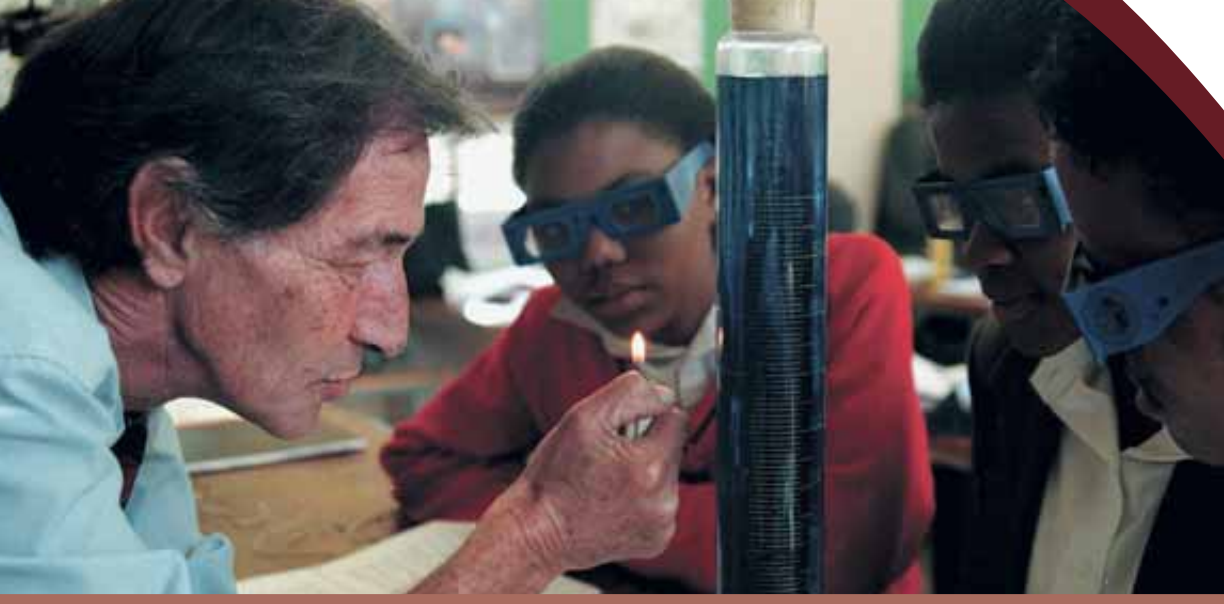

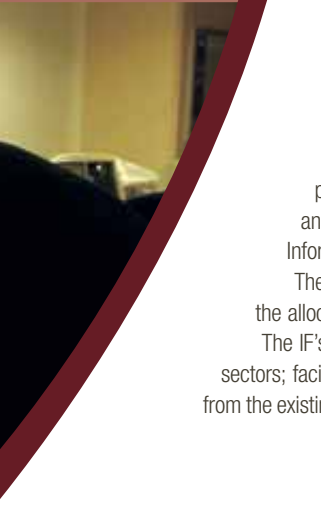

Science and technology

Policy and funding

The vision of the Department of Science and Technology is to realise the full potential of science and technology (S&T) in social and economic development, through the development of human resources (HR), research and innovation.

National S&T policy is the responsibility of the Minister of Science and Technology.

The intellectual framework for policy is the National System of Innovation (NSI), in which a set of functioning institutions, organisations, individuals and policies interact in the pursuit of a common set of social and economic goals.

National System of Innovation

The NSI focuses on the role of technology in economic growth and supports innovation and technology diffusion. Since 1994, institutions such as the National Advisory Council on Innovation (NACI) have been established to advise the minister on policy and the allocation of funding.

Some funds allocated to science councils were earmarked to address specific South African problems. The funding of science councils has been substantially reformed: core funding through parliamentary grants is complemented with allocations through a competitive bidding process from the Innovation Fund (IF). The IF applies three major criteria when making its selections: competitiveness, quality of life and environmental sustainability. Projects funded by the IF have led to new businesses, products and services in the marketplace.

Innovation Fund

The IF, a policy instrument of the Department of Science and Technology, was created to promote technological innovation; increased networking and cross-sectoral collaboration; and competitiveness, quality of life, environmental sustainability and the harnessing of Information Technology (IT).

The National Research Foundation (NRF) claims a management and administration fee from the allocated budget for support services rendered.

The IF's strategic objectives include creating a knowledge base in key technology and economic sectors; facilitating the exploitation and commercialisation of research and development (R&D) results from the existing knowledge base; investing in technological innovations that will benefit South Africa; and

supporting historically disadvantaged individuals (HDIs) in terms of infrastructure, knowledge and technology transfer. The IF enables the expansion and migration of existing industries to new value-added areas and the establishment of R&D-intensive industries. It fosters the establishment and growth of technology-based small enterprises.

The strategic direction of the fund identified a series of new funding initiatives that seek to enhance innovation in South Africa. They are:

- technology missions to support the development of long-term, high-risk, market-driven, enabling technology that will benefit an existing economic sector
- technology-advancement programmes to promote innovation in new technology frontiers
- various competitive initiatives to promote entrepreneurship through the commercialisation of the innovative ideas of young entrepreneurs and to promote R&D collaboration and entrepreneurship within the business and research community, emphasising networking among racial groups and across cultures
- the IF Commercialisation Office, which offers a comprehensive service regarding patent applications and technology transfer for publicly funded research
- seed and start-up financing for the development of a product or prototype, proof of concept and initial marketing.

The IF's budget increased to R182 million in 2005/06.

South Africa's spending on research and development (R&D) increased to R10,1 billion in 2003/04 from R7,5 billion in 2001/02. According to a survey by the Centre for Science, Technology and Innovation Indicators, this contributed to the country's economy becoming more competitive in 2003/04.

South Africa spends more in this field than Argentina, which spends 0,41% of its gross domestic product (GDP) on R&D. Lagging behind countries such as China, which spent 1,22%, and the Russian Federation's 1,28% of GDP, South Africa spent 0,81% of GDP on R&D in 2003/04.

The Organisation for Economic Co-operation and Development country with the highest R&D intensity was Sweden, which spent 4,27% of GDP, followed by Finland with 3,46%.

South Africa's R&D expenditure is fairly high compared with that of other developing countries. However, the total number of researchers is low at 2,2 researchers per 1 000 employees.

Women researchers make up 38% of the total researchers, compared with 11,2% in Japan and 28,4% in Norway. In developing countries, Argentina leads the way with 50,5% women researchers.

The largest percentage, 28% of R&D, is performed in the field of engineering sciences. This is followed at 21,9% in natural sciences and 13,5% in the medical and health sciences.

The major performer and financier of R&D is the business sector, which performs 55,5% of all R&D undertaken and finances 52% of the total spent in this field.

Government financed 28%, while 10% of R&D is financed from abroad.

Higher Education performs 20,5% of national R&D and government 21,9%.

National Research and Development Strategy

The National R&D Strategy focuses on three broad areas:

- Innovation enhancement, primarily through technology missions: The emphasis is on technological innovation, demonstrating technology, incubating new technology-based businesses, and enhancing networks of knowledge workers and organisations in specific areas of technology.
- Strengthening science, engineering and technology (SET), human resources (HR) and transformation: The emphasis is on establishing centres of excellence (CoEs); establishing and funding networks for the New Partnership for Africa's Development (NEPAD) and Southern African Development Community (SADC); strengthening global science networks; formulating strategies aimed at sourcing new financing for R&D equipment; strengthening institutional and individual research capacity in science focus areas through the NRF; and increasing public understanding and engagement.
- Creating an effective government S&T system: A clear distinction needs to be drawn between the roles of line-function departments and the

integrative role of the Department of Science and Technology. This focus area is involved in generating three-year R&D plans for science councils in line with the Medium Term Expenditure Framework (MTEF) process, developing standard-reporting frameworks and a performance management system for all institutions, and giving the department central responsibility for producing an integrative budget for all S&T initiatives.

The department has committed itself to the 2002 R&D Strategy target of 1% of gross domestic product to be invested in R&D by both the public and private sectors by 2008. This implies an annual increase of about R1 billion in government expenditure on R&D. The R25-million grant to six CoEs over the next 10 years in engineering, biotechnology, biodiversity and disease research continues to support R&D.

Advanced Manufacturing Technology Strategy

The Advanced Manufacturing Technology Strategy was launched in October 2003 and resources are being allocated towards its implementation. Planning is underway for developing innovation programmes in the energy, mining and mineral-beneficiation domains of resource-based industries.

National Technology Transfer Strategy

The National Technology Transfer Strategy is based on the inevitable role that technology plays in wealth creation and in addressing the challenges of social development.

National Energy Research Institute (NERI)

Cabinet approved the establishment of the NERI in 2004.

The institute, jointly run by the departments of minerals and energy and of science and technology, will conduct research on the energy sector.

The NERI, through R&D, provides for:

- cost-effective and efficient energy generation, transformation, transport, end-use and decision-support technologies
- energy-technology innovation
- sustainable development and utilisation of energy resources
- improving the quality of life of all South Africans
- promoting and conducting training of energy researchers
- establishing and expanding industries in the field of energy
- commercialising energy technologies resulting from its research development and innovation programmes.

Pebble Bed Modular Reactor (PBMR) Human Capital Research and Innovation Frontier Programme

In support of the Government's vision for the PBMR, the Department of Science and Technology has undertaken to establish a co-ordinated programme to advance skills and innovation frontiers along the entire technology value chain of the PBMR programme. This ranges from basic and applied research of all applicable science and engineering disciplines, to manufacturing and the distinctive aspects of waste management.

