astrous fires or even explosions (given a spill in a confined space) could result. All living organisms caught in a massive, unconfined LNG spill would undoubtedly be killed by asphyxiation, freezing, burning, or boiling.

Either the El Paso or the Arctic gas system would require a huge capital investment. A study made by the Aerospace Corporation for the U.S. Department of the Interior put the total investment necessary for the Arctic Gas system at $6.1 billion and the investment required for the El Paso system at $5.6 billion (still higher figures can be cited, depending on what is counted as an integral part of the distribution systems).

The Aerospace Corporation study concluded that both systems were technically and economically feasible. The Arctic Gas system was given a marked edge over the El Paso system in terms of the net economic benefits to the United States under the most optimistic set of assumptions as to the volume of gas transported, Canadian tax policies, and the like. Under the most pessimistic assumptions, the El Paso system was seen to have a modest advantage.

In a study made for the California State Assembly Committee on Resources, Land Use, and Energy, the Rand Corporation compared the two systems according to direct and indirect costs, reliability, timely completion, safety, and environmental effects (within California), and concluded that the Arctic Gas system appeared as good or better than the El Paso system on all counts, at least as judged on the basis of California's interests. But Alaska's Governor Jay S. Hammond strongly favors the proposed El Paso system largely because southern Alaska would be able to tap into it and obtain whatever gas might be needed to meet future demands. Also, the Western Governors Conference recently adopted a qualified endorsement of the El Paso proposal; of the 13 governors, however, 2 dissented, 1 abstained, and 2 were absent.

Although it may now seem self-evident that the federal government should have begun shortly after the initial Prudhoe Bay discovery to determine what kind of transport system would best serve the public interest, what it actually did of course was simply to await industry proposals to which it would react. And, while the oil pipeline proposal by Alyeska (the consortium made up of the North Slope majors and others) came early, the proposals by Arctic Gas and El Paso did not come until 1974.

To make matters more confused, the two federal agencies that are now making environmental and economic studies of these rival proposals are proceeding separately instead of in concert. The Federal Power Commission (FPC) will make the "threshold" decision in the case, because it is the agency to which both Arctic Gas and El Paso have had to apply for a "certificate of public convenience and necessity." Its draft impact study is not expected to be completed before early next spring.

Meanwhile, the Department of the Interior already has issued a massive draft impact study—a study which was made because Arctic Gas applied for a pipeline right-of-way. In this study the El Paso system is discussed only as an "alternative" because El Paso quite reasonably chose not to apply for its right-of-way permit pending the FPC decision. Had it applied, it would have had to join Arctic Gas in putting up the three to four million dollars which the study is expected to cost. An attempt by Interior and the FPC last year to get together and do a single impact study came to nothing.

Running to 17 volumes and 9000 pages, the Interior impact study seems largely a monument to irrelevancy. Nowhere in it can one find a succinct analysis of the choice that must be made, even as between the two rival proposals officially pending, much less as between them and others that could be advanced (some environmentalists favor an all overland system that would follow TAPS from Prudhoe Bay to Fairbanks, then follow the Alaska Highway on into Canada.)

In a recent letter to Acting Secretary of the Interior Kent Frizzell, the chairman of the Council on Environmental Quality, Russell W. Peterson, gently suggested that the very purpose of the Arctic Gas impact statement had been defeated by the statement's huge bulk and lack of analytic clarity. But the basic shortcoming with respect to official decision-making about the Alaskan oil and gas development probably rests more with the government's having confined itself to the umpire's role rather than laying out the game plan.

—LUTHER J. CARTER

Scientific Opportunities Syndrome: Invoking the British Experience

An irony of recent economic history is that Britain, which was one of the victors in World War II, has lagged in postwar economic development, while nations which suffered military defeat or occupation have surged ahead. Germany, Japan, France, and Italy recorded their economic "miracles," while Britain, the dowager of trading nations, suffered chronic troubles with its balance of payments position and watched its relative economic rank among nations steadily decline.

An analysis of the British experience in the 1960's, combined with an attempt to point a moral for American policymakers, is the substance of a report* for the National Science Foundation (NSF) by Alan G. Mencher, a former U.S. science attaché, whose 7 years in the London embassy roughly spanned the years during which the British moved from faith to skepticism on the question of the sovereign power of R & D in the economy.

