FROM APARTHEID TO DEVELOPMENT: SCIENCE POLICY AND THE POLITICS OF RACE IN SOUTH AFRICA

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Opsomming

Toe die ANC aan die bewind gekom het, het hulle 'n nuwe wetenskapsbeleid aangekondig wat verbind is tot gemeenskaplike ontwikkeling. Voorstanders het beswaar gemaak dat navorsing voorheen voortgedryf is deur blanke belange, vermom as "objektiewe" wetenskap, en dat dit net blanke voorregte, rassediskriminasie en etniese skeiding bevorder het. Hierdie artikel beweer dat die waarheid egter meer gekompliseerd is. Alhoewel party wetenskaplikes moontlik wel in bewindsverbonde velde gewerk het en in die eerste dekades van die eeu rassistiese teorieë bevorder het wat die opkoms van apartheid bevorder het, het die meeste wetenskaplikes in die apartheidsjare hulle werk as "apolities" beskou. Teen 1994 het die Suid-Afrikaanse wetenskap ongetwyfeld heelwat probleme in die gesig gestaar, sommige wel voortspruitend uit die nalatenskap van apartheid. Maar die regering het nie gewoonlik navorsing uitsluitlik vir blankes bevorder nie. Die enkele opvallende voorbeelde van die misbruik van die wetenskap vir die doeleindes van die apartheidsregering was toenemend hoogs geheime projekte. Amptelike dokumente in die Botha- en post-apartheidsjare vertoon 'n verbasende bestendigheid aangaande die mees doeltreffende gebruik van beperkte staatshulpbronne, vir toegepaste eerder as suiwer navorsing, en tot voordeel van die hele gemeenskap, dikwels met spesiale verwysing na die lot van minderbevoorregte groepe. Die beleidsmakers onder die ou stelsel het reeds baie gemeende probleme in die wetenskapsbeleid erken, en baie haakplekke sal waarskynlik nog steeds voortduur - ook onder 'n meerderheidsregering.

Introduction

This paper is a collaborative effort by a historian specializing in South African politics and a natural scientist with an interest in South African affairs. The role of scientists, like that of the entire old "white" establishment in pre-1994 South Africa, has attracted much criticism in recent years. Many aspects of the controversial relationship between the state and natural science in the transition from apartheid to majority rule remain to be explored. Nevertheless, we believe that we can offer some tentative conclusions about the complex nature of this relationship, with special reference to the question of the impact of race politics on the shaping of science policy. As will become clear below, these conclusions turned out to contradict much of what we had expected to find.

Simplistic rhetoric versus complex reality

Nelson Mandela's African National Congress-led government has sponsored a much touted science policy geared explicitly to development and innovation. This policy attempts to overcome what the 1996 government Green Paper on science and technology described as "the absence of any new direction for SET [Science, Engineering and Technology], following the eroding of mission driven [research and development] associated with securing economic and military resources for the pre-1990... state."[1]

Some ANC-aligned promoters angered scientists by charging that previous research was at best ivory tower theoretical work driven by elite white interests, dressed up as "objective" science, and at worst promoted white privilege and a racist state. At the 1993 ANC Conference on Science and Technology, Andile Ngcaba, of the ANC Department of Communication, denounced technology in South Africa (and, by implication, science) for never having been "neutral" and for serving as the means of "recolonisation."[2] In the words of the Green Paper, SET "played a strong role, particularly by means of military technology, in helping to enforce the previous regime's policies."[3] These critics' demands for an approach geared more explicitly to applied development needs has generated controversy among scientists. By 1994, the year of the first non-racial elections, Isaac Amuah, science policy advisor to the government's Foundation for Research and Development and a leading critic himself, conceded that there was "seething anxiety" over "the possible loss of research excellence, or the sacrifice of basic science to applied fields."[4]

We argue below that, even though the critics of "traditional" South African science address significant issues requiring urgent attention, we should not over-simplify the complex role that South African scientists, especially natural scientists, have played, especially from the 1980s to 1994. We had originally planned to trace what we imagined was a fairly straightforward trajectory from a science openly serving the interests of apartheid in particular and whites in general to a more democratic and "national" model. The evidence we found conformed only in part to the image we had gleaned from reading the critics' assessment.

[1] Http://wn.apc.org/technology/toc.htm, Republic of South Africa, Department of Arts, Culture, Science and Technology, "Green Paper on Science and Technology; Preparing for the 21st Century", 1996, par. 1.1

[2] See M. Mphahlele and M. Kahn, (eds), *Proceedings of the ANC Conference on Science and Technology* (Johannesburg, September 1993), p. 35.

[3] Department of Arts, Culture , Science and Technology, "Green paper on Science and Technology", Introduction to Chapter 11.