The PBMR Human Capital Research and Innovation Frontier Programme is a consensus of

The Department of Science and Technology recognises the wealth of indigenous knowledge through various projects. These include:

- drafting the Indigenous Knowledge Systems (IKS) Bill
- financial support for the IKS of the South Africa Trust
- establishing interdepartmental committees on IKS
- dedicated ring-fenced funding from the National Research Foundation for IKS research
- developing a framework for the establishment of the South African Indigenous Knowledge Digital Library based on the Traditional Knowledge Digital Library in India.

The IKS Policy and Bill were adopted by Cabinet in November 2004. The policy builds on initiatives already in place, such as the National Language Policy, the promotion and copy-writing of indigenous music and art forms, and the Traditional Health Practitioners Act, 2004 (Act 35 of 2004).

key stakeholders, including the departments of minerals and energy and of trade and industry; Eskom; the Nuclear Energy Corporation of South Africa; universities; and science councils.

The PBMR programme represents a significant development for South Africa in the field of nuclear S&T. This programme is about four years ahead of any other high-temperature gas-cooled reactor programme in the world. To maintain this competitive edge, rapid development of the research and skills base in South Africa is essential.

This fast-track five- to 10-year programme is aimed at:

- utilising and co-ordinating existing capacity and instruments to grow a critical research and skills base to support the PBMR programme for a sustainable nuclear industry in South Africa
- promoting new programmes at universities to stimulate innovation and high-calibre intellectual capacity in PBMR-specific science and engineering disciplines, with a special focus on HDIs
- stabilising attitudes towards nuclear technology in society, through the creation of awareness programmes.

National Advisory Council on Innovation

The NACI is appointed by the Minister of Science and Technology to advise on the role and contribution of innovation, including S&T in promoting and achieving national objectives. These include:

- improving and sustaining the quality of life of all South Africans
- developing human resources for S&T
- building the economy
- strengthening the country's competitiveness in the international sphere.

NACI membership is broadly representative of all sectors and is constituted to ensure a spread of expertise and experience regarding national and provincial interests, scientific and technological disciplines, innovation regarding the needs and opportunities in different socio-economic fields and R&D in all sectors.

Public understanding of science, engineering and technology (PUSET)

The department's efforts in this regard include:

- The South African Reference Group on Women in S&T, established in March 2003. This ministerial body advises on ways to increase the visibility and development of women, and on making science more relevant to the needs of society by incorporating women's needs and expectations.
- The Women in Science Awards, first awarded in 2003, to honour female scientists and their achievements.
- The SET Week project, implemented for the first time in 2000. The 2005 National Science Week (NSW) was launched in May 2005 by the Minister of Science and Technology, Mr Mosibudi Mangena, under the theme *Tomorrow's Science and Technology is in our Youth's Hands*. The NSW is an annual week-long event aimed at highlighting the important role that science plays in everyday life and encouraging more youth to participate in Science, Mathematics, Engineering and Technology-related studies and careers. Over 40 sites throughout the country offered SET awareness events during the NSW.

National Biotechnology Strategy (NBS)

The 1996 *White Paper on Science and Technology* set the course for the transformation of South Africa's S&T system into a better co-ordinated and inclusive system aimed at benefiting all South Africans.

The biotechnology industry in South Africa is growing rapidly off a small base. Funding for genetic engineering grew by 360% between 2002 and 2004. The growth in all related fields, namely biochemistry, genetics and molecular biology, microbiology, genetic engineering and biotechnology, exceeded 46%.

The NBS, which was launched in 2001, sets the agenda for the development of South Africa's biotechnology industry.

Other initiatives include the establishment of biotechnology regional innovation centres (BRICs),

namely: BioPAD, Cape Biotech, LIFElab and the Plant Biotechnology Innovation Centre (PlantBio). BRICs were created to act as instruments for the implementation of the NBS.

BRICs' focus areas cover a wide spectrum of the subdisciplines in biotechnology. These include human and animal health, biopharmaceuticals, industrial bioprocessing, mining biotechnology, bioinformatics and plant biotechnology. One of the challenges facing the South African biotechnology sector is the public's lack of understanding and knowledge of biotechnology applications and benefits.

Another programme initiated as a result of the NBS is the Public Understanding of Biotechnology (PUB) Programme. The PUB Programme provides the South African public with information, enabling them to participate meaningfully in debates about biotechnology and to make informed decisions.

Godisa Programme

The Godisa Trust is bringing about fundamental development in South Africa through the application of technological innovation.

Enhancing the competitiveness, productivity and sustainability of small, medium and micro enterprises (SMMEs), Godisa aims to induce long-term employment, economic growth and sustainable development as an imperative factor in the overall development of South Africa.

Since its establishment in 2001, Godisa has assisted 1 280 small business enterprises through its centres across South Africa.

The Godisa Trust is partnered by the departments of science and technology and of trade and industry, with additional support provided by the European Union (EU).

Godisa derives its name from the Setswana word meaning 'nurturing' or 'helping to grow'. As such, it incubates and nurtures SMMEs to play an increasingly vital role in developing sustainable employment and advancing essential skills and technologies.

The Godisa Trust is helping South Africans to cultivate their innovations and business ideas, and in the process, uplifting and empowering individuals and their communities.

Tshumisano

The Tshumisano partnership programme aims to encourage a closer partnership between stations based at participating universities of technology and SMMEs. The Tshumisano Trust, a joint venture between government, the German Agency for Technical Co-operation and the Committee of University of Technology Principals, is generating stronger working relationships between the departments of science and technology and of labour.

The Tshumisano technology stations offer support to South African enterprises for technology transfer and innovation. In 2003/04, 67 students involved in work programmes at the Tshumisano stations, gained practical exposure to real industry challenges as part of their training, which generally requires certain periods of work-integrated learning.

By June 2004, there were nine Tshumisano stations operating from the universities of technology environment in specific sectors to enrich their R&D, teaching and learning activities with better equipment and more realistic understanding of the industry and its needs. The sectors include chemicals, textiles, electronics, metals processing, mechanical engineering and food technology.

A key objective of these programmes is Black Economic Empowerment (BEE) through new small and medium enterprise (SME) development, and

On 7 June 2005, the Deputy Minister of the Department of Science and Technology, Mr Derek Hanekom, launched the South African Biodiversity Facility (SABIF) and its portal at the Innovation Hub in Pretoria.

SABIF aims to contribute to South Africa's sustainable development by facilitating access to biodiversity and related information on the Internet. The SABIF portal serves as South Africa's national gateway to open and free scientific biodiversity information. In doing this, SABIF will contribute towards a co-ordinated international scientific effort to enable users throughout the world to discover and put to use vast quantities of biodiversity data.

South Africa, as a voting member of the Global Biodiversity Information Facility (GBIF), has established the SABIF as a national node to the GBIF.

productivity improvement, technical mentoring and innovation services for existing SMEs.

Poverty-reduction programme

The Department of Science and Technology believes in a multipronged approach to fighting poverty.

Its poverty-alleviation projects have had positive outcomes in businesses and co-operatives focused on, among other projects, bee-keeping, paper-making, African design incorporation in clothing and textiles based on natural fibres, and indigenous cattle production. These projects are concentrated in the poverty nodes as identified by the Government's Integrated Sustainable Rural Development Strategy.

International science and technology co-operation

Science is an increasingly global activity and international funding for South African science rose from essentially nil in 1994 to 6% in 2002.

The strategy to use southern Africa's local (geographical) advantages and efforts to attract large international science-based investments are paying off. Key examples include the construction of the High-Energy Stereoscopic System (HESS) observatory in neighbouring Namibia and the Southern African Large Telescope (SALT) in Sutherland in the Northern Cape, as well as winning the bid to host the European Developing Countries Clinical Trials Partnership. Added to this are bold efforts to bolster South Africa's bid to site the Square Kilometre Array (SKA) radio telescope in South Africa. A 1% SKA demonstrator called Pathfinder is being built, which will enable the South African industry and academia to participate in the technology development process.

SALT is a multimillion-rand project involving Germany, Poland, the United States of America (USA), New Zealand and the United Kingdom (UK). SALT is the largest single optical telescope in the southern hemisphere. It was officially inaugurated on 10 November 2005.

The Department of Science and Technology is committed to building strong international relations. It manages over 30 S&T bilateral agreements with various countries and is a key player in many multilateral fora, including the Commonwealth; the African, Caribbean and Pacific Group of States; the EU; and the Organisation for Economic Co-operation and Development.

The main areas of S&T co-operation between South Africa and its international partners are material science, manufacturing technology, biotechnology, environmental management, sustainable exploitation of natural resources and minerals, medical research and public health, engineering science and the advancement of technologies, water-supply projects, and Agriculture, Mathematics and Science education.

The NRF manages the implementation of the agreements.

South Africa's role at the forefront of NEPAD is, to a significant extent, based on its ability to deploy scientific knowledge and technological solutions on the continent.

In 2002, the International Council for Science (ICSU) took a decision to establish four regional ICSU offices in the developing world. In September 2005, the council's Regional Office for Africa was launched in Pretoria. The office is located at the premises of the NRF and is hosted by South Africa.

The department has successfully promoted South Africa's participation in strategic multilateral organisations, of which the International Centre for Genetic Engineering and Biotechnology (ICGEB) is a good example. A number of South Africans have been nominated for key positions on ICGEB, including the role of external auditor.

The Department of Science and Technology has taken a leadership role in the international process to establish the Global Earth Observation System of Systems (GEOSS). Acting through the department, South Africa participated in the development of the 10-year implementation plan and was elected co-chair of the Group on Earth Observations. GEOSS aims to enable globally co-ordinated earth observations, across a number of domains, to provide better and more reliable data in areas of benefit to society, including agriculture, weather, climate, water, disasters, health, energy, biodiversity and ecosystems.

