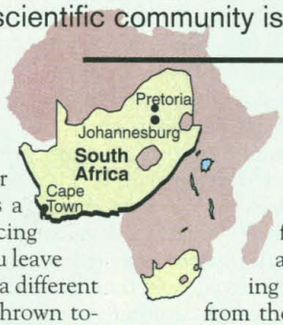
Elite Science in a Poor Country

Now that South Africa is grappling with the problems of a Third World country, the scientific community is struggling to find a new role for itself



PRETORIA AND CAPE TOWN—The 45-minute drive from Cape Town to the National Accelerator Center (NAC) at Faure provides a stark reminder of the dilemma facing South Africa's scientists. Once you leave the modern city limits, you are in a different world: mile after mile of shacks thrown together from wood and corrugated iron, with no electricity, no running water, and no sanitation. Many inhabitants of this desolate suburb stand by the side of the highway, waiting for minibuses to take them to low-paid jobs in the city. When you pass through the NAC's security gate, you enter yet another world: Wild deer and zebras graze on the wide lawns surrounding the well-maintained experimental halls. Inside, nuclear physicists use the 10-year-old cyclotron to probe the fundamental properties of matter; medical researchers experiment with proton and neutron beams to treat rare cancers; and radioisotopes are created for medical use elsewhere in the country.

The pristine facilities of the NAC and the contrast with its grim surroundings symbolize the position of South African science. For decades, this country's scientists have worked in an elite world, not only isolated from problems besetting the poor black majority, but also without strong links to South Africa's industry. Under the apartheid regime, the wealth of the white minority was largely maintained by the export of raw materials, such as gold, diamonds, and fruit—industries that require little research. Manufacturing tended to be done by multinational companies that carried out their R&D elsewhere. As a result, South Africa spent comparatively little on science: less than 1% of its gross domestic product, compared with up to 3% in other industrialized countries. But what money the government did give to basic researchers came with just one proviso: That they should strive for excellence on the world stage.

But all that is changing. "Suddenly, South Africa is a Third World country," says Sean Davison, a New Zealander who heads the microbiology department of the University of the Western Cape (UWC). In the year since the Government of National Unity, dominated by the African National Congress (ANC), came to power, it has made tackling poverty and improving access to health care and education its top priorities, and it is now asking scientists: "How are you going to contribute to solving these problems?"

As a result, the scientific enterprise is being transformed from top to bottom, and many researchers are being pushed—some reluctantly—from their ivory towers. In the next few weeks, the government's basic science funding council will announce a suite of new research programs. In a few months' time, the government will produce a white paper laying out its plans for research and development. And later in the year it will back up its policies with sweeping budgetary proposals. "The budget is a key agent of change. The 1996–97 budget will include drastic changes. ... Every department will have to match criteria set by the Cabinet. They will have to ditch activities that don't fit," Bernie Fanaroff, a radioastronomer now in charge of the government's Reconstruction and Development Program (RDP), told a science policy conference organized by the Royal Society of South Africa in April.

Researchers are awaiting these changes with a mixture of fascination and trepidation. "The success of the scientific endeavor will be judged by the improvement in quality of life of the majority of the population. South Africa with its two worlds—First World and Third World—faces huge and exciting challenges," says Malegapuru Makgoba, deputy vice chancellor for personnel at the University of Witwatersrand.

TOP 10 RESEARCH PRODUCERS

Institution	Total cites	Cites per paper
Univ. of Cape Town	18,122	38.2
Univ. of Witwatersrand	11,220	37.9
Groote Schuur Hosp.	3,951	46.5
Council for Scientific & Industrial Res.	3,135	38.7
Univ. of Natal	2,882	32.4
Univ. of Stellenbosch	2,597	35.1
S. African Observatory	2,502	38.4
S. African Medical Res. Council	2,298	38.3
S. African Inst. for Medical Res.	2,234	42.2

Institutions ranked according to the total number of citations to papers with at least one author from that institution, in a database of the 100 most cited South African papers published each year between 1981 and 1994.

