mysterious enrichment process and its uncertain nuclear intentions have lent an extra touch of intrigue to the international energy scene. The Vorster government has nurtured the mystery with a delicate touch, it being second only to heart transplantation as a source of national scientific prestige. From time to time the AEB's attractive publication *Nuclear Active* would drop a hint that the pilot plant was coming along quite well, and once it printed a conspicuously fuzzy picture of the plant—a nondescript cluster of concrete buildings marked by a row of smokestacks. The government also disclosed that the plant was located near Pretoria at a site called Valindaba, a Bantu word that means "This we do not talk about."

But lately South African officials have been talking more about their plant. The most recent occasion was the European Nuclear Society conference in Paris in late April, where AEB president Roux said he intended to "lift the curtain somewhat." Roux's speech fell short of the now-it-can-be-told class, but he did provide a tantalizing glimpse.

He and W. L. Grant, who is credited with having invented the process, called it a "high performance stationary-walled centrifuge," a term they left largely unexplained. What it apparently means is that a high-speed stream of gas—a mixture of uranium hexafluoride and hydrogen—flows along a path that allows centrifugal force to separate the heavier uranium-238 from the fissionable uranium-235. This approach dispenses with the troublesome high-speed rotors of conventional gas centrifuges, hence the term "stationary-walled." The process is less energy-efficient than the two now in commercial use—gaseous diffusion and the gas centrifuge—but South African officials say their process requires fewer stages and simpler technology than the other two, and thus runs about one-third the cost of other processes. (This apparently assumes, however, that electricity from coal or hydroelectric dams is relatively cheap, as it is in South Africa.)

To American enrichment experts, all this sounds strikingly like the jet-nozzle enrichment process developed over the past 20 years by Erwin-Willy Becker at West Germany's Karlsruhe Nucear Center. Becker, in fact, sometimes describes his technique as a stationary-walled centrifuge, in which a sheet of uranium gas flows through a slitlike nozzle and along a curving path. One big difference, however, appears to stem from what the South Africans call their "helikon" technique,* whereby the number of succesive stages for enriching uranium can be reduced to about 100—in comparison to thousands of stages used in gaseous diffusion and hundreds for the gas centrifuge and for Becker's process.

In spite of this difference, the Roux and Grant speech was notably devoid of claims that the process was wholly and uniquely South African.

Research began in 1961 and has thus far cost $148 million. Without mentioning any names, Roux and Grant said things were sufficiently advanced 2 years ago "to consider sharing some of our know-how with the outside world and in this way to test the feasibility of our process with foreign experts." Almost certainly this was a reference to the relation South Africa struck up in 1973 with Becker and with STEAG, AG, the large energy firm in Essen which is carrying Becker's nozzle process toward commercial development.

*Somewhat cryptically described as being "based on the principle that an axial flow compressor can simultaneously transmit several streams of [gas] of different isotopic composition without there being significant mixing between them."

Some U.S. analysts believe Becker and STEAG have helped the South Africans over some technical rough spots in scaling up their process and estimating its cost; the frequent presence of South Africans in Karlsruhe had fueled speculation that the two nations' processes were similar, and that speculation now seems confirmed.

The next major development may be the announcement in the next few months of an international partnership to build a commercial plant based on the South African process. Roux and Grant disclosed that negotiations with "interested foreign parties" are now under way and in some cases are at an "advanced stage."

Just who these interested parties might be is, as ever, open to speculation. One U.S. analyst says relations with STEAG were "pretty close for a while," but are now unclear. The STEAG group would be a logical helpmate, but it is also a potential competitor, having all but concluded a deal with Brazil's military government to sell a nozzle enrichment plant. Coincidentally, South Africa has been strengthening its commercial ties with Brazil, and there are indications that talks have touched on an enrichment partnership. British and Japanese nuclear officials deny that they're among the "interested parties"; but France, Australia, and Canada are speculative possibilities.

Even if South Africa fails to come to terms with foreign participants, Roux and Grant concluded, it is almost certain that it will proceed to build an enrichment plant of 5000 tons capacity, roughly a third that of the United States. By the mid-1980's that may be only enough to satisfy 10 percent or less of the world's enrichment demand. But it will be more than enough to make South Africa a military nuclear power if it so chooses.

