SABS Design Institute

Chapter 19

Science and Technology

Policy

National science and technology policy is the responsibility of the Minister of Arts, Culture, Science and Technology.

The intellectual framework for the 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.

The economic and social clusters of Ministries deal with science and technology at Cabinet level.

The Ministry uses the National Science and Technology Forum (NSTF) as a sounding board when considering changes in policy. The NSTF consists of all major science and technology role-players, within both the public and private sectors.

The *White Paper on Science and Technology*, published in 1996, sets the stage for processes to be implemented by the Department of Arts, Culture, Science and Technology in its mission to realise the potential of science and technology.

◀ The Edu-Peg is a simple educational apparatus requiring no power source. It is aimed at improving children's mathematical skills and instilling in them a love of mathematics. It won a SABS Design Institute Award in 1995 as an excellent South African designed product.

It wants to trigger sustainable socio-economic development and nurture a climate of innovation.

Science and technology constituted 60% of the Department's expenditure in 2000/01.

The 2001 Budget increases the medium-term allocations by R24,8 million in 2001/02 and R32,9 million in 2002/03. These amounts include adjustments for higher than expected inflation, and policy-related adjustments for language policy and associated services.

Additional amounts of R55 million, R48 million and R64 million were allocated from the Poverty Relief Fund. An adjustment for increases in the remuneration of associated institutions (amounting to R8 million, R8,5 million and R9 million) has also been provided.

Over the past five years, the Science Vote has increased by 27,6%. During this time, the Department of Arts, Culture, Science and Technology has been able to redistribute approximately 40% of the Parliamentary Research Grant Funding across the science council community.

Direct access to research grant funding by the higher education (HE) sector has been trebled, and includes access to science councils' funds through the National Research Foundation (NRF) as well as through competitive mechanisms such as the Innovation Fund. In the redistribution of research funding, approximately 10% has been redirected

to the broader science and technology community via competitive processes.

One of these competitive processes is the Innovation Fund, a major initiative introduced by the White Paper.

It promotes large-scale projects, involving participation from throughout the NSI. It focuses attention on the major themes of government, namely competitiveness, quality of life, environmental sustainability and the harnessing of information technology to address the needs of society and the economy.

One of the success stories is Technology 100. An Innovation Fund project secured the Technology Top 100 Award that was presented by the President in the category Research and Development in November 2000. The Award went to Electric Genetics, with work carried out by the South African National Bioinformatics Institute at the University of the Western Cape.

Private-sector engagement in research and development is riding at approximately 55% of gross expenditure on research and development.

Innovation Fund

Economic, science and technology policies have to recognise the process of innovation, which is one of the agents driving technological change. Many countries believe that it is primary to economic growth. The Innovation Fund was accordingly launched in March 1998 and gives effect to this concept.

The Fund is a policy instrument to lever economic and social resources. It seeks to address socio-economic challenges by harnessing South Africa's science and technology competencies to simultaneously develop and maintain cutting-edge global competitiveness and to address the needs of those citizens who are unable to assert themselves in the marketplace.

The Fund has been increased every year, and it is envisaged that it will ultimately absorb 25% of the research budget of central government. It focuses on specific priority areas that are reviewed regularly. The Innovation Fund will support projects to the amount of R125 million over the next three years.

The Crime Prevention Fund was treated as a pilot project for the Innovation Fund. Proposals for collaborative projects between more than one council, or between a council and any other suitable organisation, were encouraged.

Information

Over 100 scientists from Africa, the United Kingdom and United States (US) attended the 3rd Annual Southern African Association of Science and Technology Centres Conference in Pretoria in November 2000 to discuss the shortage of scientists in Africa.

National Advisory Council on Innovation (NACI)

Government has a constant need for informed advice on the development and implementation of science and technology policy and the stimulation of innovation. The NACI is responsible for carrying out inquiries, studies, policy research and consultations in respect of the functioning of the NSI as requested by the Minister.

The Council enables the Department to consolidate and develop the NSI in an informed and proactive manner. It provides a focused mechanism to access and target critical science and technology research and information for the purpose of socio-economic development.

The members of the NACI are broadly representative of government and the HE, business and non-profit sectors.

Public science and liaison

The Chief Directorate: Public Science and Liaison of the Department of Arts, Culture, Science and Technology is responsible for programmes and activities in the areas of public understanding of science and technology, and local and international liaison.

Public Understanding of Science, Engineering and Technology (PUSET)

The *White Paper on Science and Technology, Preparing for the 21st Century*, highlights

PUSET as a fundamental requirement and key thrust area for establishing a successful NSI. Under the Directorate: Science and Society, the programmes within PUSET aim to establish coordinated projects that will have a measurable impact on the long-term public awareness and understanding of science, engineering and technology (SET).

In terms of science, awareness and education, the national SET week is held each year in provinces where exhibitions and other hands-on activities are presented to target audiences.

Projects are of an outreach nature and focus on human resource development, how science and technology impact on people's lives, careers in specific fields, and the day-to-day applications of SET. The role-modelling campaign strives to encourage more children to take up science in school and as a career.

In 2000, more than 32 382 people participated in SET Week in the North-West, 22 000 in the Northern Cape, and 25 000 in the Western Cape. Since then, there has been a growing emergence of science clubs, the launch of a US-sponsored bursary in meteorology, and the establishment of a mobile science laboratory.

Gender issues and the underrepresentation of women in science and technology are also addressed. Activities include the Triennial Women in Science Conference, national science and technology camps for girls, and the Women in Science Reference Group, which focuses, among other things, on gender sensitisation, science careers awareness, network support and monitoring. A Directory of Women Scientists in South Africa will be developed.

With the recent addition of science communication to this Directorate, a number of programmes such as science communication planning and media skills workshops for scientists and engineers have been implemented. They teach the skills researchers need to promote their work, source funds and work with the business sector.

The PUSET website provides information to SET practitioners, communicators and journalists in southern Africa on scientific, research and industrial activities.

Various science awards have been introduced such as the PUSET Awards Scheme, the PUSET Grants-in-Aid Awards, and the Presidential Awards for Excellence in SET Categories. Other PUSET projects include the PUSET Biennial Conference and the establishment of a database.