SOURCE: THE INSTITUTE FOR SCIENTIFIC INFORMATION

Overcoming the past

South Africa is not the only country pushing its scientists to focus on pressing national problems. But no other government faces quite such a challenge in overhauling its research system. The dimensions of the task were laid out 2 years ago in a report written by an international group of technology policy experts who were asked by the ANC and several other members of South Africa's democratic movement to analyze the country's research structure. James Mullin, former vice president of the Ottawa-based International Development Research Center (IDRC), which organized the assessment, says, "We found two societies: a white society, carrying out First World science with its usual lack of relevance, embedded in a poor, Third World country."

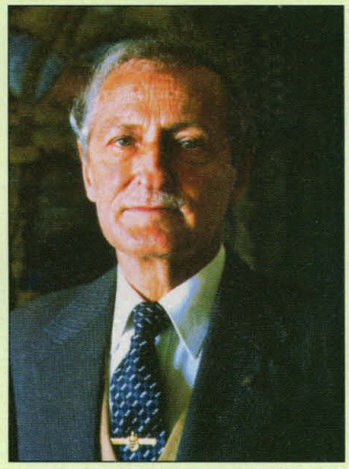
Even worse, the report said some scientific institutions had been props of the old regime. Technological development was largely geared to serving state security and suppressing the majority of the population, the report said. Until the mid-1980s, for example, the Human Sciences Research Council had provided much of the analysis supporting the policy of apartheid. And the Council for Scientific and Industrial Research (CSIR)—the largest of South Africa's seven research councils—was heavily involved in research for defense and state security. "The CSIR was far removed from the people: remote, secret, protected as a strategic installation," says CSIR's executive vice president, Neo Moikangoa, a mathematician who taught at Cornell University in the 1970s before heading the ANC office at the United Nations. "There was a long period when I could not have worked at the CSIR," he adds.

The IDRC report did not just look for scapegoats, however; it also focused people's attention on what needed to be done. One of its key proposals was for the setting up of a Cabinet-level department responsible for science and technology, which the new government did soon after its election last year (although it lumped them in with arts and culture). "[The IDRC report] is a historic thing in South Africa," says Roger Jardine, a 29-year-old physicist and former ANC staffer who earlier this year was appointed director

South African Research Comes In From the Cold

During the 1970s and 1980s, while the racist policies of apartheid made South Africa an international pariah, its researchers were often treated like disgraced relatives in the world family of scientists—they could turn up at family gatherings, but they weren't exactly welcomed. Some say their research wasn't seriously affected: "I maintained long-term contacts, attended conferences, and made lab visits," says chemist P. W. Linder of the University of Cape Town (UCT). "We suffered less than many. People were drawn by the wealth of material," says Phillip Tobias, head of the Paleoanthropology Research Unit at the University of Witwatersrand Medical School, home of one of the world's foremost collections of early hominid fossils. But for many scientists, South Africa's political isolation created numerous problems.

The situation could have been far worse, though. Scientific societies, such as the International Council of Scientific Unions, opposed the exclusion of South African scientists. "IUPAC [International Union of Pure and Applied Chemistry] was a key factor in keeping us alive and in contact with the rest of the world," says Linder. Where there were boycotts against South African scientists, they tended to be imposed by governments, and their severity varied from country to country. India, African nations, and most other Third World countries imposed complete bans on scientific contacts with South Africa, while other nations maintained an ambiguous stance. Japan, for example, would not issue visas to South Africans who said they were attending an international conference in the country, but they did issue them tourist visas.



MICHAEL DORAN

New era. Phillip Tobias welcomes reacceptance by world's scientists.

Western countries were generally quite open to South Africans, but with notable exceptions. Tobias recalls the case of a biochemistry postgrad student who needed to go to the Netherlands to learn a technique essential to his doctorate. The whole visit was planned, but it was finally vetoed by the Dutch foreign ministry. "The academic boycott only harmed a few individuals, and it was hitting the wrong people," says Tobias.

The boycotts also stopped some researchers from visiting their South African colleagues. Some declined invitations to visit as a political statement; others feared their students would revolt or were forbidden to come by their universities. And many who did come asked to keep a low profile. "Even in the worst stages it was never difficult to travel out, but few visitors came here," says UCT mathematician Chris Brink.

Worse, some international journals were closed to South Africans—papers were returned unrefereed. And the ban on exports to South Africa of technology with military applications also had an effect on science, particularly astronomy. "Solid-state devices and image tubes were hard to get, but we had our own workshops, so we didn't suffer much," says Ian Glass of the South African Astronomical Observatory.