[4] Isaac Amuah, *Science and Technology policy for the New South Africa: A rational perspective on using science and technology to leverage national economic development* (Pretoria: Foundation for Research Development Report series, no. 5, August 1994), p. 11.

Home scientists certainly willingly served the interests of the apartheid state, even in terrifying ways such as at the secret Roodeplaat Laboratory made public before the Truth and Reconciliation Commission, and some worked in nuclear and other weaponry programs, which took up far too great a proportion of government funds. Some early twentieth century South African scientists also undoubtedly promoted spurious racist theories which undergirded the rise of apartheid. Some scientists, however, surely found comfort believing that their work was above politics: a mission from Canada observed that many tried to absolve themselves of "any responsibility for the policies which their activities served" by rationalizing that scientific and technological developments were apolitical.[5] But such a criticism could just as readily be made of federally-funded American "big science."

We concluded that in the apartheid era most natural scientists in South Africa, other than those involved in explicitly regime-linked projects in areas such as defence, were indeed largely justified in viewing their work as apolitical, and in the broadly defined national interest. While the state intruded into most sectors of society, notably during the "total strategy" era from the 1970s, it is easy to understand why natural scientists in particular felt relatively immune to government pressure as they worked in the comparative isolation of their laboratories. This was obviously more true in the universities than the science councils, which were subject to considerable government micro-management until the adoption of "framework autonomy" in 1987.

Nor did we find evidence that the regime routinely promoted officially sanctioned natural science research (even that conducted by government-funded science councils such as the Council for Scientific and Industrial Research and the Medical Research Council) exclusively for whites. Admittedly, defence-oriented research in effect amounted to this.[6] The few striking examples of abusing science (sometimes with state funds) to bolster racist theories and attack government foes were covert in nature and did not represent the main thrust of scientific research.

We were very surprised to reach such conclusions. We had assumed that official documents on the science councils and overall science policy would show some explicit connection with the interests of the apartheid state, whose masters were rarely reluctant

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[5] Thomas G. Whiston, *Research policy in the Higher Education sector of South Africa*, Science and Technology policy series no. 3 (Pretoria: Directorate for Science and Technology policy, FRD, 1994), p. 221.

[6] Even in the Botha "Total Strategy" era, most of the thirty-two institutes of the CSIR worked on mundane matters such as improving nutrition, fisheries and timber, water quality, road and housing construction, and natural fibre and leather processing. A few worked in areas clearly related to overcoming sanctions, such as the development of synthetic materials as import-substitutes, and some institutes, such as the National Accelerator Centre, were likely involved in defence work in addition to their main public tasks. See *The CSIR in a nutshell* (Pretoria: Council for Scientific and Industrial Research, ca. 1986).

(except on security and defence issues) to show their hand in so many other matters. Yet, official documents in the Botha and post-apartheid eras show surprising continuity on using limited state resources to best effect, for applied rather than pure research, and, in most cases, to benefit the whole community.[7]

Ironically enough, when there was a clearly stated focus on one section of the population in the apartheid era, it most often seemed to be to "uplift" the black community (for instance in areas such as housing and nutrition). The chief change in recent years has been an insistence that research priorities be determined not by paternalistic white elites, but by a dialogue between scientists, state officials and community leaders, so as to empower the underprivileged and involve them in delivering the benefits of science and technology. But the principle of serving the interests of the broader community was well established before 1994, at least in theory.

South African science in crisis

The process of democratic transformation since the end of apartheid has gradually extended to ever more spheres of South African life, and the natural sciences have not been exempt from this process. Scientists themselves became increasingly aware during the transitional period of the early 1990s that South Africa was falling behind in research and in science education, and that an enormous challenge faced them if they were to overcome the *de facto* exclusion of the black majority from full involvement in the world of science and technology.[8]

Huge inequities existed. Only one out of 312 African pupils who entered school in 1980 had by 1991 graduated from high school with university entrance-level mathematics and physical science as subjects, the prerequisite for most careers in the physical sciences and engineering. The comparable figures for white pupils were one in five, for Indians one out of six, and for mixed race "Coloured" pupils one out of forty-six.[9]

There were massive gaps between the quality of scientific research at the better historically white universities, such as Cape Town and the Witwatersrand, and that at the

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[7] In the mid 1980s the CSIR Foundation for Research Development, which funded cooperative research with universities, technikons and government departments, supported national programs almost exclusively in applied areas, including marine pollution and the ecology of the Benguela current system, environmental sciences, renewable feedstocks, waste management, energy technology, aquaculture, climate research, and biotechnology. *Ibid.*, p. 10.

[8] See for instance George F Ellis's full-length study *Science Research policy in South Africa: A discussion document for the Royal Society of South Africa* (Cape Town, 1994).