Information

Scientists from east and southern Africa met in November 2000 at CommQuest, the interactive science discovery centre programme of the Commonwealth. They exchanged ideas and learned about how to set up interactive science discovery centres and their associated outreach programmes. They will lead CommQuest in their countries and for their subregions using the Commonwealth Knowledge Network for sharing ideas and resources and for finding solutions to common problems.

CommQuest seeks to assist member countries to find innovative ways of improving the public understanding of science by encouraging the use of interactive science discovery centres.

Dr Ben Ngubane, Minister of Arts, Culture, Science and Technology, is the Chairman of the Commonwealth Science Council (CSC) for the triennium 2000–2003. South Africa will host the 21st meeting of the CSC in 2003.

International co-operation

The Science and Technology International Co-operation Policy provides a framework for the governance of bilateral co-operation at political, administrative and execution level. It seeks to facilitate processes and decisions that will have a strategic impact on the development of science and technology human resources and socio-economic development, as well as the optimisation of financial and other resources for research and development.

Bilateral agreements exist with nearly 30 countries worldwide in the fields of materials science, manufacturing technology, biotechnology, environmental sustainable management, exploitation of natural resources and minerals, medical research and public health, engineering science and advancement of technologies, water supply, agriculture, and mathematics and science education. The Lead Programmes Fund, approved by the Department in 1998 to the amount of R24 million over a three-year period, will promote joint

research with international partners in the areas of biotechnology, new materials and manufacturing development, information technology, sustainable management of environmental issues, natural resources, and mapping and exploitation of natural resources and minerals. Out of 32 project proposals submitted, seven were eventually selected for funding. The second call for the Lead Programmes Fund of R21 million for a three-year period commenced on 30 June 2000 and closed on 30 September 2000.

The Department received 49 project proposals. The Science and Technology Regional Co-operation Fund of R3 million per year is running for a three-year period to promote science and technology co-operation in the Southern African Development Community (SADC) region in areas such as water management and Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS). A total of 83 project proposals were received, and eight received funding.

On the multilateral side, as a second leg of international interaction, the most prominent bodies include the European Commission, United Nations Education, Science and Cultural Organisation (UNESCO), SADC, Non-aligned Movement, World Federation of Technology Organisation, Commonwealth Science Council, and Organisation for Economic Co-operation and Development.

The Department has embarked on the establishment of a database on international co-operation in the science and technology fields. Major international initiatives include the establishment of a Satellite Laser Ranging System with the National Aeronautics and Space Administration (NASA) in the US, with operational costs of approximately R1 million annually, which was established at Hartebeesthoek; the South African Large Telescope (SALT) to be constructed at Sutherland; and a study of the science and technology profiles of 18 countries to establish the potential for co-operation in this field.

The Department is developing a monitoring and measuring mechanism to evaluate the functioning of science and technology agreements and output/results of such international co-operation.

The National Research and Technology Foresight (NRTF)

By means of the NRTF exercise the Department set out, in 12 sectors, to establish what technologies will be important to South Africa over the next 10 to 15 years. The sectors are:

- Agriculture and agri-processing
- Biodiversity
- Business and financial services
- Energy
- Environment
- Health
- Information and communication technologies
- Manufacturing and materials
- Mining and metallurgy
- Safety and security
- Tourism
- Youth.

In order to establish the factors facing the science and technology system in South Africa, a scenario-building exercise was undertaken. The results were announced in Pretoria in March 2000.

Broad findings of the Foresight project indicate a saturation of the agrarian and industrial economies.

The next 10 to 20 years will be dominated by huge growth in the information and digital economies.

There are signs of the birth of a bio-economy driven by developments in biotechnology and the combination of biotechnology and information technology (bioinformatics). The economy is expected to impact on a number of sectors such as agriculture, recombinant deoxyribonucleic acid (DNA) and genetically modified foods, health (transgenic foods, gene therapy and micro biosensors), materials (molecular mapping and atomic architecture) and others.

The challenge for South Africa is how the country deals with a declining industrial economy. The results of Foresight will be used to sharpen the choices in allocating funds from

the Innovation Fund; lay the basis for institutional capacity to conduct Foresight in both the private and public sectors identify priorities for publicly funded research; encourage greater research and development investment in in-dustry; improve the technology awareness and uptake in small, medium and micro enterprises (SMMEs); and identify skills shortages in science and technology and action initiatives thereof.

Technology diffusion and transfer

The Department facilitates the promotion of SMMEs through the following programmes:

- Technology Stations Programme (TSP)
  - These are being rolled out at various technikons. Since January 2000, four technology stations are in operation in three sectors: electronics (Technikon Pretoria); chemicals (technikons Mangosuthu and North-West), and metals (Technikon Free State).
- By May 2001, three additional TSPs had been awarded to the following technikons:
  - Clothing and textiles-testing technologies (Peninsula Technikon)
  - Automotive components (Port Elizabeth Technikon)
  - Composites technologies (Vaal Triangle Technikon).

Information

The Government is committed to grow South Africa's 'problem-solving' capabilities by

- increasing support for research capacity-building in the HE sector
- encouraging multidisciplinary research on problems large and serious enough to impede socio-economic development
- strategically directing skills and technology development in the emerging growth areas of information and communication technology, biotechnology and new materials
- placing equipment and additional technology-specific equipment at technikons to support SMMEs to develop their technologies and skills to get closer to international best-practice
- providing environment and technology transfer support for new technology-based start-ups
- internationalising South African science and technology with the aim of developing human resource capacity in research and development, technology transfer and diffusion, to name but a few.

Technology Roadmapping exercise

Subsequent to the launch of the NRTF exercise, the Department of Arts, Culture, Science and Technology embarked on technology roadmaps.

While the Foresight exercise had provided the country with a window into the future regarding which technological futures will exist and what can be expected in terms of emerging technologies in the 10- to 20-year time frame, a detailed mapping-out of the technological landscape is required. Roadmaps provide a long-term strategy for attaining industry-wide goals by providing specific, quantifiable performance targets.

Three of the sectors were selected for roadmapping, namely information and communications technologies (ICTs), biotechnology and bioinformatics, and advanced manufacturing.

These sectors have the highest priority for the growth and development of South Africa's economy.