Perhaps the blackest point in the academic boycott of South Africa was the 1986 World Archeological Congress (WAC) in Southampton. In 1985, following renewed violence in South Africa, the government declared a state of emergency, and pressure for a complete boycott against the apartheid regime intensified around the world. The WAC organizing committee in Southampton was besieged by calls from students' and lecturers' unions and anti-apartheid groups to disinvite South African delegates. When they bowed to the pressure, large numbers of other delegates withdrew in protest, although others, especially those from Third World countries, signed up in support.

Debate on the conference raged in the letters pages of national newspapers and journals such as *Science* and *Nature*. As the furor mounted, the congress's governing body, the International Union of Prehistoric and Protohistoric Sciences (IUPPS), withdrew its support and most of the organizing committee resigned, but the congress went ahead anyway. "It caused a huge rift in the field of prehistory," says Tobias. And some aspects of the rift persist: Today, the WAC and the IUPPS hold their own competing meetings.

Since the sudden collapse of apartheid in 1990, the world community of scientists has welcomed South Africans back into the fold. "There has been a huge difference in behavior at meetings. It's a psychological effect," says David Woods, deputy vice chancellor of UCT. "Since 1990 things have been gradually opening up. We have more involvement in international societies. Old ties have been taken out of cold storage. We're once again part of the community," says UCT mathematician Daya Reddy.

South Africa has also opened up to the rest of the world. "Now there is tremendous interest in groups coming over to visit. It's almost an embarrassment," says UCT mathematician George Ellis, president of the Royal Society of South Africa. And that influx is not restricted to foreign scientists, but also includes South African émigrés who fled from apartheid. "Quite a lot are coming back. They now want to do something positive for the country; especially the young like the idea," says UCT oceanographer Geoff Brundritt. Malegapuru Makgoba left his job as deputy director of the department of chemical pathology at the Royal Postgraduate Medical School in London to return to South Africa earlier this year. Although as deputy vice chancellor of the University of Witwatersrand he was instantly thrown into negotiations with protesting students and striking workers, he has no regrets. "It is my home. There is enormous potential to make a blueprint change for a future society."

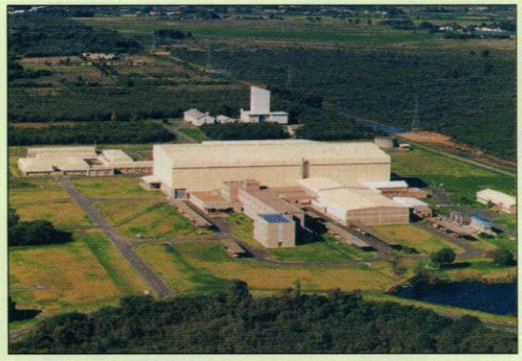
Another significant change is the sudden access to scientists in neighboring countries in Africa. "African universities are starting to look to South Africa instead of the United States and Europe. It's cheaper and they are more comfortable with the atmosphere," says UCT chemist G. E. Jackson. Although many researchers like to portray South Africa as a regional focus for science in Africa as a whole, they are realistic about the depressed state of science in most of the continent. "We are slowly getting contacts in Africa, but the level of technological development in these countries is very low," says Steve Mills, deputy director of the National Accelerator Center near Cape Town.

Whatever South Africa's future role in its own continent and the world, its scientists are enjoying being part of the community once again. "Now we are in a new era. It is a wonderful rich experience," says Tobias. And some old wounds from the past are being healed: The next World Archeological Congress is due to take place in Cape Town in 1999. Says University of Southampton archaeologist Julian Thomas, current secretary of the WAC, "It seemed appropriate."

–D.C.

Accelerator Center: National Symbol or White Elephant?

CAPE TOWN—As South Africa's new government tries to figure out how to adapt an elite research enterprise to the needs of a developing African nation, it faces a difficult decision: what to do with the National Accelerator Center (NAC). This facility, home to a state-of-the-art 200-megaelectron-volt proton cyclotron completed less than 10 years ago, carries out nuclear physics research, conducts proton and neutron beam cancer therapy, and creates radioisotopes for medical use. The problem is that it takes up a hefty chunk of South Africa's total spending on science, and many researchers are arguing that it is an unaffordable luxury. "The budget of the NAC is large compared to its output," says E. Zingu, head of physics at the University of the Western Cape. Others agree: "I find it almost impossible to defend. ... There is no academic justification," says structural chemist Jan Boeyens of the University of Witwatersrand in Johannesburg.