[9] Figures from *South African Statistics 1988* (Pretoria: Central Statistical Service 1988) and Department of National Education, Pretoria, cited in William Blankley, "The abyss in African school education in South Africa", *South African Journal of Science*, 90, 2 (February 1994), p. 54.

historically black universities (HBUs). In 1992 only 5% of papers in journals covered by the *Science Citation Index* were from HBUs; 73% came from the top historically white institutions.[10] In a country where whites are less than 13% of the population, this imbalance was intimately linked to the effects of apartheid, and before that, segregation, on research and education at all levels.

At the same time, serious questions arose even about the quality of "white science" in terms of adequacy of funding, the direction of research, and the quality of education of whites for the next century. By 1995 South African per capita research and development funding had fallen to one tenth of that in Australia and one fortieth of that in the United States.[11] By the early 1990s, in contrast with most industrialized countries, which provided 80% of university funds from the public sector, the South African public sector funded only 55% of university income.[12] The share of the state budget assigned to tertiary education fell from 28% to 24% between 1988 and 1993, to accommodate increased needs at the elementary and secondary levels. While the share of South African publications listed by the Institute for Scientific Information's indexes had increased in social science and humanities, it had dropped in the natural sciences and engineering. In a parallel development, 1992 data showed that whites received 56% of degrees granted that year in the social sciences and humanities, but these in turn were 39,400 out of 48,500 degrees conferred by South African universities.[13] In addition, gender imbalances were such that in undergraduate engineering programs only one in thirteen students was female.[14] All these areas of imbalance clearly affected the total number of practising scientists.

Critics also complained that even those involved in high quality research often did not make the necessary links to applied technology: the quasi-state Foundation for Research and Development supported world-class university research in terrestrial ecology, but there was little follow-through to farmers, rangeland managers and rural communities;

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[10] *SA Science and Technology indicators 1993* (Pretoria: Foundation for research and development, 1993), cited in Editorial, "Yes, but what about the facts?"; *South African Journal of Science*, 92, 1 (September 1995), p. 416.

[11] "The Green Paper on Science and Technology: The future is not what it used to be", *South African Journal of Science*, 92, 1 (January 1996), p. 2.

[12] Whiston, *Research policy, p. 12.*

[13] Editorial, "Yes, but what about the facts?", *South African Journal of Science*, 91, 9 (September 1995), p. 416, citing data from *SA Science and Technology indicators 1993* and The Education Foundation, Johannesburg, 1995.

[14] "Green Paper on Science and Technology", par. 8.2.3.

similar problems were experienced with narrowly-focussed agricultural research.[15] Isaac Amuah argued:

> We must face the fact that the religion of science is a costly diversion; indeed, too costly for the new nation. The big science which has characterised the twentieth century has been impelled largely by national need, and negligibly by service to the rest of humanity... If there is a lesson in this, it is the need to remove illusions about big science for a democratic South Africa. This would be accompanied by the realisation that high technology research in South Africa to date has been dictated by pragmatic and survival needs...[16]

For post-apartheid policymakers, these issues were profoundly linked to the way in which science had cohabited with the old regime. Amuah warned angrily that any future science policy would have to "discourage the unthinking equation of science with white, with the implicit reduction, given the country's history, of non-science with non-white."[17] The ANC government therefore put its weight behind an exploratory "Green Paper", leading via an official "White Paper" to a new science policy. The new policy-makers stressed the novelty of such a concept, as the state sought to develop a centralized, coordinated policy involving all stake-holders (not just traditional ones such as industry, the universities and the science councils), and seeking maximal input from the public by commentary on the Green Paper.[18] The outcome was a White Paper which embraced as a "radical departure from the current situation" the creation of a "National System of Innovation" geared to using the outputs of science and technology for "promoting competitiveness and employment creation," "developing human resources" and "enhancing quality of life."[19]

Both implicitly and explicitly scientists were attacked in the Green Paper as aiders and abetters of the old order: it was not just that state funding for research and development was inadequate for future growth and had actually dropped in the previous seven years, but that scientists' output, relative to resources, was inadequate. The reformers charged that science had been organized in a fragmented and uncoordinated way which rarely translated ivory tower research into effective technology useful to ordinary people. Too

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[15] Editorial, "New directions for research funding", *South African Journal of Science*, 91, 1 (January 1995), p. 2.

[16] Amuah, *Science and Technology policy*, p. 22.

[17] Amuah, *Science and Technology policy*, p. 27.

[18] Editorial, "The Green Paper on Science and Technology: The future is not what it used to be", *South African Journal of Science*, 92, 1 (January 1996), p. 2.

