Macalester International

Volume 9 *After Apartheid: South Africa in the New Century*

Article 23

Fall 12-31-2000

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But when that dawn will come, of our emancipation, from the fear of bondage and the bondage of fear, why, that is a secret.

For some inexplicable reason, I had never read Alan Paton's 1948 classic *Cry, The Beloved Country* before I got to South Africa. When I finished the last lines of the book, at midnight on my last night in Cape Town, I knew I had found an epigraph for this essay. I am afraid that the five weeks I spent in southern Africa, in December 1999 and January 2000, did not reveal to me the secret Paton pondered. Perhaps the dawn has already come, in the lifting of restrictions and the end of apartheid in 1990, or in the first free and democratic elections in 1994. Perhaps that complex and troubled country is still awaiting the dawn. But I like to think that I did glimpse the first streaks of light in the sky over Table Mountain.

Every traveler visits a different country — one created, in part, by the eyes and expectations of the observer. But that multiplicity is magnified in South Africa because it is simultaneously many countries. During the three weeks of the 2000 Macalester College Faculty Development International Seminar and the two weeks that preceded it, when I was traveling with my wife, I experienced several South Africas. It is unbridled hubris to suggest that in such a brief time one can learn enough to write anything of real significance or great insight about these parallel universes. All I can offer are my imperfect impressions of the places and the people.

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My first experience was of a land of incredible biological richness and diversity. We visited three game preserves, most notably Kruger National Park, and saw an amazing array of wild animals, almost

within reach. True, the safari lodges provide today's camera-carrying tourists with the same sorts of creature comforts enjoyed by the white hunters of earlier times, but I refuse to feel guilty or apologetic. I know the lodges also provide incomes to hundreds of Africans of all shades and that tourist dollars help protect endangered species. All of the rangers, guides, and trackers I met impressed me with their knowledge, their self-confidence, and their genuine stewardship of the animals.

Before the arrival of the Seminar group, I spent two days in Kimberly, exploring another dimension of South Africa — the days of the diamond rush and the mineral wealth that generated it. The former Colesberg Kopje is now a "Big Hole." It is a mile in circumference, a half a mile deep, and it is now mostly filled with water. From 1871 to 1914, 6,000 pounds of diamonds were pried from the 22.6 million tons of blue earth dug from that hole. Adjacent to the hole is the Kimberly Mine Museum, a collection of about fifty original and replica buildings that recreates the heady days when 50,000 fortune hunters invaded the area.

Somewhere on the trip I saw a replica of the check for 5,338,650 pounds that Cecil Rhodes wrote to Barney Barnato in 1888. This transaction marked a pivotal point in the creation of DeBeers Consolidated Mines and the diamond monopoly. I have not been able to find an estimate of the human price paid for those diamonds. My interest in this is more than academic. At one point in my life I was privileged to enjoy a rare opportunity ultimately derived from those bits of crystalline carbon and the blood and sweat of those who dug them. I did not pass up the opportunity because of the source. In fact, I confess that I barely thought about it at the time. As I learned more about Cecil Rhodes, my feelings became more ambiguous. However, I remain proud of my continuing involvement in efforts to wisely invest those much-multiplied monies in promising men and women

The fingerprints and footprints of Cecil John Rhodes are all over Kimberly, as they are all over South Africa and Zimbabwe. In the former Kimberly Sanatorium (now the McGregor Museum) I visited the rooms where Rhodes lived during the 124-day siege of Kimberly, just a century ago, during the Anglo-Boer War, which he helped provoke. Here Rhodes is honored as the hero of the siege. He advocated the welfare of the citizens over military considerations, organized soup kitchens, lowered women and children to safety in the mine shafts, continued to pay his miners though the mines were closed, and turned

the DeBeers machine shops into a munitions factory. The products were 4-inch, 28-pound shells marked "Comps. CJR" and "Long Cecil," the cannon that fired them. I stopped at the headquarters of DeBeers Consolidated Mines on Stockdale Street but I was unable to see the boardroom where Rhodes presided because it is still in use. The Africana Library, another of his creations, is filled with documents, maps, and books about the days of the diamond rush. At the Kimberly Club, a black employee proudly showed me the dining rooms, the bars, the library, the lounges, and Rhodes' own suite of rooms. But my guide tactfully declined to offer his own appraisal of the character and contributions of Kimberly's most famous citizen. The Founder scowls down from almost every wall of the Club and from his bronze horse on DuToitspan Road. I raised a glass in honor of my benefactor at the Star of the West, a pub that displays a barstool that supposedly supported Rhodes, and again at the Halfway House, where Rhodes was served his pint on horseback. The latter watering hole has the dubious distinction of continuing the tradition by serving drinks to drivers in their cars.

