change. Mission-oriented R&D, still central to progress toward our national goals, must be comprehensively rethought in order to restore the public confidence necessary for adequate support of science and technology.

References and Notes

1. Abbreviations: Department of Defense (DOD); research and development (R & D); General Accounting Office (GAO); National Science Foundation (NSF); Department of Health, Education, and Welfare (HEW); Department of Commerce (Commerce); Atomic Energy Commission (AEC); National Aeronautics and Space Administration (NASA); fiscal year (FY); National Bureau of Standards (NBS); National Institutes of Health (NIH); Planning, Programming, and Budgeting Systems (PPBS); chlorophenothane (DDT); supersonic transport (SST); antiballistic missile (ABM); lysergic acid diethylamine (LSD); Office of Science and Technology (OST); Office of Economic Opportunity (OEO); Department of Housing and Urban Development (HUD). Throughout this article I use the terms "R & D," "national science," and "science and technology" more or less interchangeably. In addition, I try to be relatively precise in referring to research as opposed to development, despite the difficulty in making clear-cut, consistent distinctions.
2. Letters referred to in this article are available through the Office of the Assistant Secretary of Defense for Public Affairs and have been included in various congressional hearings and issues of *Congressional Record*.
3. *Congr. Rec.* 10 July 1970, p. S11063.
4. *Ibid.*, 21 August 1970, p. S13932.
5. *Ibid.*, 10 July 1970, p. S11063.
6. *Implementation of 1970 Defense Procurement Authorization Act Requiring Relationship of Research to Specific Military Functions, B-167034* (General Accounting Office, Washington, D.C., 23 June 1970).
7. *Congr. Rec.* 28 August 1970, p. S14553.
8. *Ibid.*, p. S14559.
9. Conference report accompanying H.R. 17123, Report No. 91-1473, House of Representatives, 91st Congress, 2nd Session.
10. The new phrasing was passed in P191-441, FY 1971 Military Procurement Authorization Act.
11. *Congr. Rec.* 1 October 1970, p. S16927.
12. Report of the House Subcommittee on Science, Research, and Development, 91st Congress, 2nd Session, Serial S, 15 October 1970.
13. Development projects are, of course, much more susceptible of planning than research projects are. Yet even research could be "planned" in the gross statistical sense that, say, one out of every five projects or one out of every ten investigators will turn out to be much more significant than the rest. We can't predict the significant ones in advance, however, so we must plan on supporting most of the clearly qualified investigators if we wish to maintain steady progress (and, perhaps, international leadership) in those areas of science upon which our national goals depend. Such a "statistical" theory of research planning wouldn't satisfy many congressmen.
14. See, for example, "Conflicts between Federal Research Programs and the Nation's Goals for Higher Education," 18th report of the House Committee on Government Operations, H.R. 1158, 89th Congress, 1st Session, October 1965.
15. H. Brooks, *Can Science be Planned?* (reprint No. 3, Harvard University Program on Technology and Society, Cambridge, Mass.).
16. See, for example, R. Hofstadter, *Anti-intellectualism in American Life* (Knopf, New York, 1963), pp. 34, 45–46, 397–398.
17. One of the best summaries on this issue is *Centralization of Federal Science Activities*, report to the House Subcommittee on Science, Research, and Development, Serial B, 29 May 1969 (Government Printing Office, Washington, D.C., 1969).
18. Bureau of the Budget, *Special Analysis Q* (Government Printing Office, Washington, D.C., February 1970), p. 256.
19. *Special Analysis R, Federal Research and Development Programs*, from *Budget of the United States, 1972* (Office of Management and Budget, January 1971).
20. R. M. Nixon, "FY 1972 budget message to Congress," *New York Times*, 30 January 1971, p. 13.
21. A. H. Dupree, *Science in the Federal Government* (Harvard Univ. Press, Cambridge, Mass., 1957), p. 367.
22. R. Gilpin, *Science* **169**, 441 (1970); J. S. Foster, Jr., address given at the 16th Annual James Forrestal Award Dinner, Washington, D.C., 12 March 1970 (available from the Office of the Assistant Secretary of Defense for Public Affairs, Department of Defense, Washington, D.C.); *Science, Technology, and American Diplomacy: The Evolution of International Technology*, prepared for House Subcommittee on National Security Policy and Scientific Developments by Legislative Reference Service, Library of Congress (Government Printing Office, Washington, D.C., December 1970).
23. H. Himsworth, *The Development and Organization of Scientific Knowledge* (Heinemann, London, 1970).
24. E. Ashby, *Technology and the Academics* (St. Martin's, New York, 1966), p. 65.
25. D. S. Greenberg, *Science* **170**, 952 (1970); V. Cohn, *Washington Post*, 25 January 1971, p. A5.
26. A provocative summary has been offered by (P. R. Ehrlich ["Population and panaceas: A technological perspective," *BioScience* **19** (No. 12), 1065 (1969)].
27. R. Gilpin, *Science* **169**, 441 (1970). See also unpublished data compiled and analyzed by M. Boretsky in the Department of Commerce.
28. State of the Union Message, 22 January 1970.
29. R. M. Nixon, "Economic Policy Message," *New York Times*, 18 June 1970, p. 24.
30. See, for example, *Mission Agency Support of Basic Research*, report to the House Subcommittee on Science, Research, and Development, Serial L, 25 February 1970 (Government Printing Office, Washington, D.C., 1970).
31. P. Handler, statement before the House Subcommittee on Science, Research, and Development, 21 July 1970.
32. W. D. McElroy, statement before the House Subcommittee on Science, Research, and Development, 29 July 1970.