[19] See http://www.polity.org.za/govdocs/white_papers/scitech.html, Department of Arts, Culture, Science and Technology, "White Paper on Science and Technology: Preparing for the 21st Century", (1996), par. 1.1, 1.3 and 2.1.

many government sector resources, they alleged, had been devoted to narrow purposes such as defence or the nuclear program "with negligible benefits for the civilian population"; scientists served the business sector better than they did social needs. Benefits had to be maximized and redirected "to the population at large instead of to a minority", and policy decision-making had to be more inclusive and consultative. Above all, human resources had been grossly neglected, leading to a white stranglehold on the science and technology establishment.[20]

Science as the handmaiden of the apartheid state

Such charges were in some ways confirmed by the allegations before the Truth and Reconciliation Commission that secret government-funded laboratories had engaged in bizarre research schemes. These involved developing poisons to dispose of enemies of the National Party regime, breeding killer wolf-dogs for the army, using illegal drugs for crowd control, and even some preliminary discussion of reducing black fertility.[21]

Following the imposition of international sanctions on exporting armaments to South Africa, some scientists were also involved in developing an indigenous arms industry, which included anti-insurgent ground vehicles and long-range artillery such as that exported to Iraq. By 1974 South Africa had established a testing site for a nuclear bomb and, with Israeli scientists' help, built at least six nuclear devices in succeeding years. In the early 1980s Armscor, the state armaments agency, announced that it had engineered an intermediate range missile system, and the development of long-range missiles followed. Such large-scale projects necessarily drew in many of South Africa's best and brightest, who were therefore not available for more humane projects.[22]

In addition, there was the medical profession played an ambivalent role under apartheid. It did not discipline doctors who covered up torture and murder of detainees. After the police murder of Steve Biko, the South African Medical and Dental Council took action only after the Supreme Court, responding to public outrage, demanded a more serious response. The Truth and Reconciliation Commission noted that medical faculties had failed to denounce with any vigour the impact of apartheid on medical practice, gave

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[20] "Green Paper on Science and Technology", Introduction to Chapter 11; see also par. 1.1, 2.3 and 2.5.

[21] See "Special investigation: Chemical and biological warfare" in Charles Villa-Vicencio, Susan de Villiers *et al*, (eds), *Truth and Reconciliation Commission of South Africa, Report volume two* (Cape Town: Truth and Reconciliation Commission, 1998), pp. 511-523; See also David Beresford, "Apartheid's Lab Rats under the microscope", *Mail and Guardian,* 12-18 June 1998, p. 10.

[22] Chris Alden, *Apartheids last stand: The rise and fall of the South African Security State* (New York, 1996), pp. 118-119.

inadequate attention to teaching ethics and human rights, and discriminated against the few black students allowed to attend the superior medical schools reserved for whites.[23]

In an earlier era, scientists had helped promote explicitly racist doctrines by misusing intelligence tests, supporting eugenic programs premised on the belief that blacks were biologically inferior to whites, and still earlier supported phrenology and comparative anatomy" programs that inferred racial superiority from supposed physical differences between groups.[24] The English-speaking establishment abandoned such ideas as early as the 1930s, and they were thoroughly discredited by the experience of Nazism and the Holocaust. At least some prominent Afrikaner intellectuals, however, such as the geneticist Gerrie Eloff and the criminologist Geoffrey Cronjé, held on to aspects of such beliefs through the 1940s, and these academics (especially Cronjé) were important in providing the intellectual undergirding for rejecting earlier *ad hoc* segregationist measures in favour of a more systematic apartheid model. While overt references to biological racism largely disappeared in the 1950s, pro-government academics still used euphemisms such as "cultural differences" to justify backing apartheid, and considered these well-grounded in "science." As late as 1955 the government-appointed Tomlinson Commission, which produced a plan to update apartheid by developing the African reserves as "homelands", assumed biological differentiation as a justification for apartheid. The commission thought apartheid essential to avoid "biological assimilation."[25]

Toward a middle ground

Despite this heritage, science for the most part abandoned its fascination with racial difference after the Second World War, and this was no less true in South Africa than elsewhere, even if somewhat slower. Those who engaged in craniology, racist use of intelligence tests or promoting eugenics were now on the fringe.[26]

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[23] J. van Heerden, "The meaning of the MASA apology", *South African Medical Journal*, 86, 6 (June 1996), pp. 656-660; "Institutional hearing: The Health Sector", in Villa-Vicencio and De Villiers *et al*, *Truth and Reconciliation Commission Report, volume four*, pp. 109-157.

[24] Paul B. Rich, *Hope and despair: English-speaking intellectuals and South African politics 1896-1976* (London and New York, 1993), pp. 13-39; and the detailed study by Saul Dubow, *Illicit Union: Scientific racism in modern South Africa* (Johannesburg, 1995). See also Andrew Bank, "Of 'Native skulls' and 'Noble Caucasians': Phrenology in colonial South Africa", *Journal of Southern African Studies*, 22, 3 (September 1996), pp. 347-404; and Suanne Klausen, "'For the sake of the race': Eugenic discourses of feeblemindedness and motherhood in the *South African Medical Record*, 1903-1926", *Journal of Southern African Studies*, 23,1 (March 1997), pp. 27-50.