NATIONAL ACCELERATOR CENTER

Multipurpose lab. NAC conducts physics research and cancer therapy and makes medical radioisotopes.

The facility's proponents spent 20 years lobbying to get it built and now argue that the NAC is a world-class center of which South Africa should be proud. They point to its multiple uses and the fact that the more than 30 hospitals which it supplies with short-lived radioisotopes would find it difficult to get them from overseas. During the academic year 1993–94, the NAC accommodated some 230 scientific users, including 34 overseas researchers. Moreover, says NAC Deputy Director Steve Mills, "The NAC makes students aware of science and technology, and you shouldn't take that away from those people. It excites people in a country where there are few such things."

These attributes come with a hefty price tag, however. The NAC's current annual budget is $9.5 million, which is set by the government and managed by the Foundation for Research Development (FRD), its basic research funding body. Opponents are quick to compare this with the $24 million the FRD spends on university research. Yet the two figures are not directly comparable—60% of the NAC budget is spent on salaries, whereas academic salaries are paid by universities. Nevertheless, an influential 1993 report on South African science by the Ottawa-based International Development Research Center was scathing: "No country with the huge educational backlog faced by South Africa should perpetrate this misallocation of very scarce resources."

Some observers believe there is more to the opposition to the NAC than just concern about the cost. In March 1993 it was revealed that South Africa's Atomic Energy Corporation (AEC) had developed nuclear weapons during the 1970s and 1980s. While the country's seven warheads were scrapped in 1989 as the Cold War ended, the revelation cast a shadow over all of nuclear physics, even the basic research carried out at the NAC. "When the bombmaking of AEC was exposed, it was linked to all nuclear physics, and the NAC was criticized. It made people very suspicious of the rest of physics," says Zingu. "The government needed to train nuclear scientists and so built the NAC. There is little scientific logic in the whole operation," adds Boeyens.

If the NAC is scrapped, however, there is no guarantee that the money will be spent on science. "It wouldn't necessarily go to the science [budget]. The capital is spent and can't be recovered. [The debate] is a distraction," says Friedel Sellschop, deputy vice chancellor for research at the University of Witwatersrand. "It is there. We should give physicists 5 years to show what can be done, then ask if the quality and importance warrants the expenditure," he adds. Says FRD President Reinhard Arndt: "The threat is there. It is a pity if the scientific community doesn't take ownership [of the NAC] and be proud of it."

The final decision on the project's future lies with the government, which is currently scrutinizing every item of the budget for its contribution to solving problems of poverty and inequality. Physicist Roger Jardine, the director general of the Department of Arts, Culture, Science, and Technology, is expected to make the final recommendation. "We need to address the problem of the NAC, to take the bull by the horns," he told *Science*. "We need to find a way to keep it, but with a reduced government share." Like other big science facilities, such as the ill-fated U.S. Superconducting Super Collider, the NAC's future may well depend on its ability to find outside sources of funds.

–D.C.

general—the top executive position—of the Department of Arts, Culture, Science, and Technology (DACST).

But the new department has been slow to get moving and lay down concrete policies. As a result, most of the change so far has come from the grassroots, from the scientific community. "There has been a culture change—individuals chose to shift," says University of Cape Town (UCT) oceanographer Geoff Brundritt. To many researchers, it has been obvious for some years that pursuing science for science's sake could not continue. "We are looking to move into more relevant areas, such as photovoltaic cells [for solar power] and thin film protective coatings against corrosion and wear. We looked carefully at the areas we covered and changed early," says E. Zingu, head of physics at UWC. Jennifer Thomson, head of UCT's microbiology department, has been trying to genetically alter maize to make it immune to maize streak virus. "It's endemic in Africa, a real killer," she says.

Some of South Africa's research councils also got moving early. Take the long transformation in the CSIR, which operates a collection of labs on a campus just outside Pretoria. The labs used to be organized according to traditional academic disciplines, much like multipurpose national labs in the United States. But in the late 1980s, Brian Clark, then president of the CSIR, completely overhauled the organization, cutting more than 2000 jobs and reorienting its work toward industrial applications in areas such as food processing, mining, forestry, microelectronics, and construction. As a result, CSIR has attracted a huge increase in contracts from the private sector—private funds now make up 60% of its total income—while its total government support has remained constant.