The output of this exercise will be an industry-driven document outlining the following:

- the industry vision for the future and its possible realisation
- a strategy to create partnerships among industries, and other supporting institutions to accelerate technology research development and deployment
- the key goals in the areas of products, markets, materials technology, manufacturing technology, environmental technology and regulations, human resources and research, and development within the industry
- a roadmap of the technologies necessary to reach the industry's goals.

The National Biotechnology Strategy (NBS)

As part of the implementation of the recommendations of the Foresight exercise, the Department was tasked by government to be the lead department in an interdepartmental steering committee to ensure the drafting of the NBS.

The document is intended to inform government, industry and the broad research

community in South Africa on the necessary steps to be taken, to be able to realise the potential for biotechnology to contribute to the economic development of South Africa.

The document outlines the current situation with respect to legislation, practices or status with regard to research and technology development, resources for developing research and development in biotechnology, and private and public support for the growth of skills and industry in biotechnology. Note is also taken of areas of uncertainty, existence of knowledge gaps and varying perspectives about the effects and benefits of biotechnology within the South African economy, as well as future trends and developments in the field.

Submissions and various input to the project were made by several role-players in the biotechnology field, and issues addressed ranged from requirements for amendments to current legislation regulations, policy, and programmes such as the Innovation Fund, as well as options on new interventions for business ventures, research support, institutional infrastructure and human resource development.

The Strategy was published for comment in August 2001.

Information

At the end of February 2001, the Minister of Arts, Culture, Science and Technology unveiled a spectacular reproduction of a rock art mural from the richest San rock art site found since the early 20th century. Researchers from the Rock Art Research Institute of the University of the Witwatersrand then announced its existence for the first time, together with the first details of the paintings.

The site, called Storm Shelter, is in the foothills of the southern Drakensberg in the Eastern Cape. The 6-m-long panel of paintings contains a comprehensive range of 231 images, some of them previously unknown variations on central themes in San rock art. They offer possibilities for more detailed understanding of San religious experience and the history of the area.

The panel was found by Geoff Blundell in the company of fellow student Sven Ouzman on an expedition led by Professor David Lewis-Williams in 1992.

The NRF funds activities of the Rock Art Research Institute as one of its units in the social sciences and humanities.

Special projects

Indigenous Knowledge Project

The Indigenous Knowledge Project aims to document and evaluate the potential of local knowledge systems for the purpose of encouraging the forming of small technology-based enterprises and investigating the protection of the intellectual property rights of communities as opposed to companies.

The affirmation of the indigenous, cultural, intellectual, scientific and technological knowledge systems of South Africa and Africa is crucial to the development of a common consciousness and pride among the people of Africa of their collective and scientific heritage.

The Project, which was started in the Northern Province, and extended to other provinces in 1998, had the aim of finding ways of integrating indigenous knowledge and technology within existing institutional frameworks. It will enable the Department to facilitate the sharing and application of indigenous knowledge, and its benefits at a national level.

An innovative information management system has been developed by the Council for Scientific and Industrial Research (CSIR) for the capturing and safeguarding of indigenous knowledge on traditional medicines and related confidential information.

A nation-wide bio-prospecting consortium was also established. Consisting of the major scientific research councils, universities, traditional healers and medical doctors, it focuses on the discovery of drugs from indigenous plants.

Legislation aimed at establishing regulatory mechanisms for the protection of resources will be introduced.

Godisa Programme

The *White Paper on Science and Technology* identified an urgent need to raise the level of technical competence, particularly in the SMME sector in the country.

The sector is highly diverse, and factors such as the lack of information on technology hamper innovation.

The Godisa Programme, formerly the Technology for SMME Programme, was designed to encourage technology transfer and capacity-building to enable small business to compete in a globalised economy.

The overall objectives of the Programme are economic growth and employment creation through the enhancement of technological innovation and the assimilation of available technologies.

The main problems or issues to be addressed by the Programme include outdated technology employed by the SMMEs; low engagement rates of SMMEs in value-adding activities; the high failure rate of start-up SMMES; and poor access to facilities for testing and promoting SMME innovators' ideas.

As part of its foreign aid programme, the European Commission made a grant available for the support of SMME development in South Africa.

The Department of Arts, Culture, Science and Technology will apply these funds to establish pilot programmes in the areas of technology development, innovation support and technology demonstration for a three-year period. The pilot programmes include the establishment of a Technology Demonstration Centre (TDC), an Innovation Support Centre (ISC) and a Technology Incubator (TI).

The TDC will be based at Mintek. It will be dedicated to the small-scale mining associated value-added sectors. Its main purpose will be to demonstrate and encourage the use of new and appropriate mining and associated technologies within this sector.

The ISC will be based at the University of Natal. It will focus on embedded systems and information technologies. Its main purpose will be to optimise and commercialise innovative technologies in this sector.

The TI will be based at the CSIR in Pretoria. It will focus on information and communication technologies, with the core emphasis on smart software for wireless applications. Its main purpose will be to stimulate, grow and launch technology-rich start-up businesses in this sector by providing a protected environment.

It is envisaged that the TIs will be rolled out to other sections and locations throughout the country over the next five years.

Science councils

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

Seven Imperatives were outlined by President Thabo Mbeki during his inauguration speech in mid-1999. Later that year, the science councils established mechanisms to commit to the Presidential Imperative Programmes (PIPs). They identified areas of common interest and agreed to promote collaboration.

Each science council undertook to apply its specific and unique skills, technology and expertise to focus on the specific national priorities.

Joint working groups were set up to address the seven priorities, each under the convenorship of a different science council:

- Rural development: Agricultural Research Council (ARC)
- Job creation: Council for Mineral and Metallurgical Technology
- Regional integration (African Renaissance): Council for Geosciences (CGS)
- Urban renewal: Human Sciences Research Council (HSRC)
- Human resource development: South African Bureau of Standards (SABS)
- Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS): Medical Research Council (MRC)
- Crime prevention: CSIR.

National Research Foundation (NRF)

On 1 April 1999, the NRF was established as an autonomous statutory body. The NRF provides services and grants to support research and postgraduate research training, vital to the development of science and technology in South Africa.

Other areas of its core business are to promote research capacity development to serve the country's workplace needs and to establish equity and redress.