33. I thank N. Ammerman, W. Donnelly, A. Gold, S. B. Levin, J. A. Shannon, C. E. Sunderlin, F. Seitz, and N. Zinder for their comments.

NEWS AND COMMENT

Technology and World Trade: Is There Cause for Alarm?

For several years now Europeans have been complaining bitterly about an alleged "technology gap" between the United States and Europe which supposedly gives American corporations such an advantage in world trade that they can beat down foreign competitors with the flick of a computer switch. American opinion has long regarded that image as grossly overdrawn, but leaders of the American technological community have recently been nourishing some fears and apprehensions of their own. For the past year or so, technology experts in this country have voiced increasing concern that the United States is in danger of losing its preeminence in advanced technologies, particularly those technologies that are important in world trade. The most pessimistic of these experts predict that foreign industrial powers—usually Japan and West Germany—will eventually overtake the United States and gobble up a major share of the world market in high-technology products, thus threatening future economic growth in this country and causing a severe balance of payments deficit to boot. The irony in the situation is apparent. While foreigners seem worried that the American technological colossus will get so far ahead that it can't be competed with on equal terms, the Americans seem alarmed that the hot breath of foreign competition is already on their necks.

Perhaps the highest ranking government official to feel the foreigners closing in has been Secretary of Commerce Maurice H. Stans, who told the Joint Economic Committee on 17 February that "the trend of our trade balance is of great concern." The thrust of Stans's testimony was that the United States has relied on exports of "technology-intensive" manufactured products to provide a favorable balance of trade, but in recent years our exports of these products have not been sufficient to make up for rising deficits in other goods. Moreover, according to Stans, our imports of "technology-intensive" products have been increasing more than twice as fast as our exports of these products. "Our technological superiority is slipping," he warned.

Similar concerns have been expressed by a number of leaders in the scientific and engineering communities. Patrick E. Haggerty, board chairman of Texas Instruments, Inc., told a con-

gressional committee last August that "even in technology-intensive products, and after our tremendous national expenditures for research and development, our lead over our industrial competitors and customers in the industrialized world is narrowing rapidly." Myron Tribus, former assistant secretary of commerce for science and technology and now a senior vice-president with Xerox Corp., warned in a speech last December that "we are not as inventive, compared to the rest of the developed world, as the myths would have us believe." And even William D. McElroy, director of the National Science Foundation, an agency concerned primarily with basic research, told a recent science writers' seminar: "We're concerned now that this country's going to get behind in the technological developments."

Greater Challenge than Sputnik?