Science councils

The statutory science councils are a key part of South Africa's NSI. Through them, government is able to directly commission research in the interest of the nation and support technology development in its pre-competitive phase.

National Research Foundation

The NRF is the key public entity responsible for supporting the development of HR capacity for research, technology and innovation in all fields of S&T. Within the context of the National R&D Strategy and NEPAD objectives, the NRF is one of the major players in educating and training a new generation of scientists able to deal with South African and African needs.

The NRF is guided by corporate core missions and strategic priorities based on the needs of the NSI and the imperatives outlined in the National R&D Strategy.

The four corporate core missions of the NRF are to:

- develop and support high-quality HR in substantially increased numbers
- generate high-quality knowledge in prioritised areas that address national and continental development needs
- use knowledge, technology transfer and innovation to ensure tangible benefits to society from the knowledge created
- provide state-of-the-art research infrastructure that is essential to develop high-quality HR and knowledge.

The six cross-cutting corporate strategic priorities are:

- redressing inequalities in race and gender
- adhering to quality
- internationalising research
- focusing on Africa
- positioning the NRF within the NSI
- transforming the NRF organisationally.

With a growth of 25% in its budget from R766 million in 2003/04 to R956 million in 2004/05, the NRF is becoming a major player in the NSI. This budget includes ring-fenced funds, and the budget for national research facilities and CoEs. It excludes funds for the IF and Technology and Human Resources for Industry Programme (THRIP).

As one of the key players in the NSI, the NRF focuses on positioning itself squarely in government's strategy to deliver on the creation of wealth and the improvement of the quality of life. Achievement of these goals in the long run depends critically on highly-skilled people who can generate new knowledge, develop and use new technologies, innovate, and drive the competitiveness of the country in international world markets.

Recommitment to support for 'Big Science'

The NRF will continue to promote the competitive advantage of South and southern Africa for capital-intensive 'Big Science' initiatives among the international community of scientists. The decision on the siting of the SKA radio telescope is expected in 2008. It is anticipated that the success of the SALT will positively influence the deliberations.

Both the African Coelacanth Ecosystems Programme (ACEP) and Inkaba ye Africa (a multi-institutional German/South African collaborative research programme in the Earth and space

The Minister of Science and Technology, Mr Mosibudi Mangena, officially opened the Women in Science Awards in August 2005, in Johannesburg. Hosted by the Department of Science and Technology, the awards are aimed at celebrating the significant contribution of outstanding women in scientific research that has led to economic growth and an improvement in the quality of life of all South Africans.

The 2005 awards were supported by L'Oreal South Africa as part of the company's partnership with the United Nations Educational, Scientific and Cultural Organisation. Ten winners were identified in eight award categories.

The Women in Science Awards underscore the Department of Science and Technology's efforts to radically increase the number of women entering the sciences and remaining there, as part of the national pursuit of sustainable economic growth.

sciences) are evolving into two major internationally co-sponsored flagship programmes.

The conceptualisation of the Major Radiation Medicine Centre, using the unique infrastructure and expertise at iThemba LABS that includes a separated sector cyclotron, is at an advanced stage. It was anticipated that financing for this project would be secured in 2005/06.

The first of several South African Environmental Observation Network nodes was launched in September 2004. The NRF was requested by the Department of Arts and Culture to assist with the establishment and management of the Human Language Technologies Facility. In line with policy to support 'Big Science', the NRF is committed to ensure that South African scientists gain access to major international research facilities.

Research and Innovation Support Agency (RISA)

The purpose of RISA is to advance the promotion and support of research and research-capacity development in all fields of knowledge and technology. This is done by investing in knowledge, people and infrastructure; promoting basic and applied research and innovation; as well as developing research capacity and advancing equity and redress to unlock the full creative potential of the research community. RISA facilitates strategic partnerships and knowledge networks, while upholding research excellence.

The South African Government aims to transform South Africa into a knowledge society that competes effectively in a global system. Because this requires educated and appropriately skilled people, much effort has been directed towards ensuring that RISA-supported research is focused on areas that are relevant to the development challenges of South Africa in a rapidly changing, highly competitive and knowledge-driven environment.

RISA has restructured to build its activities around the NRF key driver to produce large numbers of high-quality doctorates. The Knowledge Field Development function promotes new knowledge and research capacity. Institutional Capacity Development promotes the capacity of Higher Education (HE) and other research institutions in South Africa to deliver skills of the quality and quantity required by the national R&D challenges. Knowledge Management and Strategy provides policy advice and ensures rational decisions in grants management and administration.

RISA's granting functions centre on nine focus areas, which provide a framework for generating new knowledge and training HR through research. The focus areas are:

- unlocking the future: advancing and strengthening strategic knowledge
- identifying distinct South African research opportunities
- conservation and management of ecosystems and biodiversity
- economic growth and international competitiveness
- education and the challenges for change
- indigenous knowledge systems (IKS)
- Information and Communications Technology (ICT) and the information society in South Africa
- socio-political impact of globalisation: the challenge for South Africa
- sustainable livelihoods: the eradication of poverty.

Research Capacity Development (RCD)

RCD programmes focus on boosting historically black universities and universities of technology committed to the research process. In addition, the Thuthuka Programme supports individual researchers. It comprises researchers in training, women in research, and research development for black academics. All the NRF's RCD initiatives aim to boost the output of high-level black HR (both academics and research students at all HE institutions); develop a postdoctoral research culture; strengthen weak, yet critically important disciplines; improve gender equity; and renew outdated research equipment.

Student support

The NRF provides two complementary types of postgraduate student support.

Free-standing bursaries, scholarships and fellowships are awarded directly to postgraduate students

on a competitive basis, while grantholder-linked bursaries are granted to researchers within their NRF support package and may be awarded to students selected by the NRF grantholder. The NRF offers a limited number of travel grants for research abroad.

Knowledge management

The NRF's Knowledge Management Directorate includes Information and Strategy Advice, the Evaluation Centre and the IT Department. Knowledge management, including records management, and expanding communities of practice are high on RISA's agenda.

Internationalisation

Internationalisation has been identified as a strategic priority for the NRF. The goal of becoming globally competitive requires local professionals and researchers to collaborate with the best in the world. This collaboration enhances knowledge transfer and the sharing of expertise, improves knowledge production and offers opportunities to train research students.

A new vision will be formulated for leveraging international capacity to build South Africa's R&D capacity. In the short term, the strategy will be designed and tested within the research community, for implementation in the longer term. It will be expected of all RISA funding programmes to indicate their contribution to internationalisation in all knowledge domains.

Several other initiatives in internationalising South African science are vested within granting programmes and other sections of the RISA:

- Inkaba ye Africa
- the Royal Society/NRF programme, which has received approval for continued funding for a second cycle
- continued support to the steering committee of the International Group of Funding Agencies for Global Change Research
- support to the ICSU African Regional Office at the NRF in Pretoria
- implementation of newly identified ICSU priority areas
- National Science Foundation/NRF collaboration in science education research, involving partners in the UK and Australia.

An amount of R10,9 million was allocated for the internationalisation of science during 2005/06.

Technology for Human Resources for Industry Programme

Managed by the NRF, advised by the THRIP Board and sponsored by the Department of Trade and Industry, this programme supports projects that address the technology and HR needs of industry on a cost-sharing basis with industrial partners.

During 2005/06, THRIP was expected to implement recommendations made in the new five-year strategic plan approved by the Department of Trade and Industry. The programme would thus be better aligned to key strategies that government uses to guide increased R&D competitiveness, grow the economy, create jobs, eradicate poverty and provide equity within South Africa. There is also a strong focus on monitoring and mentoring to broaden participation.

The programme is focusing on increasing participation by SMMEs, BEE entities and black and women researchers and students. It also aims to increase the share of the THRIP budget allocated to HDIs and universities of technology.

In 2005/06, the MTEF budget allocation for THRIP was R143 million.

Science and Technology Agreements Committee (STAC)

The NRF is responsible for managing and administering STAC-related activities and grants and overseeing projects. The Department of Science and Technology retains the responsibility for negotiating bilateral or multilateral agreements with international partners and drafting framework programmes. These agreements develop scientific relations between the research communities of the intergovernmental signatories and establish long-term, scientific co-operation. Emphasis is placed on training, the inclusion of doctoral students and the exchange of postdoctoral fellows.

During 2005, the Swiss National Science Foundation's bilateral agreement activities and funds

were expected to be transferred to STAC. The support for activities within the IBSA (India, Brazil and South Africa) agreement was also expected to be launched. The co-operation within the EU Framework will continue through marketing and workshops around the EU research platforms.

In 2005/06, the STAC budget increased to R26,5 million.

Scarce Skills Development Fund

The Department of Labour, in conjunction with the departments of education and of science and technology, is responsible for ensuring training in scarce skills, both in HE and other training institutions, especially in S&T. To deliver on this objective, the Department of Labour recommends the allocation of resources from the National Skills Fund (NSF) for bursaries and scholarships. The NRF has become the implementing agency for the Department of Labour to provide and support scarce skills at postgraduate levels in S&T.

Biodiversity programmes

The Department of Science and Technology requested the NRF to manage some initiatives linked to the biodiversity science thrust of the National R&D Strategy. These include the South African Biodiversity Initiative and the South African Biodiversity Information Facility.

