that publishers were occasionally embarrassed into paying him more than they had promised.

Hearnshaw's conclusion is that until about 1930 Burt deserved his high reputation. But in the late 1930's things began to go wrong. His marriage in 1932 to a much younger woman was a failure, his papers were destroyed in 1941, and he began at about the same time to suffer from attacks of Ménière's disease, a condition affecting the organs of balance. It was in the late 1930's that Burt began to make exaggerated claims about his own contributions to factor analysis, which he promptly withdrew on being challenged by C. E. Spearman, its true originator. After Spearman's death Burt's claims became even more outrageous, but with nobody to deny them they became generally accepted.

The egotistical and devious behavior, Hearnshaw suggests, was a reaction to setbacks Burt began to experience in the late 1930's and that as those setbacks accumlated, so the changes in Burt's personality became more pronounced. The 1943 paper on ability and income was a watershed in Burt's career: "provocative in content and suspect in its procedures," according to Hearnshaw. Most of Burt's work after that time represents a decline from the standards he had earlier reached.

Hearnshaw suggests that in fact Burt suffered from paranoia; his secrecy, suspicion of rivals, egocentricity, compulsive motivation, and hypochondria are all consistent with this diagnosis. But whether Burt actually deluded himself, and believed his own fictions, is harder to answer. Hearnshaw believes that the root to Burt's problems lay in a tough childhood where he had been obliged to make his own way; but many others survive such a childhood unscathed. Whatever the explanation, Burt "chose to cheat rather than see his opponents triumph" is the sad and touching conclusion Hearnshaw finally reaches.

—NIGEL HAWKES

More Stress on Applied Science at NSF

Atkinson favors faster growth for programs in this field; agency under scrutiny as Congress reviews basic law

What the Carter Administration and Congress will do to encourage U.S. industrial innovation and productivity in the face of stiff foreign competition will not be known for some months yet, after completion of the Administration's ongoing "domestic policy review" of this problem (*Science*, 27 July). But the very fact that the problem is squarely on the national agenda is having an effect on the National Science Foundation, which seems more clearly disposed than before to seek rapid growth of programs in engineering and applied science.

NSF's basic statute comes up for renewal next year and a general review of the agency's activities has begun in Congress (*Science*, 8 June). Under the circumstances now prevailing, it is possible that pressure will be applied for significant changes in the foundation's role.

Some people on Capitol Hill and elsewhere feel that, in the past, NSF deliberately chose not to push vigorously for development of programs in applied fields for fear that such growth would take money away from the support of basic research, the foundation's primary mission. Under the NSF budget for fiscal 1980 just approved by House and Senate conferees, funding levels for most applied science programs will remain flat unless supplemental appropriations are requested by the Carter Administration and approved by Congress. Support for basic science and engineering programs will be up 8½ percent, which is a slightly larger increase than usual but not enough to offset inflation.

But, according to Jack T. Sanderson, NSF's assistant director for engineering and applied science, prospects are now much improved for programs in his area. "I'm upbeat right now," he said. "The time is ripe for a substantial growth in the NSF engineering and applied science areas." In Sanderson's view, such programs are likely to receive strong support both from NSF and Congress.

Richard C. Atkinson, director of NSF, confirmed that he favors accelerating growth of these programs. "If things develop the way I hope over the next 10 years," he said, "there will be very healthy increases for the basic science budget, but the engineering budget will be growing even faster."

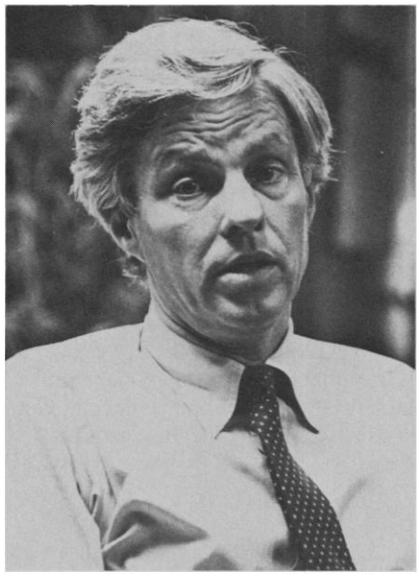
As he sees it, it will be partly a matter of building on past NSF initiatives, which have included development of three programs to strengthen ties between industry and the universities. In these particular programs, NSF is supporting cooperative research projects by industrial firms and universities; providing start-up money for the establishment of university-industry centers focused on technological innovation in certain fields; and paying for the initial phases of high-risk innovative research by small businesses, often with university collaboration.

On 31 July, at a hearing held by the House subcommittee on science, research, and technology on the question of what federal agencies can do to encourage industrial technology and innovation, Atkinson indicated that NSF hopes to get early budget increases for these programs. "We are actively seeking ways to expand our efforts in industry-university collaboration," he told Representative George E. Brown, Jr. (D-Calif.), chairman of the subcommittee. NSF was, he said, discussing this possibility with the White House Office of Science and Technology Policy (OSTP) and the Office of Management and Budget (OMB).