The image of Rhodes projected in Pretoria is a good deal less flattering. Not surprisingly, the instigator of the Jameson Raid receives a good deal of criticism. For example, Melrose House, where the treaty ending the war was signed, displays a cover from the French "*Journal Humoristique*" *Le Rire* for February 17, 1900. It is a caricature of Rhodes, cross-eyed and in need of a shave, in a besieged tower. The cartoonist, Charles Leandre, depicts Rhodes clutching a champagne bottle and what appear to be stock certificates for diamond and gold mines. The caption reads, "*Le complice de Chamberlain aura fait verser plus de sang en Afrique que de champagne*." Similarly, the exhibits in the house where Paul Kruger lived for seventeen years portray the Anglo-Boer conflict as a struggle for Afrikaner freedom from British oppression. The museum is filled with petitions and resolutions in support of the Boers and elaborate gifts to Kruger from international organizations and governments in the Netherlands, Germany, France, Spain, and Russia. Even the United States weighs in on the side of the Afrikaners, with a letter of support signed by hundreds of Philadelphia schoolboys. Unfortunately for Kruger and his cause, the beautifully lettered and illuminated documents and the engraved silver did not come with troops or weapons. While the bitter memories of the Boer War and the Afrikaner's long struggle for independence in no way justify apartheid, perhaps they help explain it.

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The organizers of the Seminar interpreted the theme, "Transformation and Multiculturalism in the New Millennium" broadly, and for that I am grateful. I welcomed the variety of topics and perspectives included the program. Bernard Magubane, Barry Feinberg, and W. J. Breytenbach all addressed issues relating to multiculturalism and race relations in South Africa. Because these three speakers are members of three identifiable groups in South African society, there is a temptation to infer that they speak for these groups. That, of course, is a naïve and dangerous oversimplification. However, their presentations were instructive when factored in with the less formal interaction we enjoyed — conversations with the "combi" drivers, the guides at Robben Island and the District 6 Museum, our hosts in the home visits, the colleagues with whom I conducted my independent study project, the organizers of the Western Cape Action Tour, and the people we met in the townships. The continuous spectrum of South Africa is still refracted into the hues codified by apartheid. Everyone still seems to use the old color categories in conversation. The fact that things are more complicated than that struck me very strongly when David Lanegran and I were having dinner with Tom and Ivy Kinnear and their friends. All have Afrikaans as their first language, and all are active in the Dutch Reformed Church. As far as I could tell, their strongest cultural identity is with Afrikaners. However, as "coloured" people, they were victimized by a system created by an Afrikaner dominated government. Therefore, it seems an oversimplification to talk about a Black South Africa, a Coloured South Africa, an Indian South Africa, and a White South Africa. Similarly, the distinction between Afrikaner and English seems problematic today. I have to believe that *de facto* as well as *de jure* blurring of these boundaries will be in the country's long-term best interest.

It is my inexpert opinion that the economy is a major key to whether South Africa will come together or fragment. I anticipated great disparity in wealth, but I was unprepared for the magnitude of the differences between Constantia and the shantytowns of the Cape Flats. I wonder how long people will be willing to tolerate this gap. I was amazed that I heard very few statements of resentment. Perhaps I talked to the wrong people, or perhaps they were unwilling to express their true feelings. If our drivers are representative, many people seem motivated by a great desire to join the middle class. Even the street

vendors who come into the cities from the townships appear to be entrepreneurs. But how successful can they be when every other stand sells the same cheap luggage or athletic shoes and every corner offers sweet corn and mangoes? And are these dreams of financial improvement realistic for an unemployed resident of what is euphemistically known as an "informal settlement?" With Pieter le Roux, I very much hope that "the airbus will take off."

To my taste, the most enjoyable and interesting exposure to the fine arts in South Africa was something not originally on the seminar program—the performance of *The Zulu* by Mbongeni Ngema at the Market Theatre in Johannesburg. It is an exciting and vibrant work, which I found more compelling than *Suip*, which we saw in Cape Town. In addressing alcoholism and its causes, the latter play considers a significant social problem, but I had a hard time hearing and understanding the actors. A presentation on South African film or drama would have been more appropriate than Anny Wynchank's introduction to a Francophone Senegalese film.