There would seem to be lessons here for other nations to consider, since the first British government headed by Prime Minister Harold Wilson came into office in 1964 brandishing a campaign commitment to use science and technology to improve the international competitiveness of British industry. The political stakes were, therefore, unusually high and the priorities given the effort were set accordingly.

Mencher and his collaborator, Michael Beesley, professor at the London Graduate School of Business Studies, have contributed to a strong revisionist trend in science policy literature which has been gaining ground in recent years. Their salient point, that an unexamined assumption that science and technology can be deployed to solve virtually any problem confronting government, has led to a number of signal—and inevitable—failures, is not original. The same point is made, for example, in the recently completed three-part study *Research Systems* from the Organization for Economic Cooperation and Devel-

**Lessons for American Policy Making From the British Labor Government's 1964-70 Experience In Applying Technology to Economic Objectives.* A limited number of copies are available from the London Graduate School of Business Studies. The study was supported by the Office of Exploratory Research and Problem Assessment in NSF's Research Applications Directorate. No decision has been made on whether NSF will publish the report.

opment (*Science*, 30 May 1975). But the new report gives the fallacy a catchy title, the Scientific Opportunities Syndrome, with obvious acronymic possibilities (SOS), and provides a detailed exposition of the origin and consequences of the error.

The analysts agree that scientists accrued the prestige and power and the confidence to influence policy through the successes of science in World War II and later in the space program. The Mencher report describes the syndrome as follows:

> Thus, both in the U.K. and U.S. there have been spare scientific and technological resources: a compulsion to derive spin-off benefits beyond the needs of the original mission; an attitude of great expectations resulting from achievements of the heroic scale programs with a consequent high level of confidence developed in the ability of scientists to match these resources to national concerns according to a procedure which we have identified and designated the *Scientific Opportunity Syndrome* (SOS). It invokes the following sequence of precepts:
>
> 1) National concerns can be met by using available or by developing appropriate new technology.
>
> 2) The identification and development of the technological solution to a national concern is the mission of the scientists and technologists whose task it should be to link the two together.
>
> 3) They discharge this mission by locating and removing obstacles to the implementation of the identified technology and/or by improving or creating an appropriate environment or causing it to be created.
>
> 4) If after changing the environment and/or removing the major obstacles the problem remains, further improvement of the environment and the removal of other obstacles are required.
>
> 5) Repeated failure is attributed to inadequate application so that the procedure is continually extended even if the situation deteriorates.

A major portion of the report, and the sections which may well be of greatest interest to American readers, describes the evolution of the Ministry of Technology during the Labour governments headed by Harold Wilson from 1964 to 1970. The report's account of the Ministry of Technology (Mintech), used as an illustration of the working of the SOS is headed "An error of system definition." The progenitor of Mintech was Lord Blackett, a physicist who had emplaced himself in the British establishment in part by his status as the "father" of operations research in World War II. In the postwar years Blackett advocated applying operations research techniques to civilian problems, notably to British industry, and his prestige and ties with the Labour party ultimately made it possible for him to apply his ideas. The first Wilson government came into office in 1964, promising to link "socialism to science and science to socialism" and pledging to do it in "the white heat of a scientific revolution." The instrumentality was to be the Ministry of Technology, which was largely Blackett's brainchild. The trouble, according to the

Briefing

Academy for Contemporary Problems Solves One

The Academy for Contemporary Problems, the Columbus-based research organization founded by Battelle Memorial Institute and Ohio State University (*Science*, 6 December 1974) has a new institutional framework—six national organizations representing the interests of state and local government.

Battelle and Ohio State found it necessary this year to bow out as sponsors. Each had agreed to provide the academy with $500,000 a year for 10 years from the time of its founding in 1972, with the proviso that each could terminate its support. Ohio State's action appears to have been dictated by current heavy pressures on the university budget. Battelle has had to carry out a major realignment of its finances since it agreed to a settlement arising out of a court challenge to the Battelle trustees' execution of the founder's will (*Science*, 14 February). As part of the settlement, Battelle is transferring the academy's $2.5 million headquarters to the recast nonprofit organization and is making a capital gift of $4.5 million. This will bring Battelle's contribution to considerably more than the total $5 million over the 10 years originally contemplated, since Battelle has been providing $1 million a year for the academy's $1.5 million operating budget.

