combination, which is more toxic than single-drug therapy, is actually any better. Side effects include nausea and vomiting, temporary (maybe permanent) sterility, and, most serious, bone marrow suppression and a decrease in the number of white blood cells in circulation.

With Bonadonna's preliminary results in, the question of where one goes from here becomes difficult to answer. Is it ethical to withhold all postsurgical treatment from one group of women? Could such a study be conducted in this country where the present climate is one in which the ethics of human experimentation are foremost in everyone's mind? DeVita answers that he is not sure, saying that a case could be made on both sides. He, himself, would argue against "doing nothing" for women with positive nodes. However, because of the risks inherent in the drugs themselves, he would not recommend adjuvant therapy for women with no nodal involvement because 75 percent of them survive for 5 years or more with surgery alone. Newell says it is ethical to do nothing postsurgically for a control group as long as you do not know whether the drug therapy is any good and cites the decision on L-PAM in the NSABP study. Whether the protocol in the Italian study will be modified remains to be decided.

The issue of the risk imposed by toxic chemotherapeutic drugs is one not likely to be resolved for some time. Holland, in his editorial, has this to say. "The risks of carcinogenesis, fatal drug intoxication, and other morbidity are certainly much less hazard than the certain death that inexorably follows clinically evident metastatic cancer."

The other side of the issue was well expressed recently, also in the *New England Journal of Medicine*. Writing in response to publication of preliminary data from the Fisher-NSABP study, which received wide public attention because it came out about the time Mrs. Gerald Ford was having breast surgery, Mary E. Costanza of the Tufts–New England Medical Center Hospitals in Boston argued for caution. "All in all," she said in the 20 November 1975 issue, "there is reason to be skeptical as well as optimistic about the effects of long-term chemoprophylaxis against breast cancer. Unfortunately, no one can rationally weigh the benefits against the disadvantages, since final results are simply not yet available. . . . It is much too soon to regard chemoprophylaxis in breast cancer as a proved method of treatment." For now, she believes, it should not be undertaken by nonresearch physicians, "however well intentioned," but should be regarded as the experimental procedure it still is.

—BARBARA J. CULLITON

Science Indicators: New Report Finds U.S. Performance Weakening

American leadership in science and technology appears to be diminishing by most available indicators, according to data in a cautiously worded report just issued by the National Science Board, the policy-making body of the National Science Foundation.

The report, entitled "Science Indicators—1974," was transmitted to Congress by President Ford on 23 February.* It is the board's seventh annual report and the second to present measurements of the strengths and weaknesses of science and technology in the United States. The indicators reflect a varied mass of data, ranging from employment statistics to patent awards to literature citations and trade balances. By some measures, the United States has improved its performance in absolute terms in recent years, but other countries have improved even more, thus reducing the American lead. In other cases, the American performance has deteriorated in absolute terms.

The report resolutely refuses to reach any overall conclusion as to whether American science is healthy or weak and whether one should be content or alarmed about the trends that it documents. Staffers who had prepared the predecessor report, "Science Indicators—1972," had attempted to include a series of conclusions and recommendations in that report. But the material was excised because of opposition from the National Science Board and the Office of Management and Budget, which felt that the indicators were not adequate to measure the entire scientific enterprise and that even the limited indicators available were often difficult to interpret. So this time there was not even a serious attempt to tease a general conclusion from the data presented.

Nevertheless, for what it's worth, the bulk of the indicators that are used to compare the United States with other countries appear to be headed downward. This is true both of the indicators that measure the resources being put into research and development—such as money and manpower—and the indicators that measure the results coming out of a nation's research establishment, such as publications, Nobel prizes, patents, innovations, and productivity. Only two major output indicators—international exchange of technical "know-how" and balance of trade in research-intensive products—show improvement in the U.S. position.