The NRF fosters partnerships and networks to make South Africa globally relevant and competitive. It provides research information and strategic advice.

The NRF's Research Support Agency invests funds, granted mainly by Parliamentary vote, to institutions, teams and individuals engaged in research. South African researchers received research grants to the value of more than R162 million for 2001. The Parliamentary grant is supplemented by joint ventures with other funding partners. The flagship of such ventures is the Technology for Human Resources for Industry Programme (THRIP), a joint initiative by industry, research and education institutions and the Department of Trade and Industry.

In 2000/01, the Department of Trade and Industry provided funding to researchers in excess of R138,5 million through THRIP. The Programme supports the development of technology and appropriately skilled people for the industry to improve South Africa's competitiveness, by providing resources and mechanisms in support of collaborative research in the areas of SET. Funding is provided on a matching basis by industry and government.

According to the NRF Act, 1998 (Act 23 of 1998), the object of the NRF is to support and promote research through funding, human resource development and the provision of the necessary research facilities.

It aims to facilitate the creation of knowledge, innovation and development in all fields of science (natural, engineering, and social sciences and humanities) and technology, including indigenous knowledge.

In July 1999, Dr Khotso Mokhele was appointed first president of the NRF. He represents South Africa on the executive board of UNESCO and is also a member of the International Scientific Advisory Board which advises UNESCO's Director-General. In September 2000, Dr Mokhele became the first scientist and 16th South African to receive the prestigious French medal – the Legion of Honour – in recognition of his involvement in creating good relations between South African and French scientists.

Information

During 2000, the Department initiated 57 technological innovation projects in biotechnology, infrastructure, communication, technology, new materials and advanced manufacturing.

The National Laser Centre was established during the year, drawing on assets and resources formally held by the South African Nuclear Energy Corporation, the CSIR and the NRF. The Department also undertook the SET Holiday Camps for Girls; National Science, Engineering and Technology Week 2000; a science and technology awareness campaign; science communication workshops; and a reference group for women in science as part of its PUSET Project.

Research and support agency

Focus areas

The NRF Research Support Agency has a suite of research funding programmes that are in line with South Africa's priorities and needs. Researchers can apply for funding in nine focus areas, all of which support fundamental and applied research. The focus areas are:

- unlocking the future: advancing and strengthening strategic knowledge
- distinct South African research opportunities
- economic growth and international competitiveness
- sustainable livelihoods: the eradication of poverty
- conservation and management of ecosystems and biodiversity
- information and communication technologies and the information society
- the socio-political impact of globalisation: the challenge for South Africa
- education for the knowledge era
- indigenous knowledge systems.

In 2000, 3 497 students received bursaries, of which 1 972 were awarded to black students. The NRF received 1 188 authorised grant

applications for 2001, of which 957 are in natural sciences and engineering, and 231 in social sciences and humanities. The total amount requested by prospective grant-holders was over R308 million, which exceeds available funding.

Institutional programmes that develop research capacity at technikons and historically black universities will continue at least until the end of 2001. The NRF also provides two types of student support that complement each other, namely:

- free-standing bursaries, scholarships and fellowships
- grant-holder-linked bursaries.

Free-standing bursaries, scholarships and fellowships are awarded directly to students on a competitive basis, while grant-holder-linked bursaries are granted to researchers within their NRF support package and may be awarded to students selected by the NRF grant-holder.

The NRF offers a limited number of travel grants for a research period abroad.

Knowledge management

The NRF's research information programme has two main components:

- the NEXUS database consists of a set of databases mainly related to the humanities and social sciences
- the South African Data Archive is an archive of computerised raw quantitative data of large-scale regional, national and international research projects mainly in the humanities and social sciences.

The NRF makes these datasets available to the research community.

Strategic advice

The NRF's strategic advice unit ensures that the necessary data and recommendations are available for internal decision-making by the NRF or by national decision-makers.

International science liaison

International science liaison aims to forge and maintain strategic and intellectual alliances between individuals, institutions and organisations in the national and international science research communities to support the international competitiveness of the country.

The South African International Council for Science (ICSU) Secretariat serves the South African scientific community and most of the ICSU unions and affiliates that South Africa adheres to. The Secretariat is administered by the NRF as part of its science liaison activities.

National research facilities

The NRF is responsible for managing South Africa's four national research facilities.

- The Hartebeesthoek Radio Astronomy Observatory (HartRAO) near Krugersdorp in Gauteng uses a 26-m radio telescope to carry out research in radio astronomy and related fields, and serves the local and international science communities. When arrayed with telescopes on other continents, HartRAO forms part of a network of 'super' telescopes able to see details hundreds of times smaller than can be seen using the best optical telescopes.

Because of its unique location, HartRAO is in great demand for international projects such as studies of the dynamics of the earth's crust and variations in its rate of rotation.

A new, state-of-the-art facility at HartRAO enables South Africa to measure with pinpoint accuracy the orbits of satellites and the movement of continents.

The satellite laser ranging equipment – named Moblas-6 – was launched in November 2000. It can provide accurate measurements of the physical changes of sub-Saharan Africa, and will allow scientists to better monitor the potentially devastating El Niño effect. Moblas-6 forms part of an international network of 40 measuring stations in different parts of the globe. NASA developed Moblas-6, and the Department of Arts, Culture, Science and Technology is funding the operation of the instrument.

- The JLB Smith Institute (JLBSI) in Grahamstown, Eastern Cape, was founded in 1968 on the scholarship of Professor JLB Smith, world-famous ichthyologist of Rhodes University. Today, it is a leading centre for

the study of fish and biodiversity in Africa and the surrounding seas. The JLBSI is responsible for the national collection of fish (more than 450 000 specimens) and promotes knowledge and awareness of fish and aquatic conservation. The collection catalogue includes a computerised database, a library, and information services.

Researchers at the JLBSI played a role in the discovery of a population of coelacanths off Sodwana Bay in KwaZulu-Natal in November 2000, when they helped identify the fish, filmed by a dive team at a depth of 108 m.

The JLBSI's educational programme for pupils and the public includes illustrated lectures and guided tours, also of the experimental fish farm.