Given the great biological and mineral wealth of South Africa, and the importance of tourism, I was pleased that the formal program included a number of sessions addressing those topics. Douw Grobler's presentation on game capture was fascinating, as was Michael Meadow's paper on land degradation. The opportunity to wander through Kirstenbosch Gardens, with its beautiful collection of indigenous plants, did much to set Meadow's talk in perspective. The paper by Farieda Khan helped illuminate the particular historical issues surrounding and complicating environmentalism in South Africa.

Science and technology can be significant forces in transforming South Africa in the new millennium. Mohammed Jeenah's presentation was a bit too bureaucratic for my taste, but I found his description of strategies and scenarios for the future to be instructive. The post-1994 emphases on the quality of life for all South Africans and competitiveness in the face of globalization are very closely allied to applied science. The fact that many of our speakers, including Dr. Jeenah, Peter Barron, and Marian Jacobs, mentioned the high crime rate and the AIDS epidemic indicates that these problems seriously undermine the fabric of South African society. Addressing these issues must be a high priority for science, as well as for government and social services. Efforts to enhance South African global competitiveness are tied to three initiatives: greater involvement in information technology, processing designed to add value to natural resources, and applications of

biotechnology. The first and the last of these focus areas seem to carry a considerable risk. The information superhighway is already overcrowded, and opposition to biotechnology in the form of genetically engineered crops is widespread, especially in Europe. I believe that much of this opposition is based on fear born of ignorance. If these biological Luddites carry the day, it may have serious negative consequences for millions of starving people in Africa and elsewhere, and for the quality of the global environment. Fortunately, Dr. Jeenah and his colleagues recognize that science education must be improved if biotechnology is to contribute to South Africa's future. How that improved education is to be achieved is not obvious, but it is closely related to my study project. Therefore, it warrants a special section.

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When I applied for the Faculty Seminar, I proposed to investigate efforts made by South African universities to attract black students to the study of science and to facilitate the successful completion of their studies. I was motivated by the fact that in the United States, African-Americans, Native Americans, and Hispanic Americans are seriously underrepresented in the sciences, mathematics, and engineering. We are not fully utilizing our human capital. As a result, not only is there a loss of talent, but there is also a lack of understanding and a potentially dangerous alienation on the part of a large segment of society.

Many strategies have been tried with the aim of attracting more minorities to science: summer programs, special scholarships, research opportunities, and mentoring. A case in point is Macalester's pre-college summer program, supported by a grant from the Howard Hughes Medical Institute. Unfortunately, these programs have met with only limited success. I set out to discover whether South Africa faces similar problems; if so, what strategies have been employed and have they succeeded?

My initial point of contact was Peter Spargo, recently retired from the Science Education Unit of the University of Cape Town. Professor Spargo and I had previously met at several international conferences, and he was very helpful in putting me in contact with other academics with similar interests. I soon learned that there are many similar problems of science education in our two countries. With respect to pre-college preparation, the situation appears to be even worse in South Africa than it is in the United States. We were informed that in a com-

parative study of the mathematical and scientific training of school children in forty counties, South Africa ranked lowest. One of the legacies of apartheid is a great disparity in the quality of elementary and secondary education. According to some of my informants, this gap has increased in the past few years. With racial barriers removed, better-educated black and coloured parents with the financial resources are now sending their children to better public or private schools. Thus, some schools have been depleted of their best students and their more involved parents. Moreover, incentives have led to the retirement of some of the best-qualified teachers, and they have been replaced with less experienced instructors. Classes are often as large as forty or more, and many schools have very poor facilities, especially for experimental work in science. According to a 1997 survey, fewer than 50% of mathematics teachers and only 42% of science teachers have specialized training of at least one year in either mathematics or science. It is estimated that approximately 8,000 mathematics teachers and a similar number of science teachers need to receive in-service training. Moreover, there is a significant shortage of science teachers. Conditions like these have led to the statistic reported by Dr. Jeenah: 50% of university science and engineering graduates come from only 100 of a total of 4,000 schools.