The new member organizations are the Council of State Governments, the International City Management Association, the National Association of Counties, the National League of Cities, and the U.S. Conference of Mayors. Another prospective member, the National Governors Conference, has not taken the legal measures necessary to join.

Representatives of the member organizations will constitute a majority of the new board of trustees, but the organizations are not committed to support the academy financially.

Ralph R. Widner, who has headed the academy since it was established, has been named by the new trustees to continue as president. The academy program of applied research on problems facing society is expected to follow its present pattern. A small central staff provides support for projects directed by academy "fellows," whose appointments will generally last for the life of a project, usually 1 to 3 years.

The academy derives income from government and foundation research grants and contracts but has depended on support funds from Battelle and Ohio State for a major part of its operating budget. Future plans call for the academy budget to continue at a level of $1.5 million a year for several years. Efforts will be made progressively to increase income from contracts, fees, and gifts, but it will be necessary to use income and principal from the founding gift from Battelle for the next few years. The obvious hope is that something will turn up, notably the economy.—J.W.

HEW Suggests End of Tobacco Subsidy

The federal government for years has been saying that smoking is bad for your health but millions of people choose not to listen. If paternalistic advice does not work, what will? The Department of Health, Education, and Welfare (HEW) boldly suggests going after the pushers rather than the users of cigarettes. In the Forward Plan for Health for fiscal years 1977-1981, HEW lists these straightforward "options" for reducing smoking:

- Phase out tobacco price supports and eliminate cigarettes from the 'Food for Peace' program.
- Ban cigarette advertisements or exclude such advertising as a deductible business expense for tax purposes.

On the subject of alcohol, the Forward Plan, which was produced in the office of the assistant secretary of health without the advice or consent of congressmen or lobbyists, is no less plain. Among its "options":

- Reduce the alcohol content of certain beverages.
- Restrict advertisements for alcoholic beverages or exclude such advertising as a deductible business expense for tax purposes.

Innumerable things have been tried to get people to protect their health by smoking or drinking only in moderation, if at all, but so far, no one has attempted to tackle the problem by going after the profits of the businesses that thrive on the promotion and sale of tobacco and liquor. Because of the controversial nature of the HEW "options" and the yet unbroken power of the tobacco and liquor lobbies, it is hardly likely that such an approach will succeed now. But it is nice of HEW to think about it.—B.J.C.

report, was that Blackett and his colleagues were not true to their own operations research principles, failing to take into account the full magnitude of the difficulties facing them in applying R & D to large-scale problems in industry.

The main strategy was to use scientists and engineers in government research stations; also the National Research Development Corporation (NRDC), intended to fund astutely targeted research in industry, to spur British industry to greater productivity. In practice, Mintech officials simply didn't know what to do to achieve the goals set for their department.

In 1966, Anthony Wedgwood Benn became minister of a noble experiment that threatened to become a political embarrassment. Benn, who had made his first mark in public life by renouncing a hereditary peerage in order to remain a Labour MP, is an ambitious and savvy politician who seems to have immediately recognized the perils and the opportunities at Mintech. He took seriously the evidence emerging of a lack of correlation between R & D and economic growth and altered the course of his department, without, however, repudiating the original objectives.

He succeeded in making Mintech into a different sort of organization with a main role, as the report describes it, of "delegate for industry." Mintech became, so to speak, the representative of industry within government. It embraced the function of "sponsorship" of industry, arguing the case in the cabinet for assistance for industries in trouble, pleading and pushing for "rationalization," whether it meant favoring the larger more efficient firms in a particular sector of industry or encouraging mergers and consolidation among small firms.