- The National Accelerator Centre (NAC) in Faure, Western Cape, provides modern research facilities to users in science, medicine and industry. Valuable experience in using sophisticated equipment is gained by senior students in many experimental sciences. Much of the research at the NAC is carried out in collaboration with scientists from local and foreign universities. Visits from schools and community groups are welcomed.

Information

The largest and most sensitive gamma-ray telescope in the world is at present being built 100 km west of Windhoek in Namibia – an area well known for its excellent optical quality.

Construction of the foundations started in August 2000, and the high-energy stereoscopic system telescope (HESS) should be fully operational in 2002. The HESS project is the result of international cooperation between 12 institutes, including the Unit for Space Physics at Potchefstroon University. The Unit was allocated an annual amount of R240 000 per year for 10 years from the Department of Arts, Culture, Science and Technology, administered by the NRF, for this project.

The University of Namibia is the only other African institution involved in HESS. The other collaborators are from Germany, France, Italy, Armenia, Ireland, the Czech Republic and the United Kingdom (UK).

Two unique features of the proposed installation are the possibility to simultaneously observe air showers with the aid of three to four telescopes under widely different viewing angles, and the combination of multiple (up to 16) telescopes in a large system to increase the effective detection area for gamma rays.

- The South African Astronomical Observatory (SAAO) in Cape Town, Western Cape, and Sutherland in the Northern Cape has seven telescopes at Sutherland, used for optical and infra-red observations. It provides an international facility for research in astronomy in Africa, and educates and informs the community.

Construction on the 9-m SALT officially started with a ground-breaking ceremony at Sutherland on 1 September 2000. When completed, SALT will collect light and infra-red rays with a mirror mosaic of 91 hexagonal segments, each 1 m wide, and will be the largest single telescope in the southern hemisphere.

It is being funded by five international partners and the South African Government, which has committed R50 million over five years.

A new Infra-red Survey Facility (IRSF) was opened at Sutherland in November 2000. The IRSF is the second-largest telescope at Sutherland, with a mirror 1,4 m in diameter. Major funding for the project came from the Japanese Ministry of Education, while the SAAO is responsible for the building, infrastructure and continued support.

It will aid Japanese and South African astronomers in putting together a clearer, sharper picture of the two nearest galaxies to our own, and of the central regions of the Milky Way galaxy. Japan and South Africa have long been partners in building and using infra-red cameras for astronomy.

The Agricultural Research Council (ARC)

The ARC is the convenor of the Rural Development Working Group. Apart from playing a leading role in this Group, the ARC is also active in all of the other focus areas, and has made substantial contributions.

As convenor of the rural development programme, the ARC promotes sustainable development and improves the quality of life of marginalised groups and communities through an extensive framework of activities. Together with the other science councils, ARC research also addresses the other six imper-

atives: job creation, regional integration, urban renewal, human resource development, HIV/AIDS and crime prevention.

The ARC has made a substantial contribution to the PIPs through its research and technology development projects.

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, technology development and technology 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 component of ARC activities.

Rural development

The ARC collaborates with government and the Independent Development Trust in the development of an Integrated Sustainable Rural Development Strategy (ISRDS) for South Africa. The ARC advises the M17 group of Ministers under the Chairmanship of the Deputy President on the development of a planning tool, based on geographic information systems (GIS).

In order to share information and assess the use options of resources in a particular area, the South Africa Integrated Spatial Information System is being developed to provide a user-friendly framework for informed decision-making.

The relevant basic data, interpreted planning information and decision support system will provide a number of rural development options for a specific area, but will also indicate constraints.

These will be geographically/spatially illustrated within the system and be accessible via the Internet. It has the advantage of a single interface from which relevant data/information from all departments can be accessed and integrated.

The proposed Decision Support System for ISRDS will encapsulate the principles of multi-criteria decision-making and expert systems by capturing political and scientific thinking in a structured environment.

The impact and wide scope of the ARC sustainable rural development thrusts are evident in all provinces. The ARC empowers people through research, information and appropriate training that address the economic and social challenges.

ARC-generated technologies also underpin SMMEs that aim to create new job opportunities through agribusiness. Its research impacts on agriculture and related disciplines such as applied science and technology, health and nutrition, food safety, education, the environment, and natural resource conservation.

The ARC interfaces with national, provincial and local governments as well as various agricultural unions and farmers' associations in South Africa. Apart from research collaboration with these stakeholders, the ARC also partners with other science councils.

More than 90 joint research projects are conducted with local universities.

Since becoming a member of the Consultative Group on International Agricultural Research (CGIAR) in 1996, the ARC has had an increase in international contacts. It also played a major role during the CGIAR Mid-term meeting, held in Durban during May 2001.

On a regional level, the ARC is involved in agricultural research activities of the SADC,

Information

The book *The Hidden Edge* was launched in November 2000 at the President's Awards for Export Achievement and the Technology Top 100 Award. The book, a description of South Africa's technological advancement, is the result of a unique partnership between the Department of Arts, Culture, Science and Technology and a number of organisations including MTN, Eskom, the CSIR, Morgan University Alliance, Sasol and Transnet.

with links to other African role-players in the Special Programme for African Agricultural Research (SPAAR).

Some of the regional initiatives include SARRNET (root and tuber network), SAFRINET (network to promote entomological taxonomic capacity), A-SNAPP (natural products) and MWIRNET (maize and wheat research network).

The ARC is also active in international collaboration, especially with universities in the US, UK, Europe, Australia, New Zealand and Africa. The ARC has contracts and research agreements with over 112 organisations in 35 countries. At present, the ARC has Memoranda of Understanding with numerous scientific role-players in other countries. Six new agreements on international collaboration were recently signed.

Agriculture was also covered in the US Binational Commission, laying a strong foundation for collaboration. This has resulted in stronger links with the US Department of Agriculture and the US Agency for International Development.

Other international collaborators and donors include the Commonwealth Scientific and Industrial Research Organisation, *Centre de Coopération Internationale en Recherche Agronomique pour le Développement*, Food and Agricultural Organisation, European Union, *Institut National de la Recherche Agronomique*, Natural Resource Institute, CAB International, Department for International Development, Network Organisation for Research and Development, *Deutsche Gesellschaft für Technische Zusammenarbeit*, Danish Agency for Development Assistance, and Swedish International Development Cooperation Agency.