—ROBERT GILLETTE

NIH Training Grants: The Uncertainty Factor

The research training programs of the National Institutes of Health (NIH) have been the cause of an annual brush between Congress and the Administration and a perennial source of anxiety and confusion to the biomedical research community.

Although there was some skirmishing late in the Johnson Administration, the advent of the Nixon Administration marked the beginning of a serious attempt by the Executive Branch to reduce the scale and alter the form of federal support of graduate and postgraduate training in the sciences. The main target was the training grant, which provides institutions with funds to conduct predoctoral and postdoctoral training programs, rather than the fellowship, which is awarded to individuals. The Administration was rather successful in squelching the training-grant in other agencies—the National Science Foundation's traineeships were wiped out—but Congress defended NIH's authority to award training grants and regularly provided funds absent from the budgets submitted by Presidents Nixon and Ford.

The biggest year for the NIH training programs was 1969, when a total of about $168 million was spent—about $139 million on training grants and $29 million on fellowships. In that year, the funds supported training for a total of 16,600 "full-time equivalent" people. Comparable figures for the most recent year in which awards were made—fiscal year 1974—are

elusive because funds impounded by the Nixon Administration in fiscal year 1973 were released the next year and therefore confuse the issue. But, from an average of the 2 years, it appears that funding for fiscal year 1974 was down to about $150 million and the number of persons in training reduced to about 11,000. Congress is now in the process of reviewing legislation on NIH training programs, and it appears that familiar patterns, with some differences, are being repeated.

For several years, total funding of the training programs has hovered at the $150 million level. Steady inflationary erosion has contributed significantly to the decisions by many basic science departments in universities and medical schools to cut the numbers of graduate students and postdoctoral fellows. Because a portion of training grant funds could be applied to faculty salaries, cutbacks in the grant program resulted in reductions in faculty in some departments. The conflict between Congress and the Administration has caused long delays in the passage of authorization and appropriations measures, and this has made planning difficult and engendered an atmosphere of uncertainty in research institutions for the past 6 years.

During this period, however, Congress has blocked bigger cuts in funding and major policy changes proposed by the Administration. On the other hand, Congress undertook some drastic action of its own to make policy changes, culminating in the passage of the National Research Act last year (*Science*, 2 August 1974). This law combined new rules for research training with regulations governing fetal research.

The training provisions of the act consolidate existing training programs of NIH and of the Alcohol, Drug Abuse and Mental Health Administration (ADAMHA) into a single program called the National Research Service (NRS) Awards. The main features of the program are (i) the awards can only be made for training in disciplines in which need has been verified and (ii) recipients of the awards are required to provide service in research and education in return for support and are subject to payback provisions if they fail to meet the requirements.

The service and payback provisions of the law pose tough new administrative problems for NIH. Most obvious is the difficulty of keeping track of those who will be fulfilling service requirements after completing training under the awards. The regulations drawn up to implement the law, finally published on 2 May, are quite detailed, and the task of keeping tabs on thousands of professionals to make certain they are discharging their service obligations could require a huge and expensive compliance office. Verification will not be easy, since many of these health professionals normally hold jobs with a mixture of duties, and it will be difficult to ascertain that they are spending "full-time" on health research or education as required by the law.

The service and payback features of the law seem to be an expression of a general feeling in Congress that heavy federal spending on health care, research, and education has not accomplished the hoped-for effects and that more specific requirements and greater accountability must be built into the system.

As the service requirements now stand, the individual who receives an NRS award must, for each year of the award, complete a year of health research or teaching as prescribed by regulations, or serve as a member of the National Service Health Corps, which places physicians and other health personnel in medically underserved areas. If the individual fails to fulfill part or all of the service requirements he must repay the portion of the award for which he is liable under a formula set forth in the act plus interest at regular private-consumer rates which would have been payable if the award had been a loan. The law forbids use of the awards for residency training in medical specialties.

