

LOCAL SCIENCE NEEDS A BOOSTER SHOT

by Anastassios Pouris

Countries such as Mexico, Turkey, China and Brazil have all overtaken South Africa in the international research race.

South African science is weakening, just as the world has become increasingly dependent on science. The Institute for Technological Innovation (ITI) is the country's leading institution in the field of science, technology and innovation policy monitoring and analysis. A recent article of the Institute¹ on the performance of the country's scientific research¹ has attracted considerable attention in the popular press and the relevant authorities. The study is of national importance and parts of the study are cited here.

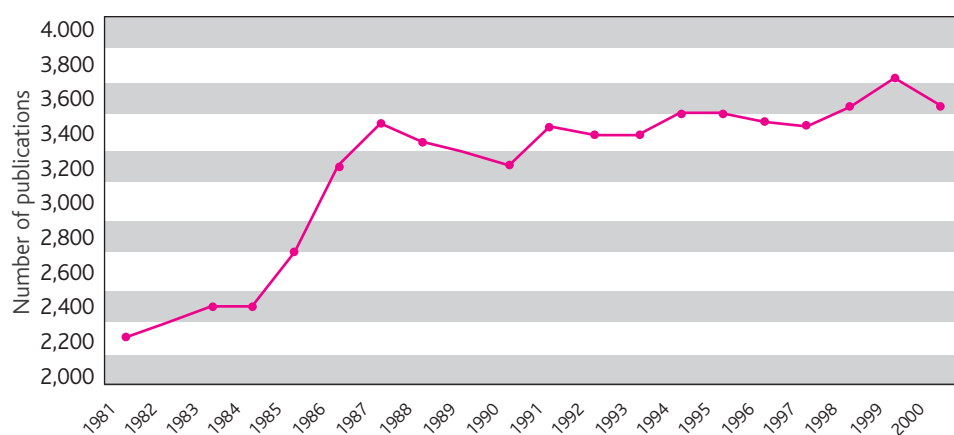
The study is an update of a 1996 study by Professor Pouris. The 1996 study² concluded that South African science had been weakening just as the world was becoming increasingly dependent on science. The strengths in South African science, furthermore, were found to be in disciplines that had been influenced by the natural wealth of the country (for example, ecology and geology), and that the relatively weak disciplines included engineering and applied physics. The new study traces the country's publication record in science to the year 2001 and attempts to identify its main characteristics. → 1 shows the number of South African publications for the period 1981–2000. The number rises steeply between 1984 and 1987, from 2,423 publications in 1984 to 3,469 publications in 1987, and rises gradually thereafter. During 2000, South Africa produced 3,592 Institute for Scientific Information (ISI)-listed publications.

→ 2 shows the South African share of world publications for the same period. The country's share rose from 0.5% at the beginning of the period under examination to its highest point of 0.67% during 1987. It then started to decline. In 2000, South Africa's share of publications, at 0.49%, was lower than its contribution 20 years earlier.

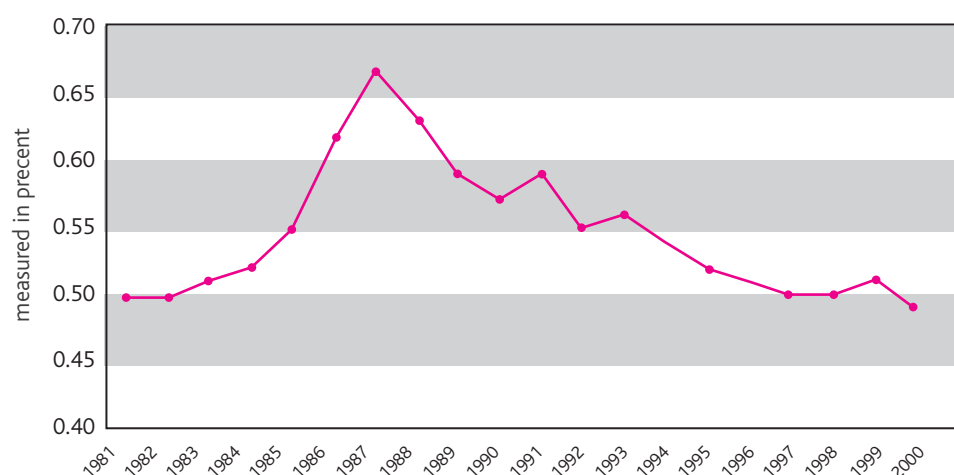
The decline in South Africa's share of the world publications is the result of other countries expanding their research systems. Between 1981 and 1994, five countries ranking below South Africa at the beginning of that period or at the same level, had passed it by 1994. The countries were Norway, South Korea, Brazil, Taiwan and the People's Republic of China. By 1994, South Africa was already losing ground in the international race.