The NRF manages the Sea and Coast Programme with the Department of Environmental Affairs and Tourism as a co-investor. This research programme provides information, advice and training in support of optimal and sustainable use and the development of sea, coasts and estuaries. The Sea and Coast Programme ends in 2006 and the South African Network for Coastal and Oceanic Research (SANCOR), administered by the NRF, was expected to undertake an independent evaluation of this programme in 2005.

The NRF will continue to manage the provincial research projects of the Branch: Marine and Coastal Management of the Department of Environmental Affairs and Tourism. These projects have a strong applied research focus which feeds into the management of marine and coastal resources, including resource allocations for the fishing industry.

South African National Antarctic Programme (SANAP)

In 2004, the Department of Science and Technology appointed the NRF as implementing agency to administer the grant award process for SANAP in conjunction with the Department of Environmental Affairs and Tourism, which will continue to administer the logistics of the programme. The programme aims to create a demographically balanced Antarctic research programme that strives for high-quality international research, and links to other African countries and interdisciplinary research. The estimated budget is R5 million.

Indigenous Knowledge Systems

Similar to STAC, the NRF receives a ring-fenced grant for IKS from the Department of Science and Technology to support research and HR development in the field of indigenous knowledge. RISA reports separately to the Department of Science and Technology on the outcomes of this programme. The IKS grant from the Department of Science and Technology amounts to R10 million annually.

Additional initiatives

- The NRF has taken on management responsibility for CoEs. The Department of Science and Technology has entrusted the NRF with managing these centres to stimulate research, generate high-quality HR development and to impact meaningfully on key national and international R&D issues.
- The Department of Trade and Industry has recognised the need for greater innovation and skills development and will fund centres that focus on national priorities and sectors for which the Department of Trade and Industry is the primary custodian. Managed by the NRF, the CoEs in industrial R&D will maximise co-operation and synergies with other relevant NRF programmes.
- Following international trends of funding-endowed chairs at HE institutions to provide

leadership and guidance in a specialist field, the Department of Trade and Industry has decided to support endowed chairs of entrepreneurship and enterprise development.
- Postgraduate bursaries for the disabled are made possible through a grant of R5 million per year by the Department of Labour's NSF.
- The Department of Trade and Industry has asked the NRF to manage the Mathematics and Science Teachers' Training Programme to enhance Science and Mathematics educators' teaching skills. A budget of R20 million was allocated for this initiative in 2004/05.
- The NRF manages the Innovation Postdoctoral Fellowship Programme on behalf of the Department of Science and Technology. It is a five-year programme that aims to support up to 100 new postdoctoral fellowships with R15 million per year from the department.

South African Agency for Science and Technology (SAASTA)

Facilitating the interface between science and society, SAASTA's mandate is to promote public awareness, appreciation and engagement of SET in South Africa. SET education, through pre-tertiary, tertiary and lifelong learning initiatives, provides the base for creating the required human capital for South Africa's SET endeavours. SAASTA aims to increase the number of previously disadvantaged learners who enrol for and perform in Mathematics and Science.

SAASTA makes a major contribution towards raising the quality of and expanding the feeder system that inputs into other NRF HR development strategies. The agency enhances the NRF's seamless approach to HR development. This approach entails the promotion of appropriate human capital from schools level to building student capacity, research expertise, entrepreneurship, technological capacity and eventually innovation. This, in turn, creates economic growth and improved quality of life.

SAASTA's three strategic pillars for the science promotion and awareness programmes of the NRF are:
- education-related programmes (preparing tomorrow's scientists and innovators)
- a SET awareness platform, incorporating a reconstituted museum, the National Zoological Gardens (NZG), the Johannesburg Observatory, and infrastructure available through the national research facilities (engaging with the phenomena of science)
- science communication (communicating the research advances of science to the public).

National research facilities

The NRF manages the following:
- South African Astronomical Observatory (SAAO)
- Hartebeesthoek Radio Astronomy Observatory (HartRAO)
- Hermanus Magnetic Observatory (HMO)
- South African Institute for Aquatic Biodiversity (SAIAB)
- South African Environmental Observation Network (SAEON)
- NZG
- iThemba Laboratory for Accelerator-Based Sciences (iThemba LABS).

South African Astronomical Observatory and Southern African Large Telescope

The SAAO is the national research facility for optical/infrared astronomy in South Africa. Its prime function is to further fundamental research in astronomy and astrophysics at national and international level.

As the premier optical/infrared astronomy facility in Africa, SAAO also plays a leading role in the promotion of astronomy on the continent. In terms of research, it is one of the most productive scientific

Two 190-million-year-old dinosaur embryos from a group of seven eggs have been identified as the oldest dinosaur embryos yet found. Discovered in South Africa, they are also the oldest known embryos for any terrestrial vertebrate.

institutions. There are strong international links worldwide through scientific collaboration and technological exchange. SAAO's research excellence is underpinned by strong technical competencies in niche areas.

In 2005, SAAO made the transition from the SALT construction phase to the SALT operation phase. Through devising a vastly superior spherical aberration corrector, and a variety of other innovations, SAAO has contributed to making SALT more capable than its prototype, the Hobby-Eberly Telescope in Texas.

SALT represents a paradigm shift for the SAAO in terms of the level and complexity of technology. It will open up new areas of research, which are currently not possible to pursue at SAAO. SAAO scientists will be responsible for spearheading the South African scientific use of SALT and training the southern African user community. Therefore, a major challenge to SAAO in 2005/06 will be the reorientation of scientific effort towards SALT science.

From the outset, SALT was conceived as an African facility. With the advent of large-scale facilities such as SALT and the HESS, and other initiatives such as SKA, Inkaba ye Afrika and ZASat, southern Africa is emerging as a regional space S&T hub.

Hartebeesthoek Radio Astronomy Observatory

HartRAO is the national research facility responsible for research and training in radio astronomy and space geodesy in South Africa. The radio telescope is available for research either as a single, independent instrument or in global networks of radio telescopes, using the technique of very long baseline interferometry (VLBI).

HartRAO is one of only five permanent fundamental space geodesy stations worldwide and participates in geodetic VLBI through the International VLBI Service, in satellite laser ranging (through the International Laser Ranging Service) and in the Global Positioning System (GPS) (through the International GPS Service). The data is available to the international community.

The radio astronomy group is repositioning itself to meet the expectations and demands of the National Astrophysics and Space Science Programme, SKA and increased university involvement. The space geodesy group is aligning itself with a multidisciplinary approach and capacity-building initiatives through expansion, collaboration and new projects.

Hermanus Magnetic Observatory

The HMO functions as part of the worldwide network of magnetic observatories. Its core function is to monitor and model variations of the Earth's magnetic field. It is primarily the HMO's scientific achievements, critical location, and unique facilities that make it indispensable in the global network of magnetic observatories.

The density of geomagnetic recording stations in Africa is significantly less than in other continental landmasses. The continuous recording stations operated by the HMO are the only operational sources of ground-based geomagnetic field data south of the equator in Africa. The HMO is one of only four geomagnetic observatories whose data is used by the World Data Centre for Geomagnetism in Kyoto, Japan, for measuring geomagnetic storm intensity.

South African Institute for Aquatic Biodiversity

The SAIAB is an interactive hub focused on serving the nation by generating, disseminating and applying knowledge to understanding and solving problems on the conservation and wise use of African fish and aquatic biodiversity.

The SAIAB cares for and develops the National Fish Collection; generates knowledge through research on aquatic biodiversity and the fundamental processes and conservation of aquatic biodiversity in Africa; and trains and educates knowledge workers in aquatic biodiversity. It addresses national and international issues in aquatic biodiversity through the priorities set by national and international funding agencies.

The most direct challenges facing SAIAB are to ensure continued funding for the ACEP; develop research capacity; develop biosystematic skills capacity; and inspire, educate and train a new

generation of South African aquatic biosystematic and conservation scientists. The SAIAB is working on a knowledge management system required to develop and manage aquatic biodiversity databases. The facility is also working on consolidating its position within the NSI, especially in relation to the South African National Biodiversity Institute (SANBI).

iThemba Laboratory for Accelerator-Based Sciences

Providing modern research facilities to users in science, medicine and industry, iThemba LABS has established itself as a major commercial centre for radiation medicine. It is also forging strategic partnerships with the private and public sectors to leverage capital, skills and the expertise required for an initiative of this magnitude. iThemba LABS focuses on providing scientifically and medically useful radiation through the acceleration of charged particles. It is the primary centre of expertise in radiation medicine and nuclear S&T in South Africa.

iThemba LABS is expanding its research facilities and infrastructure to enhance training, HR development and transformation, as well as building international collaborations (especially in Africa) to improve the S&T profile. There is a strong focus on facilitating a quantum increase in postgraduates in S&T. This is essential for transforming the South African S&T workforce and for building a successful economy to minimise the impact of poverty.

National Zoological Gardens

The NZG was declared a national research facility in April 2004. It has since been engaged in a strategic reorientation process to align with, and make a contribution to, the core missions and strategic priorities of the NRF.

The NZG is undergoing radical transformation from being a traditional zoological garden, to being a national facility for and an active participant in terrestrial biodiversity research. It has the potential to offer South Africa, Africa and the international community at large the infrastructure required to conduct world-class, and knowledge-generating research.

The NZG houses one of the largest animal collections in the world. It operates three breeding centres and covers an area of over 6 000 hectares. The NZG is well placed as an education platform, receiving close to 600 000 visitors a year, comprising learners, educators and the general public.

South African Environmental Observation Network

The purpose of the SAEON is to generate long-term information relevant to the sustainable management of natural resources and habitat over a range of ecoregions and land uses. These include pristine (wild) landscape, partially pristine (managed) landscape, agriculturally (rural) transformed landscape and urban transformed landscape.