South Africa is recognised globally as one of the five leading countries in the field of the biological control of alien invasive plants, with the highest success rate in terms of control per numbers of agents released. This research, to guard the country's natural biodiversity from being systematically reduced and replaced by alien vegetation, is driven by the ARC and, apart from the local impact, has benefited many other African countries.

Research activities are governed by five research programmes that are in line with the precepts of the *White Paper on Science and Technology* as well as the Government's national agricultural priorities. The programmes are:

- public support services
- sustainable rural livelihoods
- grain and industrial crops
- horticulture
- livestock.

The ARC supports agricultural development that promotes sustainable natural resource utilisation.

Biodiversity is promoted through the ARC's guidance regarding the conservation, management and sustainable use of South Africa's unique fauna and flora. The ARC encourages indigenous knowledge systems, promotes the sustainable use of indigenous plants and animals, and is conducting research to ensure maximum benefit to all communities in South Africa.

The ARC maintains numerous plant genebanks for the benefit of farmers and to expand the food and feed base in South Africa. These genebanks include:

- indigenous vegetables, cassava, vegetable, sweet potato and potato

Information

SERA (Pty) Ltd is a private company that forms part of the strategic alliance between the CSIR and the University of Pretoria (UP). This alliance – the Southern Education and Research Alliance (SERA) – is aimed at fostering an academic, scientific and technical environment that will benefit and enhance learning, research and development and which will be of economic value and financial benefit to both parties. SERA (Pty) Ltd will serve as a vehicle for formal contracting. Its primary focus is the exploitation of intellectual property in both the CSIR and UP through commercialisation and the licensing of patents. A venture fund will be formed to support the commercialisation initiatives.

Another major project of SERA, in partnership with the Gauteng Provincial Government, is the development of an innovation hub that will focus on kick-starting and promoting the development of innovation and knowledge-driven, high-growth enterprises. The aim is to attract not just small entrepreneurs and venture capital, but also international companies.

- an oil seeds collection comprising groundnuts, sunflower, soya beans, dry beans, lupines and cowpeas
- a subtropical crops collection comprising avocado, banana, citrus, coffee, granadilla, guava, litchi, macadamia, mango, pecan and pineapple
- a small grains collection comprising wheat, barley, oats, rye, triticale and durum
- a deciduous fruit collection comprising apples, peaches, plums, pears, berry fruits, tree nut crops, *rooibos* tea, dates, olives, kiwi fruit and hops
- table, raisin and wine grapes, and a yeast genebank.

Other crops conserved in genebanks are cotton and fibre crops, indigenous plants, medicinal plants, bulb flowers and *fynbos*. These plants offer small-scale farmers new commercial opportunities. In support of animal production, a plant voucher specimen collection, a vegetation database and a forage genebank are maintained.

ARC research contributes to food security. The quality of healthy and nutritious foods is maintained through improved shelf life, postharvest technologies, monitoring spoilage points in production lines, safe use of products, and general hygiene recommendations. New products and market opportunities are identified. Processing technologies for food and industrial crops are developed. Research into sanitary and phytosanitary issues facilitates access to domestic and export markets. ARC technologies and prototypes enhance SMME development.

One of ARC's largest contributions is in the breeding of new plant cultivars that are better adapted to South African production conditions than imported cultivars or races.

The ARC currently holds registered plant breeder's rights on 233 cultivars of all the major plant types that are commercially produced in South Africa. Export figures over the last 20 years indicate the growth in production and international demand for South African cultivars.

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

The ARC-Institute for Soil, Climate and Water

The ARC-Institute for Soil, Climate and Water in Pretoria, Gauteng, promotes the characterisation, sustainable utilisation and protection of natural resources.

Research activities cover soil science, agrometeorology, water utilisation and analytical services. Through remote sensing and geographic information systems, the Institute applies computer technology to capture and store maps (spatial) and alpha-numerical data (non-spatial) in integrated databases to provide decision-making support for farmers and policy-makers.

The 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. Prototypes and pilot equipment with numerous applications, especially for resource-poor agriculture, are also developed.

The 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, 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, ranging from quarantine of imported biocontrol agents, advice on apiculture, quality control of legume inocula, provision of cultures of biocontrol agents and identification of organisms important in agriculture, to specialised information on pesticide application, biological control and forest entomology. The Institute also houses the Plant Genetic Resource Unit that centralises and coordinates plant genetic resource activities. It liaises with regional and international agencies and is responsible for the documentation of ARC germplasm and for safety-base collection facilities.

The 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-nut, soya beans, dry beans, cowpeas, sweet white lupin and bambara. Research activities involve plant-breeding, evaluation of cultivars, grain quality, plant physiology and other production factors.

The 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, grain quality, plant physiology, tillage, weed science, plant pathology, entomology and yield potential.

The 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 that have potential as new crops in rural areas.

The 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 such as citrus, pineapple, banana, avocado, mango, litchi, guava, papaya and granadilla. Other crops on which production research is conducted include tea, coffee and spices, as well as pecan, macadamia and cashew nuts. Lesser-known exotic crops with potential are also evaluated, such as cocoa, coconut, feijoa, annona types, carambola, jaboticaba and white sapote.

Research activities comprise horticulture, cultivar development, plant nutrition and irrigation.

The 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. 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 such as apples, peaches, plums and pears. 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 the production of wine and brandy.

The ARC-Animal Improvement Institute

The ARC-Animal Improvement Institute at Irene, outside 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.

The ARC-Animal Nutrition and Animal Products Institute

Situated near Irene, 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. It also evaluates technologies to enhance the quality of meat and dairy products.

The ARC-Onderstepoort Veterinary Institute

The ARC-Onderstepoort Veterinary Institute, north of Pretoria, is responsible for the prevention and control of animal diseases. It also provides a public health service with regard to 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.

The 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. Research is conducted on ve-getation, rehabilitation ecology, animal nutrition and management, pasture agronomy and vegetation biology.

CSIR

The CSIR is the largest community and industry-directed scientific and technological research, development and implementation organisation in Africa.