The Labour government was unseated in 1970, but when Labour won again in 1974, Benn became Secretary of State for Industry, the equivalent of the job he had held at Mintech. This time he was bolder and more active as an independent political operator seeking to establish a leadership position on the radical left of his party. He had also refined the philosophy he had developed in his later years at Mintech and promoted plans for further nationalization of industry and for a policy of "participation," by which he said he meant essentially the old socialist idea that policy-making in industry must be more broadly based, principally by including workers in the process. His views raised considerable alarm in the private sector of British industry. Benn's highly vocal advocacy of British withdrawal from the European Community at the time of the referendum on the issue last June led to his being moved from the industry post, but not from the Cabinet. He now holds the energy portfolio.

As science attaché during the period, Mencher was well placed to observe developments. During those years, he organized a series of discussion meetings on management and technology, enlisting traveling Americans with acknowledged expertise in management and technology from industry, universities, and think tanks, and inviting British industry and government officials to what proved to be popular sessions. The contacts Mencher made during his long tour in the attaché's office seem to have talked to him with considerable candor about the ups and downs of Mintech. The report's interpretation of the progress of Mintech appears to elicit the assent of those familiar with the inside workings of the ministry, including, for what it's worth, since he comes off generally rather well, a commendation from Benn. Benn recently wrote Mencher a complimentary letter saying that the report "will stand as one of the most authoritative judgments that could have been made on that Department."

If the scientific opportunity syndrome helped lead Britain astray, what is the way to get the country back on the track? The report recommends a systems approach; the authors offer what they call a "system paradigm for policy selection." This comes with a theoretical superstructure, complete with a flow chart and some terminology borrowed from cybernetics, but proves to be fundamentally "no more than a guide to logical thinking."

One important thing the report urges is that government officials, in seeking to convert policy objectives to operational goals, look more realistically at the market. The report provides a concrete example of what can happen when market conditions are not taken fully into account with an interesting section on the British machine tool industry. That industry was the subject of intense concern and support efforts by government with little evident effect on its decline.

A reader of the report may decide that the authors are attributing too much to the scientific opportunity syndrome. In fact, they concede that "slow economic growth was chronic and persistent in Britain dating from early in the century," and can be traced at least partially to "cultural factors." British industry found it hard to adjust to the passing of the doctrine of imperial preference. Industry continues to suffer from acrimonious us-and-them, Upstairs, Downstairs feelings. And traces of aristocratic attitudes hang on in the cult of the gentleman amateur, which seems to perpetuate bad management in industry, and in the scientist's eschewing technology for basic research. About which of these and other causes merits most blame one can only speculate, but, cumulatively, they have given the British a long era of economic disappointment.

In applying their analysis to the American scene, the authors focused mainly on what they call a White House Science Presence (WHSP), a subject which, of course, has preoccupied many of those concerned with science policy in the United States. The new report does examine several U.S. Executive agency programs, including the New Technology Opportunities (NTO) program of the early 1970's which was headed by William T. Magruder. NTO was designed to marshal ideas for new major initiatives and the objectives set for it were in several ways similar to those set for Mintech. NTO, after creating an initial furor, faded away because of resistance from the regular bureaucracy and a loss of interest at the White House.

Not surprisingly, the authors find that NTO and the other examples fit snugly into their SOS schemata. American readers generally familiar with the examples used, however, are likely to feel that these programs were killed off or modified exactly because of the sort of skepticism about scientific opportunities which the authors counsel.

As for the White House science machinery, the authors see the President's science adviser trapped in the scientific opportunities syndrome mainly because he is unable to ascend to the top policy-making role envisioned for him by American statesmen of science. The report suggests that the science adviser be cast in the more modest role of "agent of change," acting as a realistic broker to achieve the aims of the President by negotiating with federal agencies to fashion programs consonant with their capabilities and self-interest. Mencher thinks that the present argument under which the science adviser is based in the National Science Foundation is not a bad one, but predicts that the WHSP cycle is likely to be repeated with a science adviser reinstalled in the White House and subsequently sloughed off again.

Discussion among American science policy commentators has been showing signs of inbreeding, and the Mencher report offers a variant strain of thinking. The point that too much attention has been given to the inner sanctum of science policy and not enough to the operational level seems well taken. And it is always salutary to remind policy-makers to take a hard look at what Aldous Huxley called "the major inarticulate premise."

—JOHN WALSH