[25] Dubow, *Illicit Union*, pp. 270-280.

[26] Rich, *Hope and despair*, pp. 35-36; and Dubow, *Illicit Union*, pp. 288-289.

Even in the heyday of apartheid, the rhetoric of legislation relating to the science councils, for instance, made no mention of race or serving narrow political purposes.[27] If anything, it could be argued that much research in this period was geared to enhancing the health and work opportunities of the black majority. In the 1950s paternalism underlay the research of the (CSIR), then the main government-funded research institution. The interests of private industry and bureaucratic efficiency were important in motivating the development of batteries of aptitude tests to determine selection of the most "suitable" African workers for particular tasks in the private sector and the civil service.[28] The mindset of "separate development" surely contributed to a project to improve "the intellectual potentialities of Africans, given favourable environmental conditions for their development," particularly via improving mothers' nutrition during pregnancy and breastfeeding.[29] Better nutrition would also indirectly have improved worker productivity.

But it is hard to see malevolent intent in projects investigating ways to improve the nutritional value of sorghum beer, a staple in many Africans' diet, in using fishmeal to increase protein content in the carbohydrate-heavy diet of most South Africans, or in enhancing the shelf life of milk through intensive heat treatment that retained nutritional value.[30] Ironically, in the post-apartheid environment, stripped of the earlier paternalistic language, most of these projects would be considered admirable schemes to enhance human potential.

Despite the diabolical projects of the Roodeplaat and associated laboratories, there is no evidence at this point that such schemes were widespread. The shock which met these revelations demonstrates how covert they had been: this had not found its way into the parliamentary debates or even the press of the immediate post-apartheid era. The "mad scientists" were part of the outer fringe of a regime whose servants turned to ever more desperate measures to fend off the day of majority rule; they were not typical of the South African scientific establishment as a whole.

Moreover, as science policy expert Anthipi Pouris pointed out at the time of the shift to majority rule, while earnest efforts were under way to rectify race and gender inequity in science, other weaknesses in South African science (ones which could not so easily be laid at the door of apartheid as a system). Topping his list were the retreat of government as a leader and funder of research and development, the decline of South African science

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[27] See for instance "Scientific Research Council Act in Republic of South Africa", *Statutes*, 1962, part 1 (Cape Town, Government printer, 1962), pp. 201-217. The only sense in which this Act is "political" is the inclusion of the former South West Africa within its provisions.

[28] See *Research in the service of Government and Industry: Some examples of research projects in the National Research laboratories of the South African CSIR* (Pretoria:CSIR, 1957), pp. 59 ff.

[29] *Research in service of Government and Industry,* pp. 53-54.

[30] *Research in service of Government and Industry,* pp. 55-58.

as indicated by the shrinking number of publications, and the neglect of high technology, as indicated by the deficit in this category in the balance of payments, and the tiny number of doctorates awarded by South African universities not only in science but in all fields.[31] Pouris suggested that, if not corrected soon, such deficiencies would undermine the longterm economic prospects for the country. Given the pressing need for the government to direct massive resources toward much more basic needs, such as housing, primary health care, law and order, and primary schooling, it is hard to see how any science policy, however promising in theory, could provide adequate solutions to these problems.

"Pure" versus "contextual" science

Perhaps the easiest criticism of South African science was not that it consorted with the apartheid state, but that it was too concerned with science for its own sake. As Foundation for Research Development president, R.R. Arndt, noted in his foreword to a 1994 FRD discussion document on a new science policy:

> The question of whose interests a science and technology policy for South Africa is designed to serve must be borne in mind. Is it to be a policy that defines projects for the scientific community to pursue, or will it examine the broad role of science and technology in terms of progress towards a more cultured, just and humane society?[32]

The CSIR, the grandparent of South Africa's science councils, was for many years directed to act within fairly narrow confines to promote the full use of natural resources, undertake or aid research advancing industry, aid collection and dissemination of information on scientific and technical matters, and certify standardization in precision scientific instruments. None of this was specifically to benefit whites. Developing human capital in a country with vastly unequal educational systems was at best only implicit in several clauses in the Act establishing the CSIR, directing it "to foster the training of research workers" and allowing for possible cooperation with other institutions to promote scientific education and training.[33]

In 1984, however, at the height of P.W. Botha's attempts to reform apartheid while retaining white control, it was surely no accident that language was added to an amending CSIR Act to include promoting "the productive capacity of [South Africa's] population."[34]

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[31] A. Pouris, "The deteriorating state of South African science", *South African Journal of Science*, 90, 6 (June 1994), pp. 310-311.

[32] Amuah, *Science and Technology policy*, p. 7.