Yet, in spite of this achievement, the IDRC panel argued for more. "If [CSIR] had been in a First World country, I would have said it had made an amazing turnaround—a remarkable change for a traditional science organization," says Mullin. But the IDRC report said CSIR was still a white-dominated organization that was more comfortable dealing with big companies. "It did not understand

the needs of small and microenterprises and the black communities," says Mullin.

In response, the CSIR undertook an internal review in 1993 and identified "technology for development" as one of its major goals, moving into areas such as building techniques for low-cost housing and equipment packages to set up sawmilling businesses and bakeries. "We've moved from 10% to 23% development work in the past 2 years and plan to increase more," says Moikangoa. But the organization has a long way to go to erase its past associations, he adds: "It is a problem that [the CSIR] was once so connected to apartheid. People ask how could it have changed so much?"

Basic reforms

In addition to the CSIR, the four councils that fund research and development in medicine, agriculture, mineral technology, and human sciences are all shifting resources into projects designed to benefit the majority of the population. Witwatersrand's Makgoba, who chairs the board of the Medical Research Council, says it is aiming for a program driven by first-class science, but in areas more relevant to the major health problems of South Africa. "No one can do everything—we must find a niche," he says. But the transformation which most basic researchers are nervously awaiting is that of the Foundation for Research Development (FRD), a unique government body that has been a major sponsor of South Africa's best academic researchers.

The FRD was established in 1984, at that time as a division of the CSIR, to carry out an unabashedly elitist plan proposed by mathematician Jack De Wet, retired dean of science at UCT. De Wet suggested that all university researchers be assessed by international subject panels of scientists. Those deemed to be world leaders in their field would be given a grade A; those with international standing would get a B; and those without a significant international reputation, a C. Researchers would then be given 5-year grants based on their rating to do whatever research they wanted. The work you produced determined whether your grant would be renewed or your rating upgraded.

The plan caught the imagination of the government, and the FRD's budget was increased almost 10-fold over the next 3 years. This and the academic freedom created by the scheme are credited with giving South African research a much-needed shot in the arm. "There has been a tremendous renaissance in 10 years," says FRD Vice President Khotso Mokhele. And although some scientists complain that the system favored white universities and encouraged the isolation of science from the country's social and industrial problems, most researchers welcomed the no-strings approach to funding. "Scientists were able to get on with their work. They were not all the time filling in forms," says UCT mathematician George Ellis, president of the Royal Society of South Africa.

The system is about to undergo fundamental changes. Later this month, FRD will announce a set of programs, to begin in January, that will reflect the priorities of the new South Africa. The FRD began to move in this direction when it was made independent of the CSIR in 1990, within a few months of then-President F. W. De Klerk's dramatic announcement that the ANC and the South African Communist Party would no longer be banned and that Nelson Mandela would be freed. The FRD soon put money into improving science teaching in high schools and launched a program to help the black universities develop a culture of research so they could compete more effectively for grant money.

The next step will be far more radical. "All existing programs will be terminated, although some will continue in kind," says FRD President Reinhard Arndt. Researchers got a whiff of what is coming last year when the FRD circulated for comment a draft document in which it laid out a plan to channel some of its funds into high-priority areas. Last December, the FRD sent out a request for ideas for new, directed research programs, and in March it distributed a final version of the document to 2000 academics. About 500 suggestions for programs were eventually received, and FRD administrators are still amalgamating and whittling them down to a manageable number.

Under the new scheme, all potential grantholders will still be assessed and rated, but as well as international reputation the panels will look at industrial collaboration, postgraduate teaching, administration loads, and "corrective actions" against the legacy of apartheid, such as collaborating with a historically black university. Researchers can then apply either for an "open" research grant to follow whatever studies they want, or submit a proposal to a directed program where their level of funding will be set according to their rating and the quality of the proposal.

The new directed themes range from appropriate curriculum development, through marine and coastal resources, to materials for manufacturing, and all programs must incorporate three elements: internationally competitive research, corrective actions, and cooperation with industry. Arndt estimates that 40% of FRD's funds will be spent on directed themes initially, and these will eventually claim half the budget.