SAEON will establish innovative research platforms and information-management systems for long-term multidisciplinary, multi-institutional and participatory ecosystem studies with strong regional and global linkages. These research platforms are co-ordinated as nodes, with the first one – the Ndlovu Node – established during 2004 in Phalaborwa. The SAEON Fynbos Node and the Marine and Coastal Node were expected to be launched during 2005/06.

Agricultural Research Council (ARC)

The ARC is a statutory parastatal body established in terms of the Agricultural Research Act, 1990 (Act 86 of 1990). It is committed to the promotion of agriculture and related sectors through research, and technology development and transfer.

Through its wide network of research institutes and experimental farms, the ARC provides a strong scientific base and a broadly distributed technology-transfer capacity for the entire agricultural industry in South Africa. In support of national and household food security, ARC research empowers both commercial and resource-poor farmers.

Farmers are provided with appropriate technologies to improve production. Training of farmers and agricultural extension staff in new technologies is an integral part of the ARC's activities.

The ARC is also active in international collaboration, especially with universities in the USA, UK, Europe, Australia, New Zealand and Africa. It has

memoranda of understanding with numerous scientific role-players in other countries.

The ARC's institutes have localised research and demonstration trials at about 40 sites. These include strategic research farms and satellite stations located within some provincial departments of agriculture.

ARC Institute for Soil, Climate and Water

This institute in Pretoria, Gauteng, promotes the characterisation, sustainable utilisation and protection of natural resources.

Research activities cover soil science, agrometeorology, water utilisation and analytical services.

ARC Institute for Agricultural Engineering

Situated in Pretoria, the institute is active in agricultural mechanisation, resource conservation, farm structures, irrigation, alternative energy, aquaculture and product-processing.

Research is directed at a wide range of clients, from subsistence farmers using animal traction to commercial farmers and manufacturers requiring scientific performance evaluations of advanced equipment. Innovative energy sources and applications are developed for rural areas.

ARC Plant-Protection Research Institute

The ARC Plant-Protection Research Institute in Pretoria concentrates on national agricultural and environmental problems. It is committed to the promotion of economic and environmentally acceptable pest control. Research focuses on biosystematics, ecology and epidemiology of vertebrates, as well as fungi, and pathogenic and useful bacteria and viruses.

The institute researches the control of pests and invasive plants through effective pesticide management, as well as biological and integrated control strategies. A variety of services are provided.

The institute also houses the Plant Genetic Resource Unit.

ARC Grain Crops Institute

This institute, situated in Potchefstroom, North West, is responsible for research into the improvement and cultivation of grain crops such as maize, sorghum and millet, as well as oil-and-protein seeds such as sunflower, ground-nuts, soya beans, dry beans, cowpeas, sweet white lupin and bambara. Research activities involve plant-breeding, evaluation of cultivars and grain quality, plant physiology and other production factors.

ARC Small Grain Institute

The ARC Small Grain Institute in Bethlehem, Free State, concentrates on the improvement and cultivation of small grain crops such as barley, wheat, oats, triticale and rye. Research activities include plant-breeding, evaluation of cultivars and grain quality, plant physiology, tillage, weed science, plant pathology, entomology and yield potential.

ARC Institute for Industrial Crops

This institute in Rustenburg, North West, is involved in all fundamental and applied research in the interest of the tobacco and cotton industries. Research is also conducted on other fibre crops such as hemp, sisal and flax, which have potential as new crops in rural areas.

ARC Institute for Tropical and Subtropical Crops

The ARC Institute for Tropical and Subtropical Crops in Nelspruit, Mpumalanga, is responsible for research into all aspects of the cultivation of tropical and subtropical fruits.

Other crops on which production research is conducted include tea and coffee, spices such as ginger, as well as pecan, macadamia and cashew nuts. Lesser-known exotic crops being evaluated are pitanga, feijoa, annona types, carambola and jaboticaba.

ARC Roodeplaat Vegetable and Ornamental Plant Institute

Situated outside Pretoria, this institute concentrates on a wide range of horticultural crops. Research is conducted on commercial vegetables such as

onions, potatoes, tomatoes and sweet potatoes. Traditional and indigenous vegetables receiving attention include amaranthus, cassava, plectranthus, Zulu round potato, pigeonpeas, cowpeas and bambara.

Research on the production and development of ornamentals and indigenous flora such as fynbos, woody ornamentals and bulbs, has led to a new growth industry.

ARC Infruitec/Nietvoorbij

ARC Infruitec/Nietvoorbij in Stellenbosch, Western Cape, is responsible for research on the cultivation and post-harvest technology of deciduous fruit.

Other assigned crops are berry fruits, tree-nut crops, rooibos tea, honeybush tea, dates, olives, kiwi fruit and hops. It is also responsible for research on the cultivation of table, raisin and wine grapes, as well as on the production of wine and brandy.

ARC Animal-Improvement Institute

The ARC Animal-Improvement Institute at Irene, near Pretoria, provides the livestock industry with technologies for the improved quality of animals.

It has established genetic and physiological methods to identify and study superior breeding material to improve the efficiency of the national herd.

ARC Animal Nutrition and Animal Products Institute

Situated at Irene, near Pretoria, this institute develops environment-friendly technologies to promote animal production through improved nutrition.

Research is conducted on beef and dairy cattle, sheep, pigs, goats and poultry. The institute also evaluates technologies to enhance the quality of meat and dairy products.

ARC Onderstepoort Veterinary Institute

The ARC Onderstepoort Veterinary Institute, north of Pretoria, is responsible for preventing and controlling animal diseases. It also provides a public health service regarding animal products such as milk, meat and eggs.

The institute conducts research on specialised diagnostics, parasitology, toxicology and related disciplines. Various vaccines and other biological products are developed and produced. The institute also houses a high-security facility for research into infectious diseases such as foot-and-mouth disease and African swine fever. It serves as a regional centre for diagnostic services, advice and training.

ARC Range and Forage Institute

The institute, situated in Pretoria, focuses on the development of holistic and integrated land-use strategies. It provides guidelines for sustainable livestock and rangeland management systems.

Council for Scientific and Industrial Research (CSIR)

Constituted by an Act of Parliament in 1945, the CSIR is one of the largest scientific and technology research, development and implementation organisations in Africa. It is situated in Pretoria and is represented in each of South Africa's nine provinces.

The council undertakes and applies directed research and innovation in S&T to improve the quality of life of the country's people. Building measurable value into its work through local and international partnerships remains a key component of its endeavours to provide world-class technology.

Supporting national imperatives

South Africa's national imperatives and global challenges provide the macro-strategic framework within which the CSIR conducts its research. In an effort to contribute to placing Africa on a path of sustainable growth and development, the organisation supports and actively participates in NEPAD. The CSIR's current five-year strategy, which largely shapes its agenda until 2008, highlights the following five strategic initiatives:

- aligning with and contributing to key government initiatives
- consolidating excellence in SET
- contributing to excellence in business and innovation

- contributing to sustainable development
- accessing and developing the best minds.

The CSIR's portfolio includes:

- research, development and implementation
- technology transfer and assessment
- scientific and technical education and training
- policy and strategic decision support
- global S&T links as well as perspectives
- specialised technical and information consulting
- prototyping and pilot-scale manufacturing
- commercialising intellectual property, including venture establishment.

The organisation's staff complement is about 2 500 with a core of technical and scientific specialists. HR development and transformation in the CSIR are clearly influenced by the CSIR's emerging challenges. Processes have been developed in accordance with the dictates of a knowledge economy in a global world and the challenges facing South Africa.

The CSIR's parliamentary grant is intended to keep its knowledge base and facilities at the leading edge of technological development. The grant is invested in developing new areas of expertise in emerging research fields, undertaking 'pre-competitive' research too risky for the private sector to fund, and for training young researchers.

Mintek

Mintek, South Africa's national mineral research organisation, is one of the world's leading technology organisations specialising in mineral processing, extractive metallurgy and related areas. Working closely with industry and other R&D institutions, Mintek provides service testwork, process development, consulting and innovative products to clients worldwide.

Mintek is an autonomous statutory organisation and reports to the Minister of Minerals and Energy. About 35% of the annual budget of R278 million is funded by the State's science vote, with the balance provided by contract R&D, sales of services and products, technology licensing agreements and joint-venture operating companies. Mintek has some 480 permanent staff members, over half of whom are scientists, engineers and other technical R&D personnel.

Mintek's objectives are to research, develop and transfer to industry novel and improved techniques for processing, extracting, refining and utilising minerals and mineral products, to:

- enhance the competitiveness of South Africa's minerals industry in the global market
- assist local mining and engineering companies to expand internationally
- promote job creation, economic growth and regional development.

Specific goals are:

- promoting increased beneficiation of South Africa's minerals and mineral commodities by developing competitive and innovative processing technology and equipment
- strengthening South Africa's international position as a supplier of mineral technologies, capital goods and services
- developing regional strategies for the mineral-processing sector, concentrating on value-addition, capacity-building and broad-based development.

Mintek's activities include:

- providing essential services (information, consulting and experimental)
- increasing the competitiveness of industry by developing appropriate technology to cut costs and improve recoveries
- developing 'breakthrough' process technologies and novel uses for metals and their products
- marketing its commercial products and technologies to industry
- establishing strategic partnerships and joint ventures
- participating in regional development initiatives and SADC activities and projects
- maintaining and expanding international scientific links
- developing the HR potential of the region through educational and training activities.