For the more recent period, 1995–2000, seven countries have been identified whose share of publications grew from below the figure for South Africa's share to a figure above it. The countries are Argentina, the Czech Republic, Greece, Hungary, Mexico, New Zealand and Turkey. These countries have accelerated their rates of publication so that, although their 1995 shares of world publications in the ISI were lower than those of South Africa, their shares by 2000 had become higher.

The performance of the main scientific



→ 1. Number of South African publications in the ISI's National Science Indicators



→ 2. South African publications as a percentage in the ISI's National Science Indicators Database

areas and of scientific disciplines has also been examined. →3 (next page), shows the country's performance in the six major scientific areas:

- Life sciences (biology, clinical medicine, immunology, microbiology, molecular biology and genetics, pharmacology, and neurosciences);
- Traditional sciences (physics, chemistry, materials science);
- Technology (engineering, mathematics, computer science, and space science);
- Land and primary-resources-related sciences (agriculture, ecology, geology, and plant and animal science);
- Social sciences and humanities (economics and business, education, law, psychology/psychiatry, and social sciences in general);
- Multidisciplinary sciences.

South Africa's world share of publications in the social sciences and humanities was the only one to grow during the period, and it increased from 0.42 during the period 1990-1994 to 0.50 during the period 1996-2000. In each of the other scientific areas, as manifested in South Africa's share of world publications in the area, the country's

performance declined. Table 2 (next page), outlines South Africa's performance in 24 scientific disciplines by showing its share of the world's publications; the activity indices are shown in brackets. Three disciplines exhibited substantial growth over the period: immunology by 80%, education by 51%, and psychology and psychiatry by 50%. Fourteen of the 24 disciplines show a decline. Computer sciences, materials science, and clinical medicine displayed the greatest declines (33%; 29%; and 22%, respectively). Law also declines, but off a very low base.

The activity index is the fraction of the country's publications in the particular field, relative to the fraction of the world's publications in the field. An activity index above one means that the country is producing more publications in the field than it is expected, given its total number of publications. The country's emphasis on scientific disciplines related to the environment (ecology/environment, plant and animal sciences and earth sciences) is noteworthy.

Table 3 (next page), shows the relative citation index (an indicator of research quality) of the various disciplines for the periods 1990-1994 and 1996-2000. An index of one means that the average South African article in the particular discipline attracted the same number of citations as the average

article in the discipline in the world. During the first period (1990-1994), the disciplines that attracted above-average citations were: education (Relative Citation Index) RCI = 1.48) and agriculture (RCI = 1.38). The disciplines of materials science and space science were just below the world average. All the other disciplines attracted a far lower number of citations than the world average. During the second period (1996-2000), the four disciplines with average and above-average performance registered a relative decline.

All South Africa's active disciplines (i.e. those with publication rates above the country's average of 0.5%) are those involving its natural wealth, that is, ecology/environment, geosciences, plant and animal science, and space science (astronomy), and all of them show a decline.

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Table 1: South Africa's share of world publications in major scientific areas

Disciplines	1990–1994	1996–2000	Growth/Decline (-)
Life sciences	0.45	0.39	-13.3%
Traditional sciences	0.35	0.29	-17.1%
Technology	0.4	0.38	-5%
Land and primary	1.32	1.2	-9%
Social sciences and humanities	0.42	0.5	19%
Multidisciplinary	1.25	1.16	-7.2%
Average	0.56	0.5	-10.7%