A number of programs have been launched with the goal of improving elementary and secondary education and of enhancing public understanding of science and technology. To these ends, 1998 was designated the Year of Science and Technology. I have not been able to learn exactly what this enterprise involved, but I was informed that special emphasis was placed on reaching women and youth. One agency for outreach is the Foundation for Education, Science and Technology. In Pretoria, I visited the Museum of Science and Technology (maintained by the Foundation) and spoke with Humphrey Ramone, a former teacher who is now an Education Officer. He described to me instructional and support programs that the Foundation provides to teachers. In addition, the Museum is a destination for school field trips. Mr. Ramone also gave me copies of two publications of the Foundation: *Spectrum*, a quarterly journal for mathematics, physical science, and biology teachers, and *Archimedes*, which is described as a "natural science magazine for the whole family." The quality of both publications is high. The articles are interesting, accurate, and up-to-date, and they reflect good pedagogical practice, including hands-on experimentation and discovery. On my return, I was able to send Mr. Ramone

some publications of the American Chemical Society aimed at elementary and secondary students and their teachers.

I learned that the most common means of teacher preparation in South Africa is via special teachers' colleges that offer two- or three-year diplomas. However, a number of universities have mounted efforts to promote teacher preparation and enhancement. At the University of Stellenbosch, I met with J.H. Smit, Director of the Institute for Mathematics and Science Teaching (IMSTUS). The goals of the Institute are "to promote quality teaching and an interest in mathematics and science at school level through the empowerment of teachers." This is accomplished through a variety of programs. One of the more extensive is a Further Diploma in Education in the Natural Sciences offered for secondary school teachers. The instruction is organized so that the teacher can complete the requirements for the diploma while continuing to teach full time. Workshops, usually two-days in length, are offered at Stellenbosch (there was such a workshop in session the day I visited), and remote instruction via television will soon be implemented. New instructional materials are also developed under Institute sponsorship. Many of these efforts are directed toward the implementation of Curriculum 2005, a new national educational initiative based on objectives and outcomes. This, of course, sounds very familiar to those of us who have worked on national and state standards and read about the controversy over the "Profiles of Learning" in Minnesota. I was very favorably impressed by the efforts and achievement exhibited by IMSTUS. The programs seemed to reflect some of the best practices I observed during my temporary assignment as Deputy Director of the Division of Teacher Preparation and Enhancement at the National Science Foundation.

Elementary and secondary school intervention and improved teacher preparation are very likely the most effective long-range solution to the problem of poor science literacy and low achievement in science. However, the payback time for such programs is ten years at the least and very likely two or three times that. We cannot wait, either in South Africa or the United States, for such initiatives to have their effect. We must also intervene at the tertiary educational level. A series of conversations helped inform me about what is being done to address the problem in South African Universities. My informants included Marissa Rollnick, Director, College of Science at the University of the Witwatersrand (Wits), Johannesburg; B. Daya Reddy, Dean, Faculty of Science, University of Cape Town (UCT); Saalih Allie,

Department of Physics and Center for Higher Education Development, UCT; Bette Davidowitz, Department of Chemistry and Center for Higher Education Development, UCT; and the above mentioned J.H. Smit of the University of Stellenbosch. All were most generous in the time they spent with me and the materials they gave. I was able to reciprocate with a number of offprints, books, and papers.

I gather from their remarks that inadequate preparation in science on the part of black students is more of a problem than lack of interest in studying science. We face both problems in the United States. An additional complication in South Africa is the fact that, for many black students, their first language is one of the African languages. University instruction is in English or Afrikaans and, although both languages are taught and required in school, some students arrive at the university with limited facility. Admission to South African universities is based on performance on matriculation examinations. Not surprisingly, many students from historically disadvantaged schools and populations do not perform well on these tests. In response to this problem, programs at Wits, Cape Town, and Stellenbosch all make exceptions to the usual admissions standards. Special examinations designed to assess potential for the study of science, as distinct from preparation, are administered. Indeed, such examinations were being given the day I visited Wits. In some cases, candidates are also interviewed. Most are black, but there are also white students, and some students older than the traditional age cohort.

At each of the three universities, the students selected are admitted to special programs that add one year of instruction to the three years normally required for a B.Sc. For example, at Wits, about 200 students per year enter the College of Science. Typically, the first year is spent on foundation courses in mathematics, physical science, and biological or geological sciences. Although these courses are, of necessity, somewhat remedial in character, they are designed to facilitate progress toward the degree. Every effort is made to provide rigorous university-level instruction and to integrate the students into the mainstream. Indeed, some programs have several points at which transfer can be made. The transfer is complete for the second and third year of the normal degree program (the third and forth year of the special program).