The bill was hammered together over the period of a year or so from elements provided mainly by Senator Edward M. Kennedy (D–Mass.) and Representative Paul G. Rogers (D–Fla.), chairmen of the Senate and House subcommittees which handle NIH authorization legislation. For different reasons, the bill delighted neither the Administration nor the biomedical research community, as represented by the Association of American Medical Colleges. However, it did make good on congressional intentions to protect NIH's right to employ the training grant mechanism and at the same time to tighten up the rules and regulations governing the system to meet criticism which was being heard in Congress. The major complaint seems to have been that the training programs were being exploited by some doctors who trained at public expense and then went directly into private practice, thus profiting exorbitantly from the training.

The other main feature of the law, NIH's new legal obligation to make training awards only in certified areas of need, is deferred for a year. A report on overall needs for biomedical and behavioral sciences research personnel is to be produced by a group working in the National Academy of Sciences under the chairmanship of Robert S. Glaser, president of the Kaiser Family Foundation. A detailed report is not due to be made to the Secretary of Health, Education, and Welfare (HEW) and to Congress until 31 March 1976, but the group is planning to issue a preliminary report, perhaps by mid-June, to give NIH guidance in planning how to distribute training funds in fiscal year 1976.

Meanwhile, the fencing match between the Administration and Congress continues. NRS Awards legislation expires on 31 June, and both houses of Congress have been working on bills to extend the law. On 20 May, the recently confirmed HEW assistant secretary for health, Theodore Cooper, appeared before the Rogers subcommittee to testify in behalf of an Administration bill extending and modifying the act. In the following excerpts from his prepared testimony, Cooper repeats what have been basic Administration attitudes toward research training:

> The Administration bill is based on a recognition of the changes which have occurred in the last several years related to the need for biomedical and behavioral research training. In the 1960's, biomedical research grants grew at an average rate of about 22% annually. In the context of such rapid growth, a large amount of research training support was provided to attract and educate an increasing number of qualified individuals in a short period of time.
>
> Now, however, partly as a result of past research training support, institutional training capacity and student interest in such research have grown to the point at which the overall number of biomedical and behavioral researchers is in balance with national need. There remain, nonetheless, a few subject areas which experience a chronic shortage of highly qualified research personnel. Accordingly, we believe that Federal expenditures for research training should now be focused on these specific shortage specialties.
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> The Administration bill would require the Secretary annually to determine the subject areas for which there are, or will be, significantly inadequate numbers of individuals qualified to perform biomedical or behavioral research, and with respect to which subject areas research training capacity is inadequate to meet the needs.
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> The Secretary would make awards only for research or research training in those subject areas, or aspects of areas, in which there is a shortage of qualified or proficient research personnel.
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> * * *
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> The President's 1976 budget contemplates that National Research Service Awards will, in fiscal year 1976, support 1,100 new fellowships and awards to individuals at the post-doctoral level in areas in which there are insufficient numbers of research personnel. Individual fellowship support was chosen because it is consistent with the Administration's general higher education policy of concentrating support on individual students in preference to support of institutions. This decision is based on supporting those areas of needs given the current state of the economy. Decisions with regard to future allocations of funds will take into consideration the NAS study, other studies which we may undertake, and an assessment of program needs and the budget at that time.

With the Office of Management and Budget cracking the whip, the Administration has consistently sought to shift funds for federal support of research training from institutional grants to individual fellowships and, in fact, has preferred support of training through research assistantships paid for through research grants. Just as doggedly, the Administration has argued that the bulk of training funds should go into postdoctoral fellowships rather than predoctoral support. One crop of special "Weinberger fellowships," named for HEW Secretary Caspar W. Weinberger, were a departmental effort to assert the postdoctoral principle.

Kennedy and Rogers have been equally adamant that predoctoral training not be slighted. And NIH has been faithful in its fashion to predoctoral training, all of which has been supported through training grants since 1968. (For fiscal year 1975, about 6500 predoctoral traineeships and about 5900 postdoctoral traineeships and fellowships are expected to be awarded.)

The new law specifies that no less than 25 percent of NRS Awards go to individuals, and informed observers expect that approximately 75 percent of funds for the current fiscal year will, in fact, go to grants to institutions and 25 percent to individual fellowships. The congressional appropriation for fiscal year 1975 is $151 million, and this year NIH will be responsible for identifying needed areas of research in making the awards.