Alarm over these trends seems to emanate from at least three major institutions on the Washington scene. One is the National Academy of Engineering, which devoted its fall meeting last October to a symposium on technology and international trade. The reason for choosing this topic, according to symposium chairman John R. Pierce, a research executive at Bell Labs, was that "Today we are facing a technological challenge far more important to us and far more difficult to meet than the challenge of Sputnik." As described by various speakers at the meeting, technology affects international trade through two channels: (i) new machines and new processes can lower the cost of producing traditional goods, thus improving the competitiveness of these goods in world markets; and (ii) wholly new products, such as jet aircraft and computers, can dominate the international market when first introduced because they are far better products than are available elsewhere.

A second concerned group is the President's Science Advisory Committee (PSAC), which has a panel, chaired by Texas Instruments' Haggerty, looking into the impact of science and technology on economic matters. The Haggerty panel seems to boast one of the most elite memberships of any PSAC committee. It includes two former presidential science advisers, Lee A. DuBridge and Donald F. Hornig; the current president of the National Academy of Sciences, Philip H. Handler, and his immediate predecessor, Frederick Seitz; such high-powered industrial research executives as Arthur M. Bueche, vice president of General Electric, and Michael Ference Jr., vice president of Ford; and a slew of other scientists, industrialists, and economists. The panel has not yet issued a report, but Haggerty's expression of concern to the congressional committee last August presumably reflects the thrust of the group's thinking. So, too, presumably, does a comment made by another panel member, William D. Carey, former assistant director of the Budget Bureau. "There are grounds to be deeply concerned about the intensity and diversity of what this country is doing in the field of technology," Carey warned at a science writers' seminar last month. "And if you want to pursue this just look at the balance of trade data for the last several years. . . . I think that if this country sits still and lets some of its most capable and sophisticated and organized and managed technological industry fall apart through disuse—as is happening—it's going to be maybe ten years and a lot of suffering to put it back together."

The third concerned institution, and in some ways the most influential, is the Department of Commerce. The Department's position seems to be based largely on an analysis of world trade prepared by Michael T. Boretsky, a 50-year-old senior policy analyst who has specialized in such matters as the technology gap, and the relative technological strengths of the United States and the Soviet Union. Boretsky's views—which are by no means widely accepted among professional economists—seem to pop up everywhere in the discussion of international technological problems. Boretsky was the chief doomsayer on the Academy of Engineering program last fall. He sits on the prestigious PSAC panel—indeed, his work formed the basis for panel chairman Haggerty's congressional testimony. And his analysis provided the framework for Secretary Stans's recent testimony, as well as for much of Tribus's speech of last December. It is probably not fair to say that Boretsky is personally responsible for the crescendo of alarm. But it is fair to say that many of those who have publicly expressed concern over America's technological leadership have leaned heavily on Boretsky to provide them with the ammunition to prove their point. Thus a closer look at Boretsky's thesis seems warranted.

One of the most detailed expositions of Boretsky's views is contained in a paper prepared for publication in a forthcoming symposium volume emanating from last fall's meeting of the National Academy of Engineering. In that paper, and in his talk at the symposium, Boretsky analyzes what has been happening during the 1950's and 1960's to U.S. trade in four categories of exports. He also analyzes trade between the United States and four regions of the world. Though the picture varies from commodity group to commodity group and from region to region, he says, "the overall picture is that of a long-term and drastic deterioration of the U.S. position."

The gist of the situation, according to Boretsky, is that the United States has for years experienced trade deficits in two of his categories—namely, raw materials (because of the insatiable appetite of American industry) and manufactured products that are not technology intensive (a function largely of comparative price levels). The picture in a third category—agriculture—"is not quite clear, but hardly promising," Boretsky says, while the situation in the fourth category—technology-intensive manufactured products—is "rapidly deteriorating."

Reasons for Concern

The focus of Boretsky's concern is this fourth category of technology-intensive manufactured products, which includes chemicals; electrical machinery and apparatus, including electronics; nonelectrical machinery; all types of transportation equipment, including aircraft and automobiles; and scientific and professional instruments and controls. (Technology-intensive products were defined on the basis of an industry's scientific and engineering manpower, R & D expenditures, and relative skill level of workers.) Boretsky notes that this commodity group is the "most voluminous" in our export trade and is "the only one that has consistently yielded surpluses that have covered the deficits in trade with other commodity groups as well as the deficits arising from other U.S. financial transactions with foreign countries." He notes that the trade balance in these products improved until the mid-1960's when it leveled off at about $9 billion and has remained in the $9 to 10 billion range ever since.

Boretsky finds this leveling off a cause for concern, for he believes the overall figures mask a rather disturbing trend. American imports of technology-

intensive products have grown almost 2.5 times as fast as American exports of these products over the past two decades, Boretsky says, but this disparity of growth rates has not been particularly noticeable since the imports were growing from a rather small base. Nevertheless, the aggregate dollar value of imports reached 55 percent that of exports in 1969 and, if the growth rates continue as they have in the past, our traditional surplus in technology-intensive goods will soon begin to decline. Within the category of technology-intensive goods, the United States is still doing well in the most sophisticated products, such as computers, Boretsky told *Science*, but this "upper limit of sophistication is growing tinier and tinier."

In analyzing trade patterns between the United States and various regions of the world, Boretsky concludes that we have suffered a "rapidly deteriorating trade position with practically all the developed world, and a dramatic deterioration with Japan and Canada." With Japan, in fact, the United States has had a trade deficit in technology-intensive products since 1965, largely due to deficits in electrical and electronic devices, scientific instruments and controls, and automobiles.

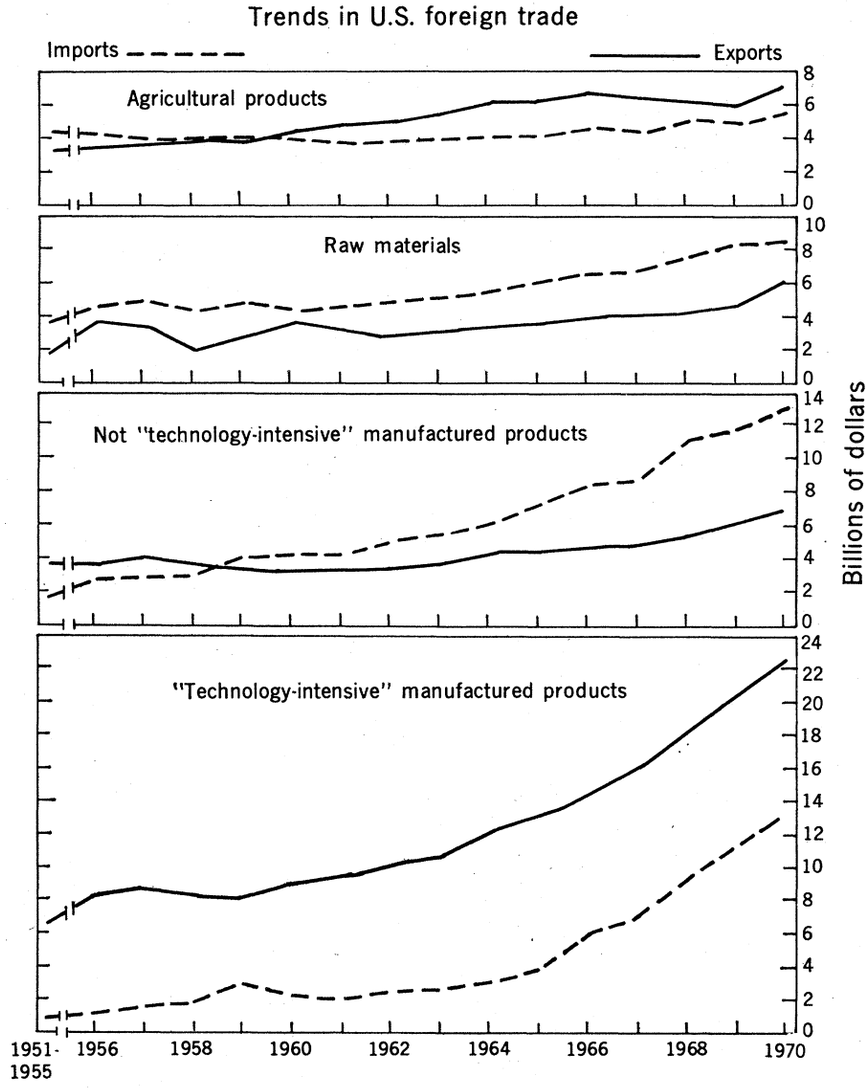
The upshot of all these trends, according to Boretsky, is that our overall commercial trade balance (excluding grants, aid, and other noncommercial transactions) made a 180 degree turn in just 6 years—from a surplus of $1.7 billion in 1962 to a deficit of $1.3 billion in 1968—the first such deficit in 93 years. In 1969 the commercial balance improved but remained some $600 million in the red, and in 1970 it improved even more dramatically, almost certainly producing a net commercial surplus. But Boretsky argues that the "apparent" improvement in 1970 is "a mere illusion"—"an aberration rather than a reversal of the long-term trends."