For university researchers who were comfortable under the previous system, these moves are creating considerable unease. "These are not beneficial changes at all," says structural chemist Jan Boeyens of the University of Witwatersrand. "The FRD is pouring money into education and taking it away from basic science," complains Vernon Coyne, a microbiologist at UCT. British chemist Robin Clark of University College London, who recently visited South Africa as part of a delegation from Britain's Royal Society, bemoans the changes: "It's becoming too narrowly focused, concentrating on very short-term payback rather than a broad technology base. I'm disappointed. It's restricting what people can do."

Most researchers realize that these shifts are inevitable, however. "Science has been too divorced. Personally I have a kind of academic snobbery against applied research, but it is wrong scientifically and politically. We need to make science more relevant," concedes Ellis. "Research must benefit the country. Relevance is important: You can't do research just for the hell of it," says UWC physiologist G. Maritz.

SOUTH AFRICA'S MOST CITED PAPERS (1981–94)

1. F. Azam, T. Fenschel, J. G. Field, J. S. Gray, L. A. Meyerreil, F. Thingstad, "The ecological role of water-column microbes in the sea," *Marine Ecology—Progress Series* **10**, 257 (1983).
   Cites: 685 ■ Institutions: Scripps Inst. Oceanog., Aarhuis Univ., **Univ. of Cape Town**, Univ. of Oslo, Univ. of Kiel, and Univ. of Bergen
2. D. A. Shafritz, D. Shouval, H. I. Sherman, S. J. Hadziyannis, M. C. Kew, "Integration of hepatitis-B virus-DNA into the genome of liver-cells in chronic liver-disease and hepatitis cellular-carcinoma," *N. Engl. J. Med.* **305**, 1067 (1981).
   Cites: 421 ■ Institutions: Albert Einstein Coll. Med., **Univ. of Witwatersrand**, Hippokration Gen. Hosp.
3. B. Bressac, M. Kew, J. Wands, M. Ozturk, "Selective G-mutation to T-mutation of *p53* gene in hepatocellular carcinoma from Southern Africa," *Nature* **350**, 429 (1991).
   Cites: 375 ■ Institutions: Massachusetts General Hosp., **Univ. of Witwatersrand**
4. S. J. Gould and E. S. Vrba, "Exaptation—A missing term in the science of form," *Paleobiology* **8**, 4 (1982).
   Cites: 360 ■ Institutions: Harvard Univ., **Transvaal Museum**
5. J. Terblanche, D. Kahn, J.A.H. Campbell, P. C. Borman, M.A.T. Konker, J. Wright, R. Kirscher, "Failure of repeated injection scleropathy to improve long-term survival after esophageal variceal bleeding—a 5-year prospective controlled clinical trial," *Lancet* **2**, 1328 (1983).
   Cites: 260 ■ Institutions: **Groote Schuur Hosp. and Univ. of Cape Town**

SOURCE: INSTITUTE FOR SCIENTIFIC INFORMATION

Marine Scientists Take the Lead From Those in Need

CAPE TOWN—South Africa's marine scientists have taken the initiative in trying to reorient their work to fit the nation's new priorities. They are now well into the first year of a research program that has the dual aim of developing the natural resources of South Africa's coastline for the benefit of coastal communities and boosting research in historically black universities. "We had the foresight to develop a program that would address the needs of a new South Africa," says program coordinator Roger Krohn of the Foundation for Research Development (FRD), the government's basic research funding body.

The inspiration for the Sea and the Coast Program originally came from the FRD and the Department of Environmental Affairs and Tourism (DEAT). They realized that managing and researching marine resources affected many people's lives, and their traditional top-down approach was too autocratic. So they enlisted the help of the South African Network for Coastal and Oceanic Research (SANCOR)—an independent body representing 58 organizations involved in marine science, engineering, and technology. SANCOR put together some proposals for areas of research and then consulted both coastal communities and marine scientists. "We got a strong 'yes' signal," says Krohn.

The program was divided into areas such as inshore and offshore fisheries, ecotourism, oceanography and climate, mineral exploration, and aquaculture. A call for proposals was sent out to researchers, and more than 80 ideas were submitted, such as assessing pollution impact, managing beaches, and setting up small plants for canning anchovies. These were refereed and rated by academics as well as by policy-makers from the African National Congress (ANC) and community representatives. "We wanted to find research we knew people wanted. It was a little incestuous in that it came from within the marine science community, but we identified good projects and it was a good way to do it," says marine microbiologist Vernon Coyne of the University of Cape Town.