It delivers scientific and technological services in areas where industry, parastatals or government clients require support, as well as innovative leadership in the development of new technologies, which can be further developed and exploited by the private sector. Approximately 7 000 clients are served every year, and nearly 60% of the CSIR's income is funded externally. The CSIR's functions are centred in eight market-oriented business units:

- food, biotechnology and fine chemicals technology
- building and construction technology
- defence technology
- water, environment and forestry technology
- information and communications technology
- manufacturing and materials technology
- mining technology
- roads and transport technology
- textiles technology.

The activities of the business units are aimed at the following:

- supporting the technological competitiveness of the South African industry in both the formal and informal sectors
- providing technological solutions to improve the quality of life of urban and rural communities
- providing scientific and technological support for decision-making in the private and public sectors.

In addition, there are several cross-cutting initiatives that draw on skills from across the organisation.

These include:

- crime prevention
- SMMEs

- technology for development
- sport
- regional and international initiatives.

The CSIR is empowered by the Measuring Units and National Measuring Standards Act, 1973 (Act 76 of 1973), to maintain all national measurement standards through its National Metrology Laboratory.

Internationally, the CSIR works with 18 African countries, has co-operation agreements with major research and development organisations and companies, and is a registered consultant with the World Bank, African Development Bank, UN Development Programme and others.

A five-year compound growth of almost 30% in international external income has resulted from long-term relationships with multinational companies and knowledge-intensive organisations.

Mintek

Mintek is engaged in the full spectrum of minerals research, from mineralogical examination of ores, to extraction and refining technologies and the manufacture of end-products.

It develops and applies improved technology to facilitate new industrial operations and improve the cost-effectiveness of existing ones on a worldwide basis. It is also closely involved in identifying and developing applications and markets for minerals and mineral products.

For more than 60 years, Mintek has been developing metallurgical and minerals processing technology for one of the world's richest mining regions. Southern Africa has an exceptional wealth of mineral resources, including world-class deposits of gold, platinum-group metals, diamonds, chromium and iron ores, base metals, coal and industrial minerals.

Through innovative research and development, Mintek aims to develop new and improved methods for extracting minerals and metals by refining and pro-cessing ores into value-added products.

In terms of the Mineral Technology Act, 1989 (Act 30 of 1989), Mintek is an autonomous organisation whose core activities are financed by the State.

It is, however, responsible for financing an increasing proportion of its own activities through operational income earned from industry clients. Mintek's annual budget is about R200 million.

Mintek's target for income derived from business contracts for 1999/00 exceeded 40% of its total income.

South Africa is one of the world's major suppliers of mineral commodities. The significance of Mintek's work stems from the need to maintain and strengthen this position and to uphold the country's reputation as a leading source of scientific and engineering skills in the field of metals and minerals.

Particular emphasis is placed on increasing earnings from minerals by turning them into higher-value products before they are exported. Much of the work is carried out in close liaison with the South African mining and metallurgical industries. A number of co-operative programmes are carried out with international partners.

Extensive work has been done in support of new minerals projects in Africa, south of the Sahara. Mintek also offers technical support to operators of small mines in southern and South Africa and assists this growing sector to take advantage of the most appropriate technology for its needs.

A number of studies have been undertaken in support of the Government's spatial development initiatives (SDIs), with the aim of encouraging investment in the metallurgical and minerals industries both in South Africa and within the SADC. The application of new technology to monitor and remediate air and water pollution emanating from mining and metallurgical and related activities is an expanding field.

Mintek supports a large number of undergraduate and postgraduate bursaries, with the aim of maintaining and developing South Africa's scientific and engineering expertise base. Basic training and skills development

are provided in several areas, including adult basic education and in-service training for trainee technicians and operators.

Mintek's MAP programme, which was launched in 1992, gives aspiring young engineers and scientists from disadvantaged sectors the opportunity to upgrade their matric mathematics and science marks so that they can embark on tertiary studies at universities and technikons. More than 2 000 students have completed the programme since 1992.

Mintek also manages the annual national science quiz for high schools, Minquiz, which promotes science and technology awareness.

In June 2001, Mintek President and CEO, Dr Paul Jourdan, signed an agreement with the Minister of Minerals and Energy, Ms Phumzile Mlambo-Ngcuka, committing Mintek to

- provide greater and more efficient beneficiation to minerals and value-addition to mineral products within South Africa
- strengthen South Africa's position as a global supplier of mineral commodity processing equipment
- develop regional SADC strategies for the mineral beneficiation sector through value-adding and capacity-building
- develop technologies appropriate to the local artisanal and small-scale mineral-processing industry, thereby expanding the industry and lowering entry barriers
- transform Mintek's internal and external business processes and human resource development to ensure that they are in line with the socio-economic realities of South Africa
- ensure a stable and motivated workforce through remuneration systems which are innovative and comparable to industry standards
- increase income in real terms from all sources.

Social initiatives

Mintek is involved in, among other things, the following social initiatives:

- Mintek technicians and engineers offer hands-on assistance to grassroots operators in rural areas.
- It supports government in the development of SDIs, e.g. Coega and the West Coast SDI where Mintek technology enabled the successful establishment of the Namakwa Sands beneficiation project some eight years ago.
- Mintek is participating in the activities of the Mining Qualifications Authority in order to help establish skills development standards for the industry.

Human Sciences Research Council (HSRC)

The HSRC is an independent statutory organisation established in 1968. As one of the science councils in South Africa, the HSRC focuses its research on social sciences.

During 2000, the HSRC has gone through radical transformation. In his inaugural speech to the HSRC staff in August 2000, the CEO launched the slogan *Social Change that Makes a Difference*, and outlined a three-part vision to transform existing HSRC disciplinary strengths into more relevant, modern and comprehensive functions from

- social databases to social-scientific knowledge management
- social research to national socio-economic research programmes
- educational assessment to policy-impact evaluation.

The HSRC's new five-part COUPE strategy compliments this vision:

- increasing contract-research earnings from users in line with annual targets, especially through large-scale research programmes, to assure the HSRC's financial sustainability
- assertively reaching out to tertiary institutions and local and international research NGOs to extend their involvement in these large-scale research programmes
- focusing the programmes on the needs of users, especially of government clusters for policy-relevant research and implementation monitoring
- enhancing performance in line with annual targets, through capacity-building, more

senior and representative research staff, and modernising support functions
- achieving excellence in research through scholarship, debate and professional engagement.