The indicators provide new insight on the importance of basic research to technological innovation, and on the relation between the size of an industrial firm and its ability to innovate. They also reveal that the American public, far from being disenchanted with science and technology, has actually grown more supportive in recent years (see box, p. 1032).

Where possible, the performance of the indicators is traced over a decade and a half, from 1960 through 1974. Like its predecessor report, the new report deals primarily with the resources put into R & D, since these are relatively easy to measure. But it also sets forth new measures of research "outcomes," some of which were developed especially for this analysis, and it extends the coverage of some indicators that were used in the previous report.

Virtually every section of the report is hedged with caveats warning about weaknesses in the data or difficulties in its interpretation. But the general message of the figures seems to be that, while the United States is still ahead by many measures, its lead is being eroded.

The downtrend shows up dramatically, for example, in a study of technological innovation that was conducted specifically for this report by an outside contractor, Gellman Research Associates, Inc. The study investigated some 500 major new products or processes brought into commercial use over the past two decades. The list included such innovations as nuclear reactors, oral contraceptives, integrated

*The report is available from the U.S. Government Printing Office, Washington, D.C. 20402; stock No. 038-000-00253-8, $4.60. It was prepared with the assistance of the National Science Foundation's Science Indicators Unit, headed by Robert W. Brainard and Robert R. Wright.

circuits, lasers, and weather satellites. Although the National Science Board concludes that the United States leads other nations "by a wide margin" as an innovator, that lead has diminished steadily and sharply over the past two decades. In the late 1950's, the United States produced 82 percent of the major innovations, but by the mid-1960's it accounted for only 55 percent. A slight upturn subsequently in our relative standing does not represent any increase in American innovation but rather a decline in British innovations.

What's more, there was a change in the nature of the innovations. The proportion of American innovations rated as "radical breakthroughs" declined nearly 50 percent between 1953–59 and 1967–73, while those rated merely as "major technological advances" doubled.

By several other measures of scientific "output," the U.S. lead also appears to be deteriorating. Thus, the United States was the largest producer of the scientific literature sampled in the 1965–73 period in all fields except chemistry and mathematics, where it was second to the Soviet Union. But in recent years, U.S. publications in chemistry, engineering, and physics have declined slightly in both absolute and relative terms, a trend which the report suggests may be linked to decreases in funding for those fields.

As for the quality of these publications, the report notes that a study of citations in the 1973 literature placed the United States first or tied for first in each of eight fields. Whether that finding has much meaning is a subject of dispute. The general theory behind citation analysis is that the most significant scientific articles will tend to be "cited" most often by subsequent authors, and that one can therefore measure the significance of a nation's scientific literature by constructing a citation index. However, one National Science Board member—Saunders MacLane, University of Chicago mathematician—argues in supplementary comments that such an index may underestimate the Russian literature (few Westerners read it or cite it) and the French literature (a "small-scale, high quality effort" that traditionally keeps citations to a minimum for lack of journal space). Whatever the merits of the index, it covers just 1 year and gives no indication of trends.

However, another measure of quality and importance—the Nobel prizes—suggests a slight decline in American dominance. In the 1971–74 period, the United States received 56 percent of the awards in physics, 57 percent in chemistry, and 44 percent in physiology and medicine—a smaller fraction in each category than was received in the 1951–60 period.

Two other measures of scientific "output" are also headed down. The "patent balance"—a measure of the success of American inventors in winning foreign patents as compared to the success of foreigners in winning American patents—remains favorable for the United States, but there was a sharp 30 percent drop in the balance between 1966 and 1973. The report suggests gloomily that "the number of patentable ideas of international merit has been growing at a greater rate in other countries than in the United States." Similarly, the level of productivity—which is affected, in part, by R & D—remains high and continues to go up in this country, but productivity gains were much larger in four other countries, with the result that the American lead "diminished significantly."

Only two of the major output indicators showed an improvement in the American performance compared with that of other nations. The United States had an increasingly positive balance of payments from the sale of technical "know-how" (patents, licenses, and manufacturing rights) over the 1960–73 period, with four to five times more "know-how" sold to other nations than purchased from them. And the United States had a large, favorable balance of trade in commodities produced by "R & D-intensive" industries; the balance doubled between 1970 and 1974 alone.

As for the input side, two key indicators were down. The fraction of the gross national product spent for R & D has declined steadily over the last decade in the United States, while growing substantially in the Soviet Union, West Germany, and Japan. By1974, the Soviets were spending 3.1 percent of GNP for R & D, the West Germans 2.4 percent, and the Americans 2.4 percent, although comparisons with the

Was There an Anti-Science Backlash?

That much talked about "backlash" against science and technology may be little more than a myth or a manifestation of paranoia on the part of some scientific leaders, judging from a survey of public attitudes commissioned by the National Science Board for its latest annual report.

The personal interview survey of some 2000 persons in 1974, conducted by the Opinion Research Corporation of Princeton, N.J., found the public highly supportive of science and technology—and increasingly so.

When asked "Do you feel that science and technology have changed life for the better or for the worse?" fully 75 percent answered "better," up from 70 percent in a similar survey in 1972. Only 5 percent said "worse," down from 8 percent 2 years earlier.

What's more, scientists continued to rank very high when people were asked to rate each of nine professions in terms of the "prestige or general standing that each job has." Scientists were ranked second in both 1972 and 1974—beaten only by physicians—while engineers were ranked third. They were followed, in the latest survey, by ministers, architects, lawyers, bankers, accountants, and businessmen.

Further evidence of high regard for the R & D community came when 56 percent described their general reaction to science and technology as one of "satisfaction or hope," compared with only 49 percent 2 years earlier.

Science and technology were believed to have done "more good" than "more harm" by 57 percent of the people in 1974, up from 54 percent in 1972. Those who saw mostly good cited medical improvements as the leading benefit. Those who saw mostly harm cited "lack of concern for the environment" as the key reason.

About half of the respondents in both 1972 and 1974 blamed science and technology for causing "some" of our problems, while 6 to 7 percent found "most" problems so caused. Roughly 37 percent blamed "few" or "none" of our problems on science.

About three-fourths of the public remained confident that science and technology will eventually solve at least some of our major problems, but the fraction expecting "most" problems to be solved dropped from 30 percent in 1972 to 23 percent in 1974. That was perhaps the greatest degree of disenchantment registered in the survey.

Areas in which the public most supported tax expenditures for science and technology were health care, crime reduction, education, prevention of drug addiction, and pollution control; areas least favored were "space exploration" and "developing and improving weapons for national defense."

Demographic analysis of selected questions suggested that the most positive attitudes toward science and technology were held by men, persons between 30 and 59 years of age, those with some college education, and those with family incomes of $10,000 or more.—P.M.B.

Soviet Union are "particularly hazardous" because of different accounting methods. Similarly, the number of scientists and engineers engaged in R & D per 10,000 population declined in the United States after 1969 but continued to grow in all other countries studied.

In addition to the international comparisons, the report presents indicators relating to R & D resources, basic research, industrial R & D, manpower, and public attitudes toward science and technology.

From the viewpoint of basic scientists, perhaps the most gratifying finding is that "basic research contributes increasingly to technological innovation, as reflected by the growing number of citations to research in patents associated with major advances in technology." That conclusion was reached in a specially commissioned study of the patent documentation associated with 179 major technical advances which occurred in the United States between 1950 and 1973. The special study also found that most of the research cited in patents is now performed in the universities, whereas in the 1950's industry had been the prime source of such research.

A new feature of this year's report was the establishment of "industrial R & D and innovation" as a major indicator category. The report found that industrial R & D is concentrated in a few industries and in a relatively small number of companies within those industries. Just 31 companies accounted for more than 60 percent of all R & D expenditures by industry. Small firms (those with fewer than 1000 employees) produced the greatest number of major innovations during the 1953–59 and 1960–66 periods, but large manufacturing companies (those with 10,000 or more employees) led in innovations in the 1967–73 period.

One of the most striking trends to emerge from virtually every chart and table in the report is that federal support of science and technology has either leveled off or headed downward in most categories when measured in constant dollars (dollars adjusted for inflation). There is also evidence that this has affected research "output." Thus publications by university-based mathematicians and engineers slackened 2 years after federal expenditures for those fields were cut. Whether it matters if the United States maintains a lead over its international rivals in *all* fields of science is a question that is neither addressed nor answered by the National Science Board. But the Ford Administration's budget experts are said to have been concerned about some of the downtrends documented in the report. One well-placed NSF official claims the report was a key factor in winning a big budget boost for basic research in the Administration's proposed budget for fiscal year 1977. —PHILIP M. BOFFEY

Science for the People: Comes the Evolution

The 1976 AAAS meeting in Boston was dominated by the Bicentennial theme, but a minor commemorative footnote might be added. The previous Boston meeting, held in 1969, was the occasion of the first in a series of protests by political activists that continued at several subsequent meetings. The return to Boston this year was notable for an absence of conflict, evidence that both the AAAS and the activists have changed.

Throughout the period the most prominent protesters were a group called Science for the People (SFTP), an organizational mutation of Scientists and Engineers for Social and Political Action (SESPA), which was formed in the late 1960's. To outsiders, Science for the People appeared to bloom perennially at AAAS meetings, defining itself mainly by opposition to the AAAS. In fact, particularly in the Boston area, where the eponymous magazine *Science for the People* is published, the group was developing an independent style of operation which enabled it to outlive the antiwar movement that nourished it and to create its own niche in radical politics.

Science for the People is not exclusively a Boston-Cambridge phenomenon. (Groups are active in Berkeley–San Francisco, Chicago, New York, and Michigan, for example.) Nor in the Boston area is Science for the People the only radical organization involving scientists and other technical people. But SFTP has had the most visibility and has probably shown the most vitality, and it is worth attempting to describe its theories and practices and to assess how it has changed. What follows is an account based mainly on interviews during the period of the recent AAAS meeting with present members of the group or with persons familiar with it, most of them sympathetic.

The history of relations between the AAAS and SFTP does throw some light on the evolution of the group. In the early years, the activists sought to make their points by disrupting meetings more or less in the style then endemic on American campuses. These tactics reached a crescendo at the Philadelphia meeting at the end of 1971 when, among other things, Senator Hubert H. Humphrey was spattered by a near miss from a tomato. The next year, at the Washington meeting, AAAS officials took a harder line on activist activities, some scuffling and several arrests ensued, and the locus of confrontation shifted to hard bargaining on ground rules between the activists and AAAS officials. These negotiations, on such things as the location of literature tables and a place for SFTP to caucus, led to an era of somewhat better feeling. This year SFTP had a literature table and its own room, and SFTP members were arrangers and participants in several sessions on the regular program.

From the SFTP's angle, what has changed is tactics, not the basic viewpoint of the organization. During the years of the Vietnam war the activists had been most vocal in criticizing AAAS for representing the "establishment" and condoning the uses to which science and technology was being put in Southeast Asia. At the same time, SFTP played on the broader theme that science in the United States served government and corporate interests. The AAAS (*Science for the People* habitually spells it AAA$) was dubbed "a propaganda organ of bourgeois science" for uncritically supporting technology responsible for dubious effects in population control and pollution abatement, urban redevelopment, law enforcement, and for general complicity in "social manipulation." SFTP, antihierarchical and antielitist on principle, believes that science should be cooperative rather than competitive, and feels that AAAS embodied all the bad old totems and taboos.

The trend toward tactical restraint occurred in part because SFTP kept hearing that its aggressive tactics were "turning people off." Also the group observed that the character of the AAAS meeting had