[33] Scientific Research Council Act, Section 4 (1) (a), in Union of South Africa, *Statutes*, 1945 (Cape Town Government Printer, 1945), pp. 300-302.

[34] Scientific Research Council Act, Section 4 (1) (a), in Republic of South Africa, *Government Gazette* (Cape Town, Government Printer, 1984), no. 9309, 18 July 1984, p. 3.

The "total strategy" required maximizing productivity, but note the lack of any reference to any specific group: total strategy required at least an implicit shift to a more developmental and inclusive approach. Botha had made clear in his "blueprint" for reform, his 1979 Twelve Point Plan," that, while retaining the homelands and "vertical differentiation," he also sought "the removal of hurtful, unnecessary discriminatory measures" and "the recognition of economic interdependence and the properly planned utilization of our manpower."[35]

This approach was yet more evident in the updated science policy issued by the government's still Afrikaner-dominated Scientific Advisory Council in 1988. While another product of the Botha era, indicated in the surely sanctions-linked emphasis on the "ideal" of "greatest national self-sufficiency",[36] this document shows growing awareness of the changed "reform" environment for doing scientific research. Long before the post-apartheid Green Paper, there was already an explicit focus on development, even if in language with some conservative echoes of Christian nationalism: "The general aim is the planned development and use of science in the promotion of the material and spiritual welfare of all the inhabitants of the country."[37] Science policy had to "mesh with national aims and priorities so that it can back up the implementation of socio-economic development programmes...."[38]

The chief obstacle to translating such theory into practice, however, was that the socioeconomic reform and development advocated by proponents of "total strategy" as essential to undercut the advocates of revolution was always subject to and even contradicted by the constraints of the flipside of that strategy, the needs of "national security."[39] Such constraints, especially given budget limitations, meant that the promise of science policy reform was rarely realized in practice.

Science policymakers were not blind to the limits of a science geared to serving the white minority or to the realities of working in a country which was not a mere extension of Europe. In 1994 the FRD's new science policy advisor, Isaac Amuah, had declared that South African scientists had to stop thinking of South Africa as part of the First World, acknowledge that it was a developing country, and give attention to human resource

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[35] Alden, *Apartheids last stand,* p. 80.

[36] C.G. Coetzee, F.P. Groenewald and D.P. Visser, *The science policy and system of the Republic of South Africa* (Pretoria: Chief Directorate of Science Planning, Department of National Education, 1988), p. 3.

[37] Coetzee, Groenewald and Visser, *Science policy,* p. 3.

[38] Coetzee, Groenewald and Visser, *Science policy,* p. 3.

[39] Alden, *Apartheid's last stand,* pp. 6-9.

development.[40] Yet the 1988 science policy document already acknowledged the "dualistic development status" of South Africa and the need to develop "highly capable human resources," since South Africa needed to double its scientific personnel numbers, which were on a par with "Third World" countries. Most tellingly, the authors, even if using the official language of that era, observed that "Population groups other than Whites will necessarily have to make the biggest contribution in this regard."[41] Some might argue that they understated the challenges facing South African science, and held onto vestiges of the assumption that South Africa was at least in part, or should be, doing science as an advanced industrial country. Nevertheless, they clearly recognized the same central issues identified as significant weaknesses by the later critics of South African science.

Theoretical versus applied research

FRD President Arndt echoed a common criticism of apartheid era science when he asserted in 1994 that a new science policy "should be guided by the belief that the effectiveness of national science and technology can be considerably enhanced if its results find practical application wherever possible."[42] Isaac Amuah compared unfavourably 1994 data on research priorities in South Africa (20% basic, 43% applied, and only 37% explicitly developmental) with figures for Taiwan (11% basic, 38% applied and 51% explicitly developmental).[43] 1989/90 South African figures were even worse (47% basic, 41% applied and 12% developmental),[44] suggesting some improvement even in the De Klerk years.

Yet, leaving aside what is "applied" or "explicitly developmental," the emphasis on funding non-basic research is, ironically enough, a major area of continuity between the apartheid and post apartheid eras: from the 1980s through the late 1990s most state research grants in areas such as Sports Medicine and Kinesiology, for instance, went to more applied/developmental projects, in recognition of limited state resources.[45]

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[40] Amuah, *Science and technology policy*, p. 7.

[41] Amuah, *Science and technology policy*, pp. 3-4.

[42] Amuah, *Science and technology policy*, foreword, p. 7.

[43] Amuah, *Science and technology policy*, p. 19.

[44] Helen Perrold, (ed.), "Building the future: Science and technology education and training for economic development", in Mphahlele and Kahn, *ANC Conference on Science and Technology*, p. 54.

[45] Information from discussions with working scientists during visits to South Africa, July 1997 and July 1999.