Details were announced last year, one month before the new government launched the Reconstruction and Development Program, its 5-year plan to fight poverty. The aims of the two documents "fitted like a hand in a glove," says Krohn. The program was launched in January with funding of $1 million, mostly from DEAT and FRD. This has allowed SANCOR to begin about 40 projects, each set to last up to 5 years.

The program is generally considered a model of how South African research should be planned and coordinated, but its future is still somewhat precarious. SANCOR has been looking for other sources of funding, but so far with little success. "We got a disappointing response from nongovernment funders," says Coyne. "No one has leapt forward and given us millions of rand, but we hope they will soon," says Krohn. And over the past year, the FRD has distanced itself from the program. The foundation is reforming its own research programs, and it is unsure how SANCOR's program will fit in. "There is an in-house debate," says FRD President Reinhard Arndt. "[SANCOR's program] is a national effort involving various players ... [and] the FRD is only one player. We cannot decide on its future, and our contribution will depend on its competitiveness against other programs."

The FRD's new programs are due to be announced later this month, and South Africa's marine scientists are hoping they will not regret being the groundbreakers. Says University of Cape Town oceanographer Geoff Brundritt, "It will be an acid test if it survives."

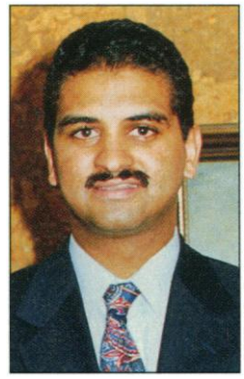
–D.C.

Friction at the top

While the research councils are moving quickly to overhaul their programs, overall government policies for research have been slower to emerge during this radical transformation. The minister in charge of the new DACST, Ben Ngubane, has been given high marks by the scientific establishment. "I'm very positive about Ngubane. He is listening," says Ellis. But the department did not make much of an early impact. Its 1995–96 budget, for example, was cut by 4% from the previous year in real terms, while on average across all government departments there was no change.

Many point to the fact that Ngubane is a member of the Inkatha Freedom Party, while his appointed deputy, Winnie Mandela, was from the ANC. "Other ministries got moving, but there was conflict at the DACST between Inkatha and the ANC," says Colin Johnson, dean of science at UWC. Mandela was fired from the government in April and replaced with lawyer Brigitte Mabandla, also of the ANC. "Maybe with Winnie gone [things] will improve," says Johnson.

Another positive sign was the appointment earlier this year of Jardine as director general of the DACST, after the post had been vacant for months. "It's true we got off to a late start, but we are making up time," he says. Jardine began working on a research policy for the new South Africa in 1992 at the request of the ANC. He quickly put together a discussion forum which, Mullin says, "brought institution directors face-to-face with members of the Democratic Movement." Jardine also won a commitment from the ANC that research would be more central to the policies of a future democratic government.



DEPT. OF ARTS, CULTURE, SCIENCE, AND TECHNOLOGY

In the hot seat. Science official Roger Jardine.

Now Jardine is in a key position to ensure that the commitment is kept. The department is working on a white paper on research policy, to be published in a few months' time, and is planning a technology foresight program similar to the one carried out in the United Kingdom. For Ngubane and Jardine, the crucial test will come later this year when the 1996–97 budget is put together. It will be the first budget to be formulated by the new government from scratch, and all departments are expected to adhere to the policies of the RDP, a 5-year plan aimed at fighting poverty and fostering growth. "[The RDP] is one whopping technology policy document. There is not a single issue in it you can separate from technology issues," says Jardine.

In a sobering address to researchers at a science policy conference in April, Fanaroff of the RDP department said: "There is a commitment from Cabinet to high-level skills. They will expect you to define what science and technology is needed for economic development. Science is still in competition with everyone else for resources." And scientists realize that there is more at stake than just the future of science. The Government of National Unity is itself on trial: If it does not improve conditions for the disadvantaged majority before the next election, that highly politicized body may elect a very different government next time. "We have a window of 5 years to change the composition of the work force, or we could lose our democratic system," says Arndt. Says CSIR's Moikangoa, "Things are mending quite rapidly, but there is so much at stake: Any mistake could have incalculable consequences."

–Daniel Clery