To ensure focus and market orientation, Mintek's R&D activities are grouped into programmes that are based largely on industry structure:

- The Gold Industry Programme focuses on developing and introducing improved technologies such as biotechnology and ion-exchange

processes, to simplify processing and increase recoveries, particularly from ores that are difficult to treat. A major joint venture with industry and other research groups is exploring new industrial uses of gold.
- The Platinum-Group Metals (PGMs) Industry Programme aims to increase the cost-effectiveness of PGM production and stimulate industrial demand for PGMs.
- The Ferrous Metals Industry Programme develops products and technical services to increase the cost-effectiveness of ferro-alloy production, as well as stainless steels and other alloys with improved properties.
- The Non-Ferrous Metals Industry Programme includes the processing of aluminium, cobalt, copper, lead, magnesium, nickel and zinc. Major emphasis is placed on the introduction of cleaner technologies.
- The Industrial Minerals Industry Programme includes the beneficiation and processing of commodities such as heavy minerals, chromite, iron and manganese ores, andalusite, phosphates, fluorite and diamonds. Mintek's research into waste management and environmental problems also fall under this programme.

Promoting industrial growth

Mintek is promoting a number of major new industrial projects based on mineral beneficiation, and utilising both existing and newly developed technologies. These include recovering PGMs from chromite tailings, producing ferronickel and electrolytic manganese dioxide, and establishing a local magnesium industry using a novel thermal production route.

Regional development

Mintek carries out surveys, evaluations and commodity and market studies to support initiatives by international, governmental, regional or industry associations. It also identifies and evaluates potential development projects, assesses and provides technology, and conducts feasibility studies. Mintek supports the activities of the SADC Mining Co-ordination Unit and was closely involved in developing the economic growth strategy for NEPAD and the African Mining Partnership.

Mintek's Small-Scale Mining (SSM) Division supports the SSM sector by developing appropriate technologies, providing consulting services and training, and promoting sustainable mining, downstream processing and value-addition through integrated development programmes.

Environment

Mintek focuses on the development of environmentally responsible technologies for the recovery and recycling of metals from metallurgical residues. A major programme is in place to monitor cyanide species after discharge in various locations around gold plants, from both an environmental and a processing point of view.

Mintek's environmental management system has been certified as meeting the requirements of the International Organisation for Standardisation (ISO) 14001 standard.

Education

The development of appropriate HR is crucial for the long-term sustainability of the minerals industry. Mintek's educational and training initiatives are provided through a section 21 company that was set up to develop technicians, technologists, engineers and others with appropriate skills from previously disadvantaged communities. The specific programmes include:
- artisanal and SSM training
- jewellery manufacturing
- upgrading of Mathematics and Science skills
- undergraduate and postgraduate bursary schemes
- in-training programmes for recently qualified engineers and technicians.

Human Sciences Research Council (HSRC)

The HSRC is South Africa's statutory research agency dedicated to the applied social sciences. It has about 130 researchers, mainly specialists, 30 interns and 110 support staff. Its revenue is derived roughly equally from its parliamentary grant and from earnings through tenders, commissions and local and international foundation grants.

The HSRC conducts social-science research concerned with all aspects of development and poverty alleviation in South Africa, the region and in Africa.

Research programmes

The HSRC's research is organised into 10 interdisciplinary programmes:

Assessment Technology and Education Evaluation (ATEE)

ATEE focuses on the monitoring and evaluation of education change at national, provincial, district, school and classroom level. It also develops instruments and techniques for assessing individuals in the workplace.

The research programme provides valuable information to address quality, equity, access and redress issues for transforming the education and training sector. It focuses on the following areas:

- language and literacy studies, including language policy development and implementation
- Science, Mathematics and Technology education, including research to provide information to policy-makers to plan for Science, Mathematics and Technology education at school level
- school reform and policy analysis, including understanding the school system, and how to transform and measure change
- methodology, modelling and analysis.

Child, Youth and Family Development (CYFD)

CYFD is dedicated to national social development through innovative research that has significant intervention and policy implications.

It works in seven priority areas:

- early childhood development and intervention, including nutrition, psycho-social development, health, illness and pre-school education
- rights and protection, including violence and abuse, child labour, children and youth in care, and law and justice as it affects children, youth and families
- socialising and learning, including language and literacy, schools, neighbourhoods and social identity
- youth development, including civic engagement, work, livelihoods and life skills, subcultures and networks
- risk and resilience, including context and determinants, risk behaviours, prevention and intervention to reduce high-risk conditions and behaviour
- sexuality and reproductive health, including HIV and AIDS, teenage pregnancy and parenthood, sexual violence, gender and relationships
- families and households, including family formation and security, dissolution and coping, roles and responsibilities, culture and values, and the impact of HIV and AIDS.

Democracy and Governance (D&G)

D&G explores contributions to and constraints upon democratisation in South Africa and the African continent. Researchers evaluate the policies, institutions and impact of government, business and civil society regarding their capacity to reduce inequality and poverty, while empowering communities to promote local, regional and national sustainable development. D&G has three major thrusts, namely democratisation, local government and delivery, and public service and development.

The programme focuses on:

- evaluating legislation, policies and administration of government in terms of its ability to reduce inequality and poverty
- exploring the linkages between state institutions and the characteristics of African political economies which contribute to, or threaten, democratic consolidation.

Employment and Economic Policy Research (EEPR)

EEPR seeks to improve and disseminate an understanding of the nature and causes of persistent unemployment and underemployment. This work feeds directly into strategy and action by enabling public and private interventions. To ensure relevance and uptake, each new step involves critical stakeholder groups and government departments.

EEPR's priority areas include:

- labour-market analysis, including skills development, regional labour-market studies, the eco-

nomic impact of HIV and AIDS and the design of active labour-market policies
- sector strategies, with an emphasis on employment creation, including industrial competitiveness studies and basic needs industries
- integrated employment studies, including evidence-based employment scenarios, such as in-depth analysis of employment statistics.

Human Resource Development (HRD)

This research programme undertakes research on the development of HR, orientated largely towards the creation of an improved information and analysis infrastructure to support government decision-making in this area.

Its primary focus is the study of the pathways of learners from school into Further Education and HE, and into the world of work. HRD is a cross-sectoral research issue, shaped by and affecting a number of related government policy domains. It aims to yield the appropriate human and technological capabilities necessary for human development, equity, and future national economic success.

Integrated Rural and Regional Development (IRRD)

IRRD promotes rural development in South and southern Africa through user-driven policy, monitoring and evaluation, and problem-orientated research. With poverty reduction as the unifying, overarching theme, the programme's objectives, orientation and activities are designed specifically to address key regional, national and Africa-wide policy priorities.

There are four distinct, but interlocking, subprogrammes:
- land and agrarian reform, which investigates land tenure, land use, land redistribution and restitution, farm labour and employment and environmental and related issues
- rural non-farm development, which investigates rural livelihoods, rural infrastructure and service delivery, rural micro-enterprise support, and eco-tourism
- regional resource flows, which investigates HR, trade and capital flows into, out of, and within southern Africa
- poverty reduction, which investigates a wide range of issues related to policy, strategy and practice to reduce poverty in South and southern Africa.

Knowledge Management (KM)

KM focuses on knowledge production, measurement and sharing, and interacting with peers nationally and internationally. It covers three overlapping domains:
- The information society, which has developed a strong working relationship with the Presidential National Commission for the Information Society and Development.
- The NSI studies, which consist of the *Research and Experimental Development Surveys* of 2001/02 and 2003/04. These important studies go to the core of information decision-making in respect of funding for the NSI.
- Knowledge-intensive research organisations, which measure KM practices that could be deployed across government.

Social Aspects of HIV/AIDS and Health (SAHA)

There is a high demand for quality research into the social aspects of HIV and AIDS. SAHA conducts research that is relevant to policy-making and has become both a national and SADC resource.

This research programme focuses on the following areas:
- the key socio-cultural, political, economic and demographic determinants that increase or reduce vulnerability to HIV-infection
- aspects that facilitate or hinder change in risky behaviour, enable or delay progress towards care, and prevent or mitigate the impact of HIV and AIDS
- the social epidemiology of HIV and AIDS and major public health conditions in South Africa and the SADC
- health-system issues necessary for disease control within a social development context.

SAHA has established the Social Aspects of AIDS Research Alliance (SAHARA), a vehicle for facilitating the sharing of research expertise across sub-Saharan Africa to prevent the further spread of the epidemic and to mitigate the impact of the disease.

SAHARA conducts multisite and multicountry research projects that are exploratory, cross-sectional, comparative or intervention-based.

Surveys, Analyses, Modelling and Mapping (SAMM)

SAMM is a cross-cutting entity that brings together the HSRC's capacity in surveys, quantitative and qualitative analyses, geographical information systems (GIS), statistical and econometric modelling, and data management.

SAMM consists of the following units:

- Surveys, which designs appropriate survey methods and instruments to gather relevant and up-to-date information on public attitudes, and assists other research programmes with their survey-based project needs
- Analyses, Modelling and Statistics, which provides technical research support and expertise internally and externally in data analysis, modelling and statistics
- Data Management, which is responsible for a range of data-management archiving, quality control and related data-support services
- the GIS Centre, which provides analytical and technical GIS support and services in project design, implementation and management
- Urban Renewal and Development, which is a dedicated urban research facility.

Social Cohesion and Identity (SCI)

SCI explores what constitutes South African identity, and the historical traditions and social processes that have shaped leadership in South Africa.

The programme also explores how South Africans view themselves within the emerging discourses of the African Renaissance, and how African leadership responds to the broader challenges facing the African continent within a rapidly changing and fluid global political order.

Medical Research Council (MRC)

The MRC's mission is to improve the nation's health status and quality of life, through relevant research aimed at promoting equity and development.

The MRC is an autonomous body, but reports to the national Department of Health. It receives 60% of its budget from the Department of Science and Technology. Its head office is situated in Cape Town, with provincial offices in Pretoria and Durban.

The MRC's research activities are aligned with the health priorities of the nation, and in accordance with the national S&T imperatives and the health priorities defined by the Department of Health under the philosophy of essential national health research. Activities are grouped into the following national programmes:

National Programme for Research in Molecules to Disease

This programme undertakes research on human and microbial genetics, genomics, bio-informatics, cell and molecular biology, tissue engineering, oesophageal cancer, molecular hepatology, microbacteriology, and liver and bone disease.

National Programme for Health Systems and Policy Research

The scientists in this programme conduct research on health systems, clinical epidemiology, biostatistics, health policy, burden of disease and telemedicine.

National Programme for Infection and Immunity Research

The research units in this programme are involved in research on tuberculosis, malaria, immunology of infectious diseases, diarrhoeal diseases, inflammation and amoebiasis, genital ulcer diseases, respiration and meningeal pathogens, and South African traditional medicines.

It also incorporates the MRC National HIV and AIDS Lead Programme, whose divisions co-ordinate the South African AIDS Vaccine Initiative; various aspects of biomedical research, including mother-to-child transmission and microbicides; and prevention of transmission through behavioural change. (See chapter 13: *Health*.)

National Programme for Non-Communicable Disease Research

This programme undertakes research on heart dis-

ease (both laboratory, clinical and public health research), nutritional intervention, diabetes, crime, violence and injury, anxiety and stress disorders, dental issues, medical imaging, chronic diseases of lifestyle and cancer epidemiology.

National Programme for Environment and Development Research

In this entity, research is undertaken on health promotion, health and development, exercise and sports science, occupational and environmental health, alcohol and drug abuse, and technology transfer.

National Programme for Women and Child Health Research

This programme undertakes research on many aspects of women's health, including high blood pressure during pregnancy, healthcare strategies in maternal and infant health, perinatal mortality, gender and health, mineral metabolism and nutritional intervention.

South African National Health Knowledge Network

The South African National Health Knowledge Network was established in 1999 at the MRC with funding from the Government's IF.

The network operates under the tradename *SA HealthInfo* and is available on the Internet at *www.sahealth-info.org*. It provides a one-stop interactive forum or resource for quality-controlled and evidence-based health-research information.

Council for Geoscience (CGS)

The main functions of the CGS are:

- the systematic documentation of the surface of the Earth within the borders of South Africa; the compilation of geological, geophysical, geochemical and other geoscientific information; and the publication of this information in the form of maps and documents
- geoscientific research on rocks, minerals, ores, fossils, etc. in South Africa, and the publication of research results in national and international journals
- the collection and conservation of all geoscientific information and data on South Africa in national collections and electronic databases
- the supply of geoscientific services and advice to the national and provincial governments, to ensure informed decisions regarding the optimal and efficient use of the Earth's surface.

The objectives of the CGS are to:

- minimise the geological and geoscientific investment risk for national and international entrepreneurs in the South African mining sector (the quality of available geological information, which is known as the 'geological risk grading', contributes to about 61% of the investment risk in any country)
- supply the country with basic geoscience data to establish a safe, cost-effective physical infrastructure
- supply basic knowledge to ensure safe, cost-effective and environmentally acceptable urbanisation and housing development
- carry out research on raw material needed to clothe, transport, feed and provide shelter for the nation.

To accomplish these functions and objectives, the CGS maintains a specialised workforce, consisting of Earth scientists supplemented by technical, support and administrative staff at its headquarters in Pretoria, as well as branch offices in the Western Cape, Northern Cape, Limpopo, North West and the Eastern Cape.

The following national institutions are maintained by the CGS:

- The National Geoscience Library in Pretoria is probably the most comprehensive geoscience library in Africa. It includes the National Geoscience Map Library, which contains a collection of South African and African geoscience maps.
- The National Core Library contains a representative stratigraphic-borehole core collection, representing most of the lithological units located within the borders of South Africa. This collection is housed at Donkerhoek, east of Pretoria.
- The Geoscience Museum in the Transvaal Museum in Pretoria contains a unique collection of minerals and fossils, catering for the Earth-

science education of the public, especially schoolchildren.
- An extensive laboratory analyses of rock and soil samples, using various specialised techniques.

The geoscience information and services provided by the CGS are particularly important for sustainable development of the country. In South Africa's arid regions, the management of groundwater resources (both the quantity and quality thereof) is aimed at providing enough clean water to communities.

Although South Africa is situated on a relatively stable part of the Earth's crust, the CGS maintains a seismic network for the recording of seismic events within the national borders and coastal waters off South Africa's coastline. This information is available to interested parties and helps mitigate the problems associated with mining-related seismic events.

The council is a world leader in the domain of geophysical surveys, using a detection system deployed on light aircraft. This significantly reduces the cost of very high-resolution geophysical data for mineral exploration.

Through its membership of the National Steering Committee of Service-Providers to the SSM Sector, the CGS helps mining entrepreneurs, particularly those from historically disadvantaged groups, to exploit South Africa's mineral resources in a cost-effective and environmentally friendly way.

The CGS plays a leading role in the SADC and as a result, several geoscience publications covering the region have been produced, describing heavy mineral sand, diamond, gold, bauxite and dimension-stone deposits in the region. A seismic hazard map of the region, a litho-stratigraphic table comparing the geological formations in the region, and maps of the Kalahari Basin have also been produced. A geological map of the region is in preparation.

In addition to its national responsibilities, the CGS is also active internationally, mainly in Africa. Geological and metallogenic maps of, among other countries, Angola, the Democratic Republic of Congo, Mozambique, Gabon and Morocco have been produced. The supervision of projects in Mauritania and Mozambique is also underway.

South African Bureau of Standards (SABS)

The SABS was established in 1948 with the purpose of developing, maintaining and disseminating standards in South Africa. Although this core objective has remained unchanged over the years, the mission of the SABS has changed to provide different focus relevant to the times. The SABS currently sees its mission as 'improving the quality of life of all South Africans, through the process of standardisation'.

Standards South Africa (StanSA)

StanSA is the SABS' core function and is responsible for the development, maintenance and dissemination of the country's national standards.

Through its main Standards Sales Division in Pretoria, as well as its offices in Durban, Cape Town and Port Elizabeth, all national standards as well as those of the International Electrotechnical Commission, the ISO and a host of other foreign standards are made available to the public.

Regulatory Affairs and Consumer Protection

This division of the SABS is responsible for the administration of certain national regulations, mainly on behalf of the Department of Trade and Industry. Legal Metrology forms a part of the division and ensures the protection of consumers against incorrect metrological practices such as the sale of underweight or undersized products. A specific function directed towards the provision of conformity-assessment services to the SME sector, and other Presidential imperatives and social responsibility activities, are also located in this division.

South African Bureau of Standards Holdings (Pty) Ltd.

All the conformity assessment services of the SABS are located in this company. These include the testing of products, providing system and product certification schemes, inspecting consignments and the training of people in these matters. SABS Holdings is a separate company, which competes in the private sector and charges for the services that it renders.

This is unlike SABS Regulatory Affairs and StanSA, which recover their costs from monies allocated for those purposes under the science budget vote of the Department of Science and Technology.

A corporate function provides overhead services such as finance, HR, legal, marketing and communication, risk management and IT.

Other scientific and research organisations and structures

Biotechnology Partnership for Africa's Development (Biopad)

Biopad was initiated early in 2003 by a community of biotechnologists and professionals as a means to put South Africa among the world leaders in the application of biotechnology.

Sasol

Sasol is an integrated oil and gas company with substantial chemical interests. In South Africa, these operations are supported by mining coal and converting it into synthetic fuels and chemicals through proprietary Fischer-Tropsch technology.

Sasol also has chemical manufacturing and marketing operations in Europe, Asia and the Americas. Its larger chemical portfolios include polymers, solvents, surfactants and their intermediates, waxes, phenolics and nitrogenous products.

The group explores and produces crude oil in offshore Gabon, refines crude oil into liquid fuels in South Africa, and retails liquid fuels and lubricants through a growing network of retail service centres. During the first quarter of 2004, Sasol started extracting Mozambican natural gas, some of which has been used as feedstock for fuels and chemical production in South Africa since mid-2004.

Sasol is also developing two joint-venture gas-to-liquid plants in Qatar and Nigeria based on its Sasol slurry phase distillate process.

Eskom

Eskom's Technology Services International group is a multidisciplinary industrial laboratory and consulting organisation. It undertakes testing, investigation studies, project management, engineering services and applied research for Eskom and other customers.

Mittal Steel SA

Mittal Steel SA is the dominant steel producer on the African continent, producing 7,1 million tonnes of liquid steel per year. Mittal Steel SA's global standing is further underpinned through becoming part of the world's largest steel producer, Mittal Steel Company N.V.

Through this agreement, Mittal Steel SA has access to world-class R&D, best practice processes, aggressive procurement contracts and international market leverage to ensure the company remains at the cutting edge of the international steel industry.

National Health Laboratory Service (NHLS)

The NHLS conducts research into the prevention and treatment of human diseases.

The NHLS comprises about 240 laboratories countrywide, including the former South African Institute for Medical Research, the National Institute for Virology, the National Centre for Occupational Health, all provincial diagnostic pathology laboratories (excluding those in KwaZulu-Natal), and tertiary laboratories used by universities' medical schools. It has approximately 4 000 employees and consists of four divisions: Research, Diagnostic Laboratory Services, Production (serum and laboratory reagents), and Teaching and Training. The NHLS conducts medical research as well as pathology laboratory tests for all provincial hospitals, excluding those in KwaZulu-Natal. Research is conducted on diseases and health dangers that are of specific importance to South Africa.