A cursory perusal of Medical Research Council projects as far back as 1974 indicates that government-funded research even in the Vorster era had an applied focus geared to the specific needs of human development in the South African context. Projects at that time included work on diseases endemic in South Africa such as tuberculosis, diabetes, porphyria (including both varieties common among Afrikaners and black South Africans), and malnutrition. Other researchers worked on liver diseases particularly prevalent in South Africa, such as cancer and cirrhosis: some of the highest rates in the world were found among Africans in South Africa and inhabitants of the Western Cape, respectively. Other researchers were investigating occupational environmental hazards such as asbestosis and pneumoconiosis in miners, and the incidence of the toxic effect of metals used in industry.[46]

Interestingly too, despite the Green Paper criticism of a narrow focus on theoretical research, even in the 1945 CSIR Act there was specific provision for cooperation with educational authorities and scientific or technical societies in promoting the training of investigators in applied science, technical experts, and even craftsmen and skilled artisans.[47] If little came of this in practice, it was probably due more to lack of sufficient provision for funding in the Act and in subsequent amendments. In a South Africa faced by a vast array of much more basic competing human needs, this is a problem which will remain true in the future, however well-intended the new science policy may be.

Autonomy versus coordination

A final area of criticism has been that the old scientific establishment was hopelessly uncoordinated, with decisions too often taken by autonomous bodies, without reference to each other. By 1993 eight research councils, at least fifteen other government bodies, the universities and some large industries conducted research; in industry, however, this was on a much smaller scale than in most industrial countries.[48] ANC-aligned critics sought to locate decision-making on science and technology policy in central government and promote long-range planning through development of a five year plan "guided by the determination of explicit national research and development priorities." They wanted funding to be conditional "for steering research and development so that socioeconomic and environment criteria are taken into account."[49]

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[46] See *MRC Guide: A manual on the South African Medical Research Council* (Tiervlei: MRC Head office, 1974), chapter 5.

[47] Scientific Research Council Act, 1945, Section 4 (2) (b) and (c).

[48] Perrold, "Building the future", p. 52.

[49] "Draft S & T Education and Training proposals", in Mphahlele and Kahn, *ANC Conference on Science and Technology*, pp. 38-39.

Such criticisms were ironically contradicted by the assertion that the old scientific order had explicitly served the needs of the apartheid regime: it is hard to imagine how such a *laissez faire* model could have provided so well for its masters in the Vorster and Botha years. In the total strategy era, when the state sought to mobilize all the resources of the white community, there was certainly cooperation between the science councils.[50] In truth, the government had always sought to coordinate scientific efforts; that was a primary purpose of the science councils. But practical reality, not least the tendency of each department and institution to jealously guard its own prerogatives, often got in the way of achieving this objective. That will remain a problem for any future government, unless it hopes to strangle the very innovation which it professes to desire in a sea of governmental red tape and central planning.

The 1988 science policy had at least recognized the need to balance coordination between government departments and between scientists, so as to avoid unnecessary overlap, with greater independence of government departments in developing a scientific infrastructure that would promote "the free generation of scientific knowledge."[51] It is hard to imagine how any future science policy can achieve both innovation and developmental needs without seeking to balance coordination with local institutional autonomy. But that necessarily does entail the risk of not achieving substantial centralized control over research.

This is not an easy task, and the White Paper rightly pointed, for instance, to the need to move beyond single year budgetary planning within the existing pattern of a Science Vote that excluded science-related monies expended by ministries other than the Department of Arts, Culture, Science and Technology.[52] On the other hand, there are real dangers in moving to a top-heavy single agency handling funding of most research.

Such centralization is exactly the outcome of the White Paper. The 1998 National Research Foundation Act replaced the already cumbersome umbrella bodies set up in the last years of apartheid to provide some coordination: the natural science-oriented Foundation for Research and Development and the humanities and social science-oriented Centre for Science Development.

Although the White Paper originally intended that the NRF be the sole funding agency for science research in higher education, three bodies managed to be exempted from the NRF Bill presented to parliament in May 1998: the Medical Research Council (restricted to applied medical research only), and the Departments of Health and Agriculture. There was some indication that the departmental turf-protection indicated above was already

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[50] Whiston, *Research policy*, p. 222.

[51] Coetzee, Groenewald and Visser, *Science policy and system*, pp. iii-iv, 9-12.

[52] "White Paper on Science and Technology", par 5.4.1.

raising its head. Even so, the NRF would have significant oversight, leading to concerns that the resource-starved social sciences and humanities would have to compete for funds from within a single budget. The NRF would have oversight of funding all research (minus the above exempted areas), including basic medical research. This function would include not only the higher education sector (the National Education Department would, however, continue to subsidize part of university research on a per-student formula through bloc grants), but all scientific societies. The NRF would have a R250 million annual state budget. It would also have the power to raise funds locally and abroad, to award contracts, grants and scholarships, to evaluate and review research proposals, and to support the acquisition and establishment of research facilities by research institutions. The ideal was that reduced overhead through centralization of funding would free more money for actual research.

Considering the huge ambit of the NRF, it is hard to see how the announced state budget (amounting to about $45 million) would go very far in this regard.[53] In 1993, the last year of the De Klerk government, total income from parliamentary grants for the CSIR, Human Sciences Research Council, MRC and Foundation for Research Development was R422 million. This included money for the councils' own research, in which the NRF would not engage; but much of the cost of that research was covered by income from contract work, which would not be available to the NRF.[54] Budget limitations already threaten to constrain the promise of science and technology, as in the past.

The democratization of science policy

The one area in which the critics have identified a real need for a break with the past is in providing for a more broadly consultative approach, one which would "encourage participatory decision-making in the introduction and use of new technologies by all stakeholders."[55] In the past, scientists discussed issues among themselves and the research councils worked in a top-down fashion. These councils had operated within a fairly authoritarian framework, which did not lend itself to the kind of public transparency and accountability sought by the ANC. This is evident, for instance, in the extraordinary powers to regulate the affairs of the Medical Research Council enjoyed by the State

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[53] See "Second Reading Debate on National Research Foundation Bill in Republic of South Africa, *Debates if the National Assembly (Hansard)* (Cape Town, Government Printer, 1998), 18 to 22 May 1998, cols. 2615-2640.

[54] Our figure is calculated from data on Science Council income in Whiston, *Research policy*, pp. 225-226. Parliamentary grants as a percentage of total income in 1993 were as follows: CSIR 49%, FRD 89.1%, HSRC 70.3% and MRC 85% (data from Table 14, p. 226).

[55] "Draft S & T Education and Training policy proposals", p. 39.

President and by the minister assigned responsibility for the council.[56] The only overarching body on science policy, the Scientific Advisory Council, worked under a cloak of secrecy.[57] The ultimate beneficiaries of science, the vast majority of the population, were never included in discussing priorities.

The post-apartheid system is quite different: universities, technikons, businesses and community groups were invited to comment on the White Paper; they expressed concerns, and lengthy conversations among all stakeholders followed. These delayed introducing the NRF and an advisory National Council on Innovation for two years. The principal change was to allow for some financial autonomy for the high cost "national facilities" under FRD control (the National Accelerator Centre, and two national astronomical observatories). Eventually the included stakeholder groups supported the NRF Bill, albeit with some reservations.[58]

Conclusion

It remains to be seen whether South Africa's new science and technology policy can bridge the gap between rhetoric and reality any better than did the science policies of the old regime. Turf-protection already promises to be a problem, even if reduced by the creation of the NRF. Budget constraints will remain a much larger issue. The science councils, stripped of their funding agency by the NRF Act, continue to undertake research. While expected to continue the practice begun in 1987 of seeking private sector funding via contract work, they still depend in part on parliamentary grants.[59] In addition, the White Paper envisaged freeing some of the science dollars previously used by government departments for an "Innovation Fund," geared to subsidizing private sector development-oriented technology projects.[60]

These developments imply more constraints on further allocation of government science dollars to FRD and MRC projects. The South African private sector is unlikely to pick up the difference in research funding, unless there is a major departure from past practice. Pressures on government to shift even more tis subsidy of tertiary education to elementary and secondary education plus the pressure on universities to devote more resources to bursaries and to effective teaching for disadvantaged black students mean that they will

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[56] See South African Medical Research Council Act, 1969, especially Section 23, in *MRC Guide* 1974, chapter 1.

[57] Whiston, *Research policy*, p. 229.

[58] See second Reading Debate on National Research Foundation Bill, cols. 2629-2633.

[59] See "White Paper on Science and Technology", par. 8.2.4.

[60] "White Paper on Science and Technology", par. 8.2.4.

be less able than before to cover a large part of research costs from bloc grants provided by the Education Vote.

In the past, vast funds were expended on national security and the impossibly expensive constitutional and social engineering of apartheid. These expenditures came at the cost of non-defence related research. Today's research needs are more compelling, but surely even more expensive, providing yet more competition for government funding: housing, crime, jobs, elementary education and public health must remain at the top of the government agenda.

Ironically too, given the criticisms of "ivory tower" research in the past, both basic and applied research continue to be funded by the public sector. The government has clearly acknowledged that the two are inexorably linked: sacrifices in funding either weaken the entire base of South African science. Considering that such dual funding, with a stress on non-basic research, was common at least as early as the 1980s, the new science policy does not represent the massive break from past practice that its promoters hoped to achieve. While the South African scientific community clearly faces many challenges, perhaps the new scientific order will not be so different from the old.