A difficulty this year and for a few more years is that training funds will be disbursed through multiple programs, compounding the confusion for NIH's constituency. "Continuation" payments on grants and fellowships awarded under the "old" NIH program will be made. Weinberger fellowships also claim funds. And a start will be made in giving NRS Awards. Adding to the confusion is the fact that the new law, as it now stands, must be renewed annually. Some relief is promised if NRS award legislation is extended for more than a single year, as Kennedy and Rogers intend. But as long as Congress and the Administration continue to be so resolutely at odds, the uncertainty will persist. And comments collected in a random sounding of researchers involved indicates that "instability" in the training sector has been as hard to adapt to as the cut in funds. As one observer put it, "This yo-yo approach to [research training policy] is what creates confusion, makes it impossible for faculty and students to do any real planning, and causes an inefficient use of funds."—JOHN WALSH

The Brain Bank of America: Auditing the Academy

The National Academy of Sciences (NAS) comes under serious criticism in a report conducted under the auspices of consumer advocate Ralph Nader and published this month.* Written by former News and Comment staffer Philip M. Boffey, the report concludes that the studies prepared by the academy's committees "often fall short of the very high quality one would expect from the nation's preeminent scientific institution." The problem, Boffey says, is that many NAS studies are "mediocre or flawed by bias or subservience to the funding agencies." His general solution is that the academy should do less and do it better, by being more open in the conduct of its business, by ensuring that contrary points of view are represented on its committees and, most of all, by breaking free of a debilitating master-servant relationship with its sources of support.

Many Nader reports are black-and-white indictments that lay out the charges in terms of sustained outrage and arrive at a preordained verdict. Boffey's study, based on more than 500 interviews, is no hasty hatchet job. Within its chosen framework, that of a critical assessment, it appears to be evenhanded and scholarly. The conclusions proceed from clearly stated evidence and are modified with frequent counterexamples and almost as many "on-the-one-hand's" and "on-the-other-hand's" as an academy report. While admitting there is no perfect yardstick for measuring the academy's performance, Boffey says that he has tried to assemble "the kind of evidence that would be persuasive even to most academicians."

NAS president Philip Handler declined a request to discuss the study, saying through an intermediary that he had perused only part of it and was reserving the rest for his summer reading at Woods Hole. At the NAS annual meeting in April, however, Handler described the study as a "very careful analysis of our defects." He told academy members that the study was not balanced and did not claim to be, adding that "The number of skeletons in the closet, it seemed to me, must be rather a disappointment to the author."

That depends, maybe, on what you recognize as a skeleton. In the sense of a discovery that conflicts with the closet-owner's public image, *The Brain Bank of America* is an Ezekiel's valley of bones, rattling with skeletons of all shapes and sizes. There are jocular little skeletons, like the circumstance that an academy subcommittee on dog and cat food standards was headed until 1973 by an official of Ralston Purina Co., a major manufacturer of pet foods. There are ludicrous but larger-looming skeletons, such as the case of the TV dinners, in which industry representatives apparently persuaded an NAS committee to adulterate a recommended dietary standard for such repasts; or the case of highway litter, in which a group of bottlers and canners, through an organization called Keep America Beautiful Inc., hired the academy to study roadside trash and gained from the NAS's Highway Research Board a highly satisfactory verdict stressing public education as the key to the problem rather than preventive action by bottle and can makers.

Then there are more serious skeletons, such as the public policy issues examined in the book's six case studies. Individual academy reports have often been criticized for lack of balance in the past. Boffey's study is unusual because on each of his chosen issues he has scrutinized a historical series of academy reports, along with the various positions taken by other scientific groups in and outside of government.

This technique has allowed Boffey to discern a trend in the academy's reporting. His thesis, put in most general terms, is that, although no one can "buy" a particular verdict, the academy is not sufficiently independent to resist pressures from special interests, such as the government, industry, and the scientific community.

Boffey characterizes the academy's relationship with the government, its major contractor, as one in which the academy has become a "technical hand-

*Philip M. Boffey, *The Brain Bank of America* (McGraw-Hill, New York, 1975), $10.95.