Bureau for Economic Research

The Bureau for Economic Research at the University of Stellenbosch, Western Cape, is an independent and objective economic research organisation. It renders a service to organisations ranging from

small one-person businesses to policy-makers at the highest level of government.

National Institute for Tropical Diseases

The National Institute for Tropical Diseases in Tzaneen, Limpopo, is responsible for the ongoing assessment of malaria-control programmes carried out by various authorities in South Africa.

Control methods are assessed, and recommendations made to the appropriate authorities regarding equipment, insecticide usage and application. A malaria-reference service is also provided. Tests for malaria are carried out by the institute, and statistical analysis of data pertaining to the programme is undertaken.

General research areas

Mine-safety research

The activities of the Safety in Mines Research Advisory Committee are aimed at the advancement of the safety of workers employed in South African mines. The committee is a statutory tripartite subcommittee of the Mine Health and Safety Council. It has a permanent research-management office managing the fields of research, namely rock engineering, engineering and mine occupational health.

Energy research

The Chief Directorate: Energy of the Department of Minerals and Energy manages a policy-directed research programme. This includes transport energy, renewable energy and energy for developing areas, coal, electricity, energy efficiency, energy economy, and integrated energy-policy formulation.

Agricultural research

Agricultural research is conducted by the ARC, several universities and various organisations in the private sector. Provinces are responsible for farm management and technological development. These activities are aimed at improving managerial efficiency on farms.

The Directorate: Scientific Research and Development in the Department of Agriculture co-ordinates all agricultural R&D activities.

Biannual meetings are held to debate and agree on research needs, programmes and budgeting. Efforts are made to ensure that the bulk of research serves the needs of small-scale producers.

Research initiatives have been integrated into the various industries in line with the overall objectives of each agricultural sector.

Water research

Water research in South Africa is co-ordinated and funded by the Water Research Commission (WRC) in Pretoria. The WRC was established in 1971 through the Water Research Act, 1971 (Act 34 of 1971), following a period of water shortage. It was deemed to be of national importance to generate new knowledge and to promote the country's water research purposefully.

The WRC is a dynamic hub for water-centred knowledge, innovation and intellectual capital. It provides leadership for R&D through the support of knowledge creation, transfer and application. The WRC engages stakeholders and partners in solving water-related problems which are critical to South Africa's sustainable development and economic growth, and are committed to promoting a better quality of life for all.

As reflected in the WRC's mission and its various undertakings, the WRC functions as a 'hub' for water-centred knowledge. It is a networking organisation, linking the nation and working through partnerships.

The WRC continues to play a leading role in building a sustainable water-related knowledge base in South Africa by:

- investing in water R&D
- building sustainable and appropriate capacity
- developing skills for the water sector
- being adept in forming strategic partnerships to achieve objectives more effectively while making optimal use of the latest global information/knowledge and other technologies available.

The Water Research Act, 1971 provides for the establishment of the Water Research Fund, which

derives income primarily from levies on water consumption.

In supporting the creation, dissemination and application of knowledge, the WRC focuses on five key strategic areas:

- water-resource management
- water-linked ecosystems
- water use and waste management
- water utilisation in agriculture
- water-centred knowledge.

The WRC also calls for specific mechanisms to address key strategic issues of national importance. These issues are dealt with in four cross-cutting domains:

- water and society
- water and the economy
- water and the environment
- water and health.

The organisations most active in water research are:

- universities and universities of technology (56,25% of the total number of contracts)
- professional consultants (16,6%)
- science councils (22,9%)
- water/waste utilities (2%)
- non-governmental organisations (NGOs) (2%).

The main areas of research are surface hydrology, groundwater, hydrometeorology, agricultural water utilisation, water pollution, municipal effluents, industrial water and effluents, drinking water, membrane technology, water ecosystems, hydraulics, mine-water management, water policy, developing communities, and the transfer of technology.

The Division: Water, Environment and Forestry Technology (Environmentek) of the CSIR specialises in research into water quality, including technology to meet effluent and water-quality standards, and to establish reclaimed water as an additional water source. Environmentek is a world leader in research into activated sludge processes and the biological monitoring of water to detect potentially toxic substances. It is also involved in research on the effects of afforestation and veld management on the quantity and quality of catchment water-yield.

Environmental research

The Chief Directorate: Environmental Management of the Department of Environmental Affairs and Tourism annually finances several research and monitoring programmes.

The programmes comprise subjects such as waste management and pollution, nature conservation, river management, the coastline and marine environment, and the atmosphere.

Some programmes are conducted in collaboration with the NRF, while others are undertaken on behalf of the department by the CSIR and universities.

Research on human-environment interaction sponsored by the department is co-ordinated by the HSRC.

In addition, institutes of the ARC are concerned with environmental research insofar as environmental problems impact on agriculture or are caused by agricultural practices.

The Department's National Environmental Potential Atlas (ENPAT) provides a visual overview of South Africa's environmental resources. The most important advantage of ENPAT is that environmental implications of land-use decisions are available before any actions are initiated. ENPAT-National contains two main data types, namely environmental and population data. The atlas also identifies possible conflict areas in the utilisation of natural resources.

The South African Weather Service (SAWS) is a statutory body functioning under the Department of Environmental Affairs and Tourism.

The SAWS delivers public-good services, mainly for the protection of life and property, as well as commercial services to the private sector, as stipulated in the Weather Service Act, 2001 (Act 8 of 2001).

Public-good services are funded by government while commercial services are paid for by the user. Public-good services include weather and climate forecasting, a weather-disaster warning system, services to subsistence farmers and fishers, the provision of information and advice to government, meeting regional and international treaty and agreement obligations, maintaining a national meteorological library, technical and scientific training in meteorology, and undertaking research to improve services.

In 2004/05, SAWS has taken a number of steps to further improve its services and capacity to deliver a world-class service.

Among other activities, SAWS has been running the Global Atmospheric Watch Programme, which measures and monitors greenhouse gas datasets. The SAWS has also rolled out a number of ozone-monitoring stations in the SADC region.

In keeping with its public-good obligations, SAWS plays a key role in offering early warning in the case of impending disasters. To this end, SAWS has increased its weather observation network in South Africa. The Mtata Radar launch in October 2004 improved the organisation's understanding of weather patterns in the Eastern Cape and the hard-to-predict East Coast. The project also involved the installation of five automatic weather stations in data-sparse areas of the province. The project provided temporary employment and training to a number of people from the involved and surrounding rural areas. In addition, SAWS has taken the first steps to acquire a lightning detection network for the country.

The NRF directs the multidisciplinary Conservation and Management of Ecosystems and Biodiversity Focus Area, primarily in collaboration with universities and museums, to promote and support research on living resources and terrestrial, freshwater, marine, coastal and atmospheric ecosystems.

Some 170 projects are approved annually, and global issues such as climate change and biological diversity are also included. The sustainable use of natural resources is a priority area, resulting in an increase in projects relying on sociology and the humanities. The NRF also supports a range of environmental research network organisations such as the Arid Zone Ecology Forum, the Fynbos Forum, the Indigenous Plant-Use Forum and the Savanna Ecology Forum.

Fisheries research

Research into South Africa's fish resources, and their conservation and judicious exploitation is carried out by research personnel of the Chief Directorate: Marine and Coastal Management, a division of the Department of Environmental Affairs and Tourism, and by several universities and NGOs. Research is designed to provide parameters for estimates of stock sizes and sustainable yields for the different fisheries.

Coastal and marine research

The Chief Directorate: Marine and Coastal Management advises on the utilisation of marine living resources and the conservation of marine ecosystems, by conducting and supporting relevant multidisciplinary scientific research and monitoring the marine environment. Sustainable use and the need to preserve future options in the utilisation of marine ecosystems and their resources are guiding objectives in the research and advice provided by the chief directorate.

The NRF supports marine and coastal research in partnership with the Department of Environmental Affairs and Tourism and SANCOR.

Private-sector involvement

South Africa's gold-mining industry works at deeper levels and under more difficult conditions than any other mining industry in the world. The research on gold mining conducted by the CSIR's Mining Technology is concerned primarily with ensuring the health and safety of the workforce. It includes those working in the areas of rock engineering and the underground environment.

Mining Technology's coal-mining research takes place on a smaller scale than that of gold mining, because the coal-mining industry can make use of various overseas developments. Areas in which research is undertaken include strata control, mining, maximising extraction of coal, and the underground environment.

Research is also carried out by a large number of industrial companies with facilities to meet their specific needs.

The more important ones are the Anglo American Corporation of South Africa (applied metallurgy, processing of precious metals, base metals and coal),

Agricura (synthesis and testing of veterinary remedies, insecticides, herbicides and entomology), Cullinan Holdings (refractories and electrical porcelain), De Beers Industrial Diamond Division (manufacture and application of synthetic diamonds and other super-hard material), Johannesburg Consolidated Investment Company (metallurgy, mineralogy, chemistry and chemical engineering), National Chemical Products (chemistry, microbiology and animal nutrition), Metal Box Company of South Africa (corrosion mechanism and microbiology), Tellumat (development of electronic instruments), the Rembrandt Group (development and improvement of tobacco and liquor products), South African Pulp and Paper Industries (wood technology, paper manufacture and water treatment) and Standard Telephones and Cables SA (long-distance transmission of information and lightning protection).

Acknowledgements

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National Department of Agriculture
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National Research Foundation
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