Guided by government's development priorities and informed by the NSI, the HSRC's research managers and Council members have identified several new priority areas (NPAs):

- Assessment studies: Assessment is an important tool for enhancing individual development, growth and empowerment in the domains of education, work and leisure. In keeping with legislative changes in South Africa, the role and function of assessment in the organisation has been reconceptualised to address the gaps in information and expertise with regard to the development and application of assessment practices, theories and techniques. There is also a greater emphasis on understanding bias, fairness and validity.
- Education and information systems: The research programme focuses on the dynamic interaction between policy-making and its implementation in the education sector. Consistent with the shift in emphasis from policy formulation to implementation, the focus is on identifying implementation successes and evaluating best-practices for replication. The HSRC's unique contribution is its utilisation of education-management information systems and databases to draw out policy-relevant information for use by policy-makers, education managers and the wider research community.
- Human resources development: This research proposal is aimed at establishing a human resources development planning facility for the benefit of government. It takes the form of a cross-sectoral management information system database that will improve the integration and analysis of information across education, training, economic growth, employment and labour market domains. This facility will offer government and other users extra analytical support with which to plan the human resource needs of society.
- Labour market imperatives: This NPA monitors, analyses and projects labour market trends. It provides research-based information in order to facilitate decision and policy-making that impact on the labour market at a national, regional or occupational level, and to stimulate organisational competitiveness. It is closely linked to and provides essential inputs into the human resource development area.
- Integrated and sustainable development: The purpose of this priority area is to promote integrated sustainable development in the rural and urban areas of South Africa in order to alleviate poverty, improve the quality of life, enhance production, and provide for a more equitable distribution of resources. The programme focuses on development and poverty alleviation in urban and rural areas, taking into account urban-rural linkages. The emphasis on sustainable development furthermore implies a focus on environmental sustainability, as well as on economic and social sustainability.
- HIV, health and welfare: Current estimates and projections of HIV infections and AIDS-related mortality indicate that this epidemic will have far-reaching impacts on the South African population, the social structure and the economy. At present, research efforts in the field of HIV/AIDS, and linkages to health and welfare, are highly diffused, and the HSRC aims to assist in providing a coherent research framework. Key tasks include data analysis, information generation, producing policy-relevant findings, and creating research networks.
- Social change and technology: Recent developments in information and communication technology drive many political, social and economic phenomena associated with the process of globalisation. Although information and communication technologies will serve as the core focus, this research programme will also encompass research projects that seek to under-

stand the interrelation between society and technology in the broadest sense. The application of technology to solve problems, and the uneven diffusion of technologies within and between human groups, are key focus areas.

- Policy impact and monitoring: Government has committed itself to intensify delivery performance in all major service-delivery sectors. This implies a corresponding need to pay greater attention to monitoring the effects of government policies to ensure that the outcomes of these policies match their stated objectives. The programme's main focus lies in the governance sector – notably, local and provincial government institutional development, and local and provincial government service delivery. Both these sets of spheres are multisectoral in their delivery focus, and could be seen as providing a cross-cutting focus.

In addition, there are important cross-cutting themes, which arise in each NPA:

- Indigenous Knowledge Systems (IKS): The IKS Programme area is intended to facilitate the development of community-conscious scientists across the natural and social sciences to help reshape the content of curricula in South African universities. They will contribute to the promotion of sustainable human development by connecting national development strategies to local knowledge, expertise and capacities that exist in rural communities. At the institutional level, this initiative will provide leadership in research paradigms, theory and institution-building for IKS in South Africa. As part of a scientific endeavour, it works to make science become more responsive to, and more inclusive of, women and other forms of knowledge.
- Social surveys: The aim of social surveys is to collect relevant and up-to-date information on public attitudes towards matters of national interest with a view to inform and guide policy-making in South Africa, using scientifically representative sampling methodologies.
- The GIS Centre translates socio-economic data into a spatial format such as maps, enabling planners and decision-makers to assess needs in certain areas of the country or to identify at a glance potential markets, or new sites, for facilities.

A recommendation of the 1997 Department of Arts, Culture, Science and Technology review of the HSRC was that the HSRC reach out vigorously to the research community in universities and technikons, parastatals, NGOs and the private sector, locally and abroad.

The aim is to have a network of partners involved in projects that are two to three times the size of the HSRC staff. Steady progress is being made in this respect.

It is accelerating the course of the HSRC's now-systematic pursuit of appropriate tenders, with academics or consultants or colleagues from other science councils being recruited as co-participants for most bids.

Medical Research Council (MRC)

The MRC was established in 1969. Its mission is to improve the nation's health status and quality of life through relevant research aimed at promoting equity and development. Its core values are a culture of human rights, transdisciplinarity in research, and being a learning and sustainable organisation.

The MRC is an autonomous body but reports to the national Department of Health. It receives 60% of its budget from the Government Science Vote.

The MRC has undergone major transformation. Its research activities are aligned to the health priorities of the nation, and are grouped into the following six national programmes:

National programme for research in molecules to disease

This group undertakes research on human and microbial genetics, genomics, bioinformatics, cell and molecular biology, tissue engineering and clinical research.

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 (TB), malaria, immunology of infectious disease, diarrhoeal diseases, inflammation and amoebiasis.

It also incorporates the MRC National HIV/AIDS Lead Programme, whose divisions coordinate 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.

National programme for non-communicable disease research

This group undertakes research on heart disease (both laboratory, clinical and public health research), nutritional intervention, diabetes, sports science, crime, violence and injury, anxiety and stress disorders, dental issues, bone disease and medical imaging.

National programme for environment and development research

In this entity, research on health promotion, health and development, and technology transfer is undertaken.

Information

In August 2000, more than 100 scientists converged in South Africa at the Safari 2000 project, with its headquarters in Pietersburg, to find out how climatic changes influenced the ecosystem and how human activity influenced the climate.

The project will last for about three years and takes place in co-operation with NASA, the University of the Witwatersrand, Environmentek, the CSIR and various other universities and institutions worldwide.

National programme for women and child health research

This programme undertakes research on women's health, high blood pressure during pregnