consultations with the research community. Over the past 2 months, Britain's Office of Science and Technology (OST) has issued 15 reports, each covering a major industrial sector, which together form the first part of a national attempt to set science and technology priorities for the next 10 to 15 years. The result of more than a year's labor, at a cost of $2.5 million, the reports distill the opinions of 10,000 experts from public and private research, business, and finance.

Later this month, a top-level steering committee that has been coordinating the whole process—the most extensive science priority-setting exercise that has been carried out anywhere in the world—will publish an overview of this mass of information. The committee will also announce how the results of this exercise will feed into public policy and influence private R&D planning. This crucial step has yet to be spelled out, but it's already clear that the government intends to use the panel reports to channel funds into priority areas. When this year's research budgets were set in February, for example, some $107 million was earmarked for projects that will be determined by this massive priority-setting exercise (*Science*, 10 February, p. 782). And that could be just a foretaste of a big shift in public spending—a prospect that is causing some unease in Britain's research community.

William Stewart, the government's chief scientific adviser and chair of the steering committee, believes the process, known as a foresight exercise, is key to getting science and technology policy right. "If you are going to have change, and you are going to look at a strategic way forward, you don't do it by a series of ad hoc initiatives. You've got to do it in a considered and structured way, and you have got to do it against a changing global back cloth of what your competitors are doing and how the global scene is changing," he says.

The initiative for the foresight exercise came from the government's 1993 policy document, or white paper, on science and technology (*Science*, 4 June 1993, p. 1419). This document launched the government's efforts to focus science and technology on wealth creation and led to the biggest shake-up of publicly funded research in more than 20 years. The aim was to create a closer partnership between academic science and industry. "We do 5% of the world's research, so we'd better make sure we do the right 5% and, importantly, access the 95% that is done elsewhere," says Stewart.



Upwardly mobile. U.K. foresight exercise processes 10,000 public and private opinions.

The United Kingdom is not alone in its enthusiasm for foresight—other countries in Europe are carrying out similar exercises—but the acknowledged master of the art is Japan. Every 5 years since the 1970s the Science and Technology Agency in Japan has carried out a large-scale survey to assess technological developments over a 30-year time scale. The results are widely publicized and are used in planning research programs at the national and company level. Germany and France have both carried out surveys based on the Japanese model, and the European Union is now considering one too. However, the U.K. has embraced foresight with the greatest enthusiasm. "No other country has carried out foresight in the breadth and depth of the U.K., and nobody has done it quite like us," says science minister David Hunt.

The key to foresight is widespread consultation, usually in the form of a technique called a Delphi survey. A group of experts is given a set of questions to elicit their views on the likelihood that particular technological advances will occur, the relative importance of factors that might determine whether those advances will be achieved, and the importance of the advances themselves. The results are collated and often then fed back to the group so that it can formulate a collective opinion. Other techniques, such as scenario analyses, are sometimes used to explore the outcomes further. Foresight techniques have superseded the largely discredited attempts at forecasting and futurology that arose after the second world war and attempted to predict the future. "Foresight techniques are more cautious, involve more dialogue, and accept we do not know the future," says Hariolf Grupp, a foresight expert at the Fraunhofer Institute in Karlsruhe, Germany.

For Britain's foresight exercise, the steering committee established 15 subject panels, each consisting of about 20 academic, industrial, and business experts. Each panel then surveyed the appropriate research and industrial community. In addition to sending out Delphi surveys by mail, panel members held face-to-face meetings with scientists and R&D managers at workshops and other meetings around the country.

The panels' visions of the future were boiled down into 15 lists of recommendations and priority actions, although not specifying levels of funding. These cover the potential impact of key technologies and improvements in the research infrastructure, as well as regulatory changes and accommodating changes in society at large. Among the suggested new initiatives were "virtual" research centers in which distant researchers would collaborate through the Internet, programs in integrated biology and integrated ecosystem management, and even the development of a "foresight vehicle" to spur automotive design. Education and training were also highlighted, and the need to strengthen multidisciplinary and interdisciplinary research was a common theme.

Life sciences emerged as a strong area for U.K. science. Mark Ferguson, professor of cell and structural biology at the University of Manchester and chair of the health and

life sciences panel, says, "Many of the visions coming out of the panel's consultations could have come from more conventional brainstorming sessions, but the key element was the surprising consensus on priorities between the academics and industrialists."

Some sector panels emphasized the importance of issues traditionally considered peripheral to the realm of science and the links between different fields. The health and life sciences panel, for example, considered research on people's assessment of risk as a key adjunct to technical developments in genetics to understand how information can be applied to preventing and treating common multifactorial diseases. "It is important to consider these questions," says Ferguson.

On the whole, scientists have supported the exercise, but some have raised concerns about how the results will be used. "What really matters is how this is taken forward," says Oxford University physicist John Mulvey, who heads the lobby group Save British Science. "The danger is it will be used as a prescription for what research councils should fund. The potential problem with emphasizing wealth creation is that less and less money may be available for free-ranging and exploratory research across all fields," he says.

That task of carrying the exercise forward is now in the hands of the OST. As the OST only controls the government's expenditure on science and technology through the research councils, other government departments must consider the results of the exercise when defining their research priorities if it is to have any real impact on public-sector science. However, although a small sum has been earmarked in this year's budget for foresight-inspired programs, Stewart is opposed to fencing off a large fixed proportion of the budget of the research councils specifically for foresight projects. "I don't think it is sensible. ... It depends on what the quality of the proposals are, what comes up, what competition there is. My own view is that it is up to us to suggest broad mechanisms, and that is one of the things that will come out of the technology foresight program."

"No other country has carried out foresight in the breadth of the U.K."
—David Hunt

Crucial to foresight's success is the response of the private sector, which is notoriously difficult to monitor. Many of the larger companies that took part in the exercise have been enthusiastic and carry out their own foresight exercises. But a key need is to involve small and medium-sized enterprises, argues Stewart. Academic scientists too are keen to push this point, as it could lead to more R&D spending by the private sector. "Unless industry puts in the investment as a result of this exercise, we won't achieve anything in the long term," says Mulvey.

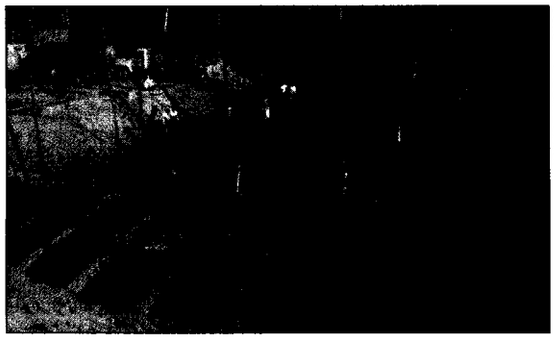
Such an intensive and large-scale exercise has heightened expectations, so the OST will have to move fast on implementation to prevent the momentum already generated from fizzling out. "It would be nice if a few things were started now, but it may take up to 5 years for the full effects of the exercise to be noted," says Ferguson. But Stewart, who retires next month, believes the exercise will have a substantial impact. "My own view is that this technology foresight program will be as influential in shaping U.K. science and technology as was the 1993 white paper. It will be shaped ... with an appreciation that the world is changing and that we'd better be part of that changing world." The first indication of how the program will shape science policy here will come later this month, when Stewart's steering committee releases its overview of priorities needed to sustain the momentum of the foresight exercise.

–Nigel Williams

OIL SPILL

Russian Arctic Battles Pipeline Leak

The spring thaw is usually a welcome event to inhabitants of northern Russia's Komi Republic, 1000 miles northeast of Moscow. It's a time for commercial fishing and driving reindeer herds to summer feeding grounds. This spring, however, brings a major worry—a potentially disastrous run-off from the largest oil accident ever on Arctic soil. Beginning last August, an estimated 100,000 barrels of oil have leaked from a corroded pipeline in nine spills covering 70 hectares of peat bog. The oil threatens salmon fisheries and marshlands used for grazing cattle and reindeer. "There's an enormous potential for environmental disaster," says Jonathan Brown, chief of the infrastructure, energy, and environment division of the World Bank.



AP/WIDE WORLD PHOTOS

Slick work. Crews race the spring thaw to clean up the Arctic's largest oil spill on land.

The Komi spill, which involves three times the amount of oil released in Alaska's *Exxon Valdez* catastrophe in 1989, threatens a fragile ecosystem of bogs and braided rivers. Experts say the ecosystem cannot be completely cleaned and will take years to recover. "The moss will absorb a huge volume of oil, just like a sponge," says Michael Miller, a University of Cincinnati limnologist who has conducted research on the effects of oil spills in northern Alaska.

Last month the World Bank agreed to provide $99 million in loans to Komineft, a Russian firm that produces the oil and maintains the deteriorating Kharyaga-Usinsk pipeline, to help mitigate the damage. Cleanup efforts began in early March but were hampered by a thaw that started several weeks earlier than normal and by delays in shoring up makeshift earthen dikes keeping much of the oil from draining into the nearby Kolva River. "Up until the end of April, none of the cleanup work was done well," says Vladimir Zamoisky, a biologist with the Socio-Ecological Union, a nongovernmental organization based in Moscow that has monitored the activity on behalf of the Russian National Security Council's interagency commission on ecological security.

The World Bank money will help to strengthen the dikes, suck up some of the pooled oil, and repair the pipeline, sections of which are more than 20 years old and are weakened by the salt water that flows along with the oil. It will also fund studies of various cleanup techniques, including burning the oil and spraying oil-degrading bacteria, as well as environmental monitoring in the region. Komineft has hired two foreign companies to oversee the project, and a 300-person base camp in Usinsk operates "24 hours a day, essentially in a race against time, to stabilize the containment structures," says Douglas McKay, a World Bank project manager. There is little debate about what needs to be done. "It's eminently sensible given the money made available," says Paul Horsman, a marine biologist with Greenpeace who visited Komi last week, about the World Bank's plan.

The two largest spills, which occurred last