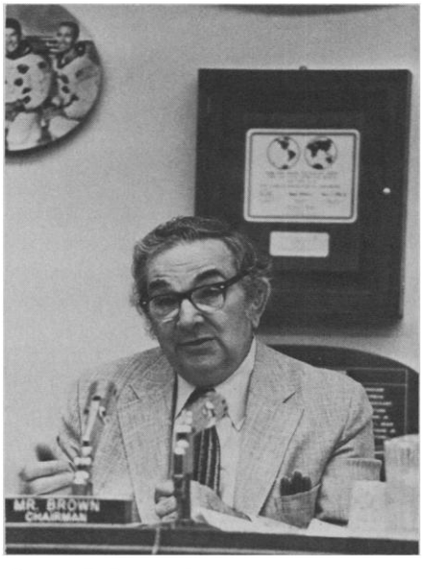
NSF has just enhanced the status of engineering and applied science by bringing programs in these two fields together in the new directorate that Sanderson heads. This marks a new stage in the foundation's fitful evolution of a role for itself in supporting research that is directly addressed to societal needs.

That evolution began with the "Daddario amendments" of 1968 by which Congress gave NSF authority to support certain kinds of applied research. Then, in 1971, came RANN (Research Applied to National Needs), a program that peaked in fiscal 1975 when its budget rose to $143 million. But that same year RANN lost its fast-growing energy research programs to the newly created Energy Research and Development Ad-

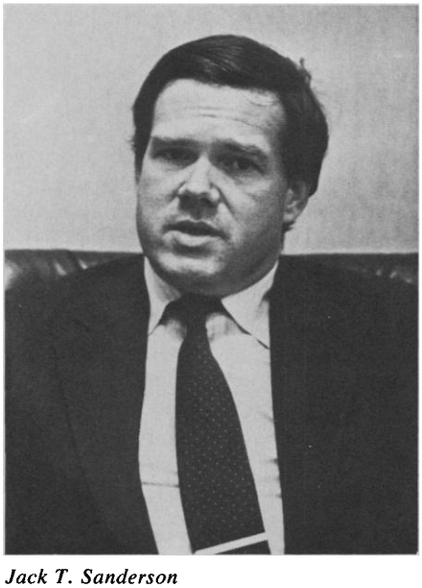
0036-8075/79/0817-0675$00.50/0



Richard C. Atkinson



George E. Brown, Jr.



Jack T. Sanderson

ministration (a predecessor of the Department of Energy) and its influence went on the wane. This was partly because of resistance within NSF to any new resurgence of support for applied science. The present commitment of the NSF leadership to push the support of research in these fields seems to have taken firm shape only within the last year, although in 1976 an advisory group chaired by John Whinnery, a professor of electrical engineering at the University of California at Berkeley, called for just such a commitment.

In an interview with *Science* a few days after Atkinson testified before his subcommittee, Representative Brown indicated that he still was not convinced that NSF was ready to make a major effort to quicken the pace of industrial innovation, now widely perceived as no longer up to the challenge from nations such as Japan and West Germany. "I don't get the feeling that they [NSF] are being enthusiastically responsive," he said.

One of Brown's aides observed subsequently that, while NSF has indeed initiated some programs relevant to industry's needs, the foundation has not, until now at least, pressed hard at OMB and in Congress to have those programs generously funded. Out of a total budget of nearly $1 billion, NSF will be spending $117 million next year on engineering and applied research, which will include some $54 million in the fundamental engineering sciences. For the three programs that are designed to encourage industry-university collaboration the total now budgeted comes to less than $16 million, or about the same amount as available this year.

The result of the Administration's domestic policy review of the perceived lag in U.S. industrial innovation will not be known until President Carter decides what new governmental initiatives are in order. His decisions, which are not expected before September, at the earliest, are eagerly awaited by Representative Brown and his counterpart in the Senate, Adlai Stevenson (D-Ill.), chairman of the subcommittee on science, technology, and space.

Senator Stevenson has introduced legislation that would create an Office of Industrial Technology in the Department of Commerce. This office would provide grants for the establishment of "Centers for Industrial Technology," either as free-standing nonprofit entities or as affiliates of universities. These centers would seek to develop the "generic research base" for industrial innovation.

Representative Brown is sponsoring a similar bill in the House, but as now drafted his measure would entrust sponsorship of the centers to the Department of Commerce and NSF jointly, without specifying which agency should play the lead role. In addition, Brown is putting forward a bill which, in keeping with a concept proposed by the Institute of Electrical and Electronics Engineers (IEEE), would establish a national engineering foundation, or as Brown prefers to call it, a national foundation for technology.

While Brown is not at this point committed to the IEEE proposal, he says it has merit. "I think it's an idea well worth consideration," he said. "If NSF feels that its role should be confined to basic science, what about the economic need for targeted research?" NSF could continue to support basic research at the same time the new foundation seeks to respond to economic and social needs, he suggested.

Atkinson says that there has been little discussion at NSF of the IEEE proposal. But, in Sanderson's view, it is a bad idea in light of the growing support for engineering and applied science at NSF. "I think that a lot would be lost if engineering were separated from the rest of science," he said, adding that numerous projects in engineering research supported by NSF involve close collaboration between the agency's engineering and science directorates.

According to Richard Meserve of the OSTP staff, the national engineering foundation proposal has not figured in the Administration's domestic policy review. The review is confined to an evaluation of various proposals for direct and indirect stimulation and support of technological innovation. These proposals range from changes in environmental regulation and patent antitrust policies to tax credits for companies that support university research and grants for industry-university collaboration.

For his part, Atkinson, buoyant over the fact that the House-Senate conferees agreed to give NSF all but about $9 million of the total of $1.006 billion that the Administration asked for, says that support for the agency on Capitol Hill has never been stronger. He does not see NSF as an agency in trouble.

Nonetheless, there is no question but that NSF is being pushed to make a larger commitment to engineering and applied science. Atkinson and the National Science Board appear willing enough to make that commitment anyway. But, as Sanderson remarked to *Science*, "The external pressures have not hurt."—LUTHER J. CARTER