What factors have caused the deterioration in the U.S. trade position? Boretsky argues that the "most important cause" has been "U.S. industry's gradual loss of industrial and technological superiority (or narrowing of the 'gap')." Contributing factors have included the "weak international price competitiveness of U.S. industry" and "the inadequate endowment with natural resources in the United States relative to the economy's needs."

Boretsky finds no evidence that the United States is falling behind technologically in any kind of absolute sense. Indeed, he explicitly states that there is "no evidence whatever" that the *level* of technological and industrial capabilities in competing countries "has surpassed those of the United States in any important product line." But Boretsky does conclude that Western Europe's, Japan's, and Canada's industrial and technological capabilities (a term which refers to the "quality" of know-how as well as its scope) are growing at *rates* faster than the United States'. This faster growth rate has caused a narrowing of the gap, he says.

Thus the outlook, in Boretsky's eyes, is not very encouraging—indeed, it gives cause for "very serious concern." But it should be noted that many distinguished economists—some with credentials more impressive than Boretsky's—would disagree with his analysis. "It's too simpleminded," one top government economist told *Science*. "We had a big inflation that adversely affected international trade, and there's been a real slowdown in productivity in the American economy in the last couple of years. As far as I know we're still exporting high-technology products like aircraft. It's with the old generation electronics stuff, where we're no longer pushing the state of the art, that the Japanese are making inroads." Another top economist—a recognized authority on international trade—muttered that the scientists and engineers who have been spreading gloom are "out of their depth" when they try to analyze causal factors behind international trade patterns.

Perhaps the most pointed criticism of Boretsky's view has been offered by Richard N. Cooper, professor of economics at Yale University and former deputy assistant secretary of state for international monetary affairs. Cooper appeared on the same panel as Boretsky at the National Academy of Engineering meeting, and he



NOAA to Try Rescue Rainmaking

Because of the urgent requests of farmers in southern Florida who are facing disastrous crop losses due to a severe drought, scientists from the Environmental Meteorology Laboratory of the National Oceanographic and Atmospheric Agency (NOAA) are going to attempt a large-scale program of cloud seeding during April and May.

The scientists still view their rainmaking technique as experimental and would prefer to do further research before widespread applications are made. But the farmers, like terminal cancer patients, are desperate and eager to try even experimental remedies, and the scientists find it hard to turn a deaf ear to this plea for emergency aid. Nonetheless the scientists are uncomfortable in their role—an unaccustomed one for meteorologists—and they are worried about being cast as miracle workers who may not be able to deliver.

Scientists at the NOAA laboratory, which is headed by Joanne Simpson, have been working for some time toward the eventual goal of finding a reliable technique for increasing rainfall by seeding clouds with silver iodide. The current program came about when officials from the central and southern water control districts in Florida, who were aware of the research work, approached NOAA scientists about the possibility of attempting a rescue effort. Eventually the state of Florida formally requested federal aid, and the federal government agreed to support a program to at least attempt to mitigate the drought in southern Florida. According to the understanding that was reached, the federal government will provide planes and the silver iodide seeding materials under the direction of the NOAA scientists, while the state will instrument the target sites with rain gauges so that rainfall information can be collected and will also provide public relations liaison between the farmers and the scientists.—ALLEN L. HAMMOND

argued that Boretsky's figures were "a bit misleading" because they spanned periods of time in which the economy was acting in different ways under different pressures. Cooper's own contention was that, in the period between 1955 and 1965, U.S. exports of research-intensive products did not suffer more than did other U.S. exports. Thus he suggested it is unlikely that our trade performance can be explained as due to "a loss of technological lead." Cooper suggested instead such factors as a rise in U.S. export prices and the formation of European trading blocs, which retained duties on U.S. goods.

In the period since 1965, Cooper said, inflationary pressures associated with the Vietnam war have been "the major factor by a long margin" in our deteriorating trade posture. "Exceptionally strong pressures of demand in the United States, resulting largely from expenditures associated with the war in Viet Nam, resulted in unprecedented increases in imports from other industrial countries, including imports of research-intensive goods," he said. Thus, where Boretsky assigns inflation a secondary role, Cooper gives it the primary role in recent years.

Moreover, Cooper does not seem greatly worried by the fact that European and Japanese firms are showing greater capacity to innovate and to diffuse new techniques. "While the United States should be alert to the possibilities that its own innovative capacity could diminish, it should not lament the growing innovative capacity abroad," he said. "There is a great deal of scope for commercial diversity, and specialization is mutually beneficial even—or perhaps especially—in invention."

Another analysis that conflicts with Boretsky's has been offered recently by Robert Solomon, an adviser to the Federal Reserve Board and director of the Fed's division of international finance. Solomon, like Cooper, argues that excess demand and rising prices caused by Vietnam war expenditures caused our balance of payments problems in the late 1960's. Studies done at the Fed, he said, "show that if the United States had avoided inflation while keeping the economy on a full employment growth path in 1965–69, our trade balance would not have deteriorated. The relevance of that finding is that the reduction in our trade surplus was not inflicted upon us; we lost it ourselves by tolerating inflation." Unlike the doomsayers, Solomon expresses "a fair degree of optimism regarding the future of the U.S. trade balance."

Still other analyses call into question some of the assumptions of those who are worried about trade deficits. A recent paper by Lawrence B. Krause, an international trade expert at the Brookings Institution, for example, suggests that substantial trade deficits in coming years may not be a bad thing, for they will almost certainly be offset by even more substantial income from American investments abroad. "It is not hard to visualize the United States in equilibrium even with a trade deficit quite large by world standards," Krause says. (Boretsky's analysis deals solely with merchandise trade, not with foreign investments). Another recent paper by Lester C. Thurow, professor of management and economics at M.I.T., published in the March 1971 issue of *Technology Review*, questions whether increased expenditures for R & D—a pet recommendation of many of those who seek to improve our international standing in advanced technologies—necessarily produce technical advance. "While it may seem almost axiomatic that more research and development activities should lead to more technical progress," Thurow writes, "it is difficult to postulate this axiom on the basis of American history since 1940. More research expenditures do not seem to lead to more technical progress."

Thus, there does not seem to be much agreement as to whether we are in danger of losing our vaunted technological superiority, or as to whether technological factors have played much of a role in recent trade problems. Some economists interviewed by *Science* felt that the technologists are getting alarmed over economic trends they don't understand. But some technologists retort that the economists pay too little attention to technology. As Myron Tribus observed: "Recently I took time out to study what economists do about technology in their mathematical models of national economies. To my amazement I found that technological indices play no real role. . . . I am quite concerned over the power wielded by economists in determining national

strategies while those who understand technology are in such a peripheral status."

Part of the problem seems to be that economists have had great difficulty in finding a compatible and efficient way to handle the technological factor. As a result, writes Raymond Vernon, professor of international trade and investment at Harvard University, economists "have been slow to incorporate that [technological] variable explicitly in the main body of trade theory."