Efforts are also made to integrate faculty of these special programs within disciplinary departments. Some faculty members have joint appointments. For example, Dr. Rollnick, the Director of the College of

Science at Wits, is a professor in the Department of Chemistry; and Dr. Allie has appointments in Physics and the Center for Higher Education Development at Cape Town. Some of these positions are tenured or tenure-track, and are funded by the universities. Indeed, in recent years the universities have assumed more of the cost of these programs. This has been necessitated by major declines in external funding. During apartheid, there were many sources for the support of education. For example, the Oppenheimer Foundation helped establish the program at UCT, and U.S. AID and the Anglo-American Corporation supported the Wits College of Science. With the end of apartheid, many of the private and international financial sources have discontinued their grants.

Much of the instruction in the bridge programs appears to employ innovative and effective pedagogical methods including relatively small classes, even smaller tutorials, student study groups, and investigative experimental work and laboratory exercises. The emphasis is on conceptual understanding, not merely the algorithmic solution of set problems. Significantly, the faculty and students in the direct entry mainstream degree program have recognized the merits of this style of teaching and learning. Some of these pedagogical strategies have been successfully incorporated into the mainstream, an affirmation of the fact that good teaching benefits all students. A similar transfer has also occurred in the United States. For example, the issues-centered approach my colleagues and I pioneered for nonscience majors in *Chemistry in Context* has infiltrated many college-level texts and courses for science majors. Imitation is the highest form of flattery, and we are pleased that we introduced a virus of reform into the chemistry education system. Many of the faculty teaching in the special South African programs are conducting research in teaching and learning, and their instructional success has given them elevated status among their colleagues. The universities I visited appear to nurture and reward research in science education, something that not all American research universities do.

The most obvious measure of the success of these academic support programs is the percentage of students who complete a bachelor's degree in science. I found the results disappointingly low — less than 50%, which is lower than the percentage for students admitted directly into the regular course sequence. However, it should be noted that the graduation rate in science departments in good American public universities is also low. It is impossible to get comparable data at

Macalester because our students do not disclose their intended majors until the end of their second year. In South Africa, students declare their majors before matriculation. It is also more difficult to change majors in South Africa than at Macalester. Nevertheless, the faculty members I spoke with are proud of the number of students who enrolled in support programs and eventually earned honors, master's, and doctor's degrees. Given the dedication, talent, and good will of these teachers, greater success should follow.

A key consideration is whether what I learned about science education in South Africa is transferable to Macalester and to science education in the United States. I did not bring back a philosopher's stone that can transmute ill-prepared and indifferent students into rocket scientists. But then, I did not expect to find one. My visits confirmed what I already knew: commitment, hard work, and good teaching can help remediate the deficiencies of inferior education, but it is not easy. It also takes time. When I described the Macalester Howard Hughes Medical Institute Program to one of my informants, she immediately stated that three weeks was definitely not enough time to accomplish anything significant. At Macalester, the program seems more motivational than instructional. I remind the reader that the South African universities add an entire year to the degree program. This is probably more than necessary at Macalester, and would be almost impossible to do without a larger number of participating students. The many differences between a liberal arts college and a large research university, especially one in a different country, make the transfer of such programs very difficult. I would suspect that the University of Minnesota and the University of Cape Town have more to learn from each other. But I certainly gained much from my new international colleagues and friends.

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Alan Paton was correct: the country is indeed beloved. Everyone I spoke with seemed to have a strong affection for South Africa and pride in its accomplishments. That represents both a peril and a hope. If the country beloved by the blacks is radically different than that beloved by the whites, if the Boers and the Brits have different visions of the future, if the haves and the have-nots want different things for their land, then the prognosis is pessimistic. Deep dedication to incompatible versions of South Africa can cause the country to come apart.

Ironically, love of country can exacerbate its balkanization and destruction. But if the various factions with their various visions can find what is common in their love affair with the land, perhaps there is hope. The love may keep the mobile from leaving. It may motivate those who profited from an evil system to make amends and restoration. It may give the disadvantaged patience to wait a little bit longer. And, perhaps all South Africans, working together, can hasten the dawn over their beloved country. ◉