Table 2: South African share of the world's publications, activity indices

Scientific Discipline	1990–1994	1996–2000	% Change
Agricultural sciences	0.42	0.52 (1.09)	20.9%
Biology and biochemistry	0.35	0.33 (0.70)	-5.7%
Chemistry	0.39	0.34 (0.69)	-12.8%
Clinical medicine	0.59	0.46 (0.89)	-22%
Computer sciences	0.3	0.20 (0.42)	-33.3%
Ecology/environment	1.18	1.14 (2.40)	-3.3%
Economics and business	0.38	0.40 (0.85)	5.2%
Education	0.57	0.86 (1.81)	50.8%
Engineering	0.33	0.32 (0.67)	-3%
Earth sciences	1.19	1.12 (2.35)	-5.8%
Immunology	0.2	0.36 (0.78)	80%
Law	0.07	0.05 (0.12)	-28.5%
Materials science	0.42	0.30 (0.62)	-28.5%
Mathematics	0.38	0.42 (0.88)	10.5%
Microbiology	0.52	0.58 (1.23)	11.5%
Molecular biology and genetics	0.3	0.28 (0.59)	-6.8%
Multidisciplinary	1.25	1.16 (2.44)	-7.2%
Neurosciences	0.13	0.15 (0.31)	15.3%
Pharmacology	0.36	0.41 (0.86)	13.8%
Physics	0.29	0.26 (0.53)	-10.3%
Plant and animal sciences	1.75	1.53 (2.98)	-12.5%
Psychology/psychiatry	0.34	0.51 (1.07)	50%
Social sciences (general)	0.52	0.53 (1.13)	1.9%
Space science	0.98	0.92 (1.93)	-5.1%

Table 3: South African Relative Citation Index of publications

Disciplines	1990–1994	1996–2000	Growth/Decline (-)
Agricultural sciences	1.38	1.08	-21.7%
Biology and biochemistry	0.5	0.56	12%
Clinical medicine	0.64	0.66	31%
Computer science	0.65	0.57	-15.4%
Ecology/environment	0.71	0.73	2.8%
Economics and business	0.23	0.32	39%
Education	1.48	0.55	-63.8%
Engineering	0.76	0.73	3.9%
Earth sciences	0.8	0.87	8.8%
Immunology	0.63	0.69	9.5%
Law	0.15	0.16	6.7%
Materials science	0.98	0.87	-11.2%
Mathematics	0.9	0.67	-25.6%
Microbiology	0.68	0.62	33.3%
Molecular biology and genetics	0.42	0.56	-10.1%
Multidisciplinary	0.69	0.52	4.3%
Neurosciences	0.47	0.49	60.5%
Pharmacology	0.38	0.61	14.5%
Physics	0.69	0.79	14.5%
Plant and animal sciences	0.56	0.61	8.9%
Psychology/psychiatry	0.34	0.42	23.5%
Social sciences (general)	0.57	0.68	8.1%
Space science	0.99	0.91	-0.8%

Clinical medicine, one of the country's active disciplines, continued its decline and has moved into the "inactive" set of disciplines. As regards quality of research, only agriculture-related research has a RCI higher than one. The decline of life sciences in general and of clinical medicine in particular warrants focused study. Historically, clinical medicine has been one of the mainstays of South African research. Since its highest level of 1,063 publications in 1987, clinical medicine has declined not only as a fraction of the world articles in the field but also in absolute terms. In 2001 South Africa published only 736 articles in this field. It is important to identify the reasons for this decline so that appropriate policy actions can be set to arrest the decline.

The study concludes that the country's research system is in a decline and argues that South Africa's hopes to become the intellectual and educational hub of the African continent can be realised only if adequate policy measures are implemented to improve the country's research publication record and impact, particularly in the higher education sector, which is responsible for more than 80% of its visible research outputs. ➔



References

1. Pouris, A., 2003, *South Africa's research publication record: the last 10 years*, *South African Journal of Science*.
2. Pouris, A., 1996, *The writing on the wall of South African science: A scientometric assessment*, *South African Journal of Science*.

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→ 1. *Professor Anastassios Pouris*

"Between 1987 and 2000, South Africa's global share of publications, as recorded by the US-based Institute for Scientific Information, dropped more than 25% from 0.67% to 0.49%, the lowest in two decades. There has been no improvement."

The number of full-time South African researchers has fallen in the past 10 years and scientific output has stagnated." I conducted a recent survey among 350 South African academics; only 12% of their time was spent on research. If no new knowledge were available, there would be no new products, ideas or processes to make South African industry competitive."

-Anastassios Pouris