One of the few economists who seems to have looked closely at Boretsky's data is Richard Nelson, professor of economics at Yale, who has done pioneering work in the economics of research and technology and who sits on Haggerty's PSAC panel. "I'm basically with Boretsky," Nelson told *Science*. "I think the argument is almost unassailable." Nelson said he agrees that an erosion of U.S. technological leadership is the key factor behind trade balance problems, but he seems somewhat less worried about the situation than is Boretsky. "Boretsky waves his arms and screams too much," Nelson said. "I'm quite worried about his alarmist tone. It may force us to do silly things." Nevertheless, Nelson credits Boretsky (who is not widely known in the economics community) with making "a major contribution" by pulling together and analyzing data that no one else seems to have studied. Nelson said that while a handful of economists have, for the past decade or so, been studying the impact of technology on international trade, their work is still only trickling into the main line literature. "I don't feel my confreres realize how important it [technology] is," Nelson says. "It's very important."

—PHILIP M. BOFFEY

Food and Drug Administration: Is Protecting Lives the Priority?

In January officials of the Food and Drug Administration (FDA) knew that the use of bottled intravenous feeding solutions manufactured by Abbott Laboratories had somehow led to an outbreak of blood poisoning and several deaths. Yet they took no action. In early March, the FDA found out that a large percentage of the Abbott solutions were contaminated with the infectious bacteria responsible for the blood poisoning. Yet they did not ban the products. They only recommended that certain precautions be taken when the solutions were given to patients. Not until 22 March did FDA recommend that hospitals stop using the Abbott products. And then only after consumer-advocate Ralph Nader appeared on national television denouncing the agency for its failure to act.

The intravenous (I.V.) solutions (mostly combinations of dextrose and salts in water) are used in virtually every hospital to feed nutrients to critically ill patients. Until the ban Abbott Laboratories supplied 45 percent of the 250,000 bottles of I.V. solutions administered daily to patients in the United States.

The magnitude of the epidemic brought on by the Abbott products is unknown. The federal Center for Disease Control in Atlanta (CDC) carefully documented 150 cases of blood poisoning including nine deaths in only eight hospitals. But over 8000 hospitals were using the Abbott products at the time the contamination was discovered. A spokesman for CDC told *Science*, "We have no way of knowing the full extent of the problem, but you can extrapolate a guess."

A decision by FDA officials to ban any product involves complex consideration, many of them subjective. And from the vantage point of hindsight, the FDA can make an easy target for critics. Nevertheless, the case of the Abbott's I.V. solutions involved enough irregularities and a sufficient number of deaths to warrant close scrutiny. Whether or not anyone acted incorrectly, the incident is likely to result in congressional hearings and another round of criticism of the FDA.

Included among the irregularities is a curious history of violations involving Abbott's I.V. solutions, none of them resulting in prosecution by the FDA. In 1969, FDA inspectors found hairline cracks in some bottles of the Abbott solutions, which resulted in contamination. Abbott agreed to recall the damaged bottles and improve its manufacturing techniques. In 1964, FDA first cited Abbott several times for mislabeling its I.V. solutions, then, later in the year, because two lots were discovered to be moldy, and finally because the caps on the bottles were shown to leak.

The House Intergovernmental Relations Subcommittee, while investigating the 1964 series of violations, discovered that high FDA officials in Washington had suddenly ordered an end to the investigation of Abbott Laboratories. During an inspection of Abbott's plant in North Chicago, two FDA field inspectors received a phone call from their superior ordering them to "get out of the plant by noon." The investigation was thus precipitously concluded. And no satisfactory explanation has been offered.

The death of a 28-year-old woman on 5 July 1970 at the Medical College of Virginia in Richmond called the first attention to the current problem. Although hospitalized for hepatitis, the woman died from blood poisoning (septicemia). And the same rare bacteria found in her blood were growing in her bedside I.V. feeding bottle. Richard J. Duma of the college's department of internal medicine, while investigating the death, found that two other patients had recently contracted blood poisoning from the same organism. Duma and two colleagues, John F. Warner and Harry P. Dalton, then sampled all of the I.V. units in use in the hospital. Thirty-five percent of the solution bottles were contaminated with the same organism. The hospital's entire supply was manufactured by Abbott. "I had a lot of trouble getting people to believe that so many of the bottles were contaminated," recalled Duma.

Despite the extent of the problem, unopened bottles of the I.V. solutions showed no signs of contamination. "We concluded that the source of the contamination was at the bottle cap," said Duma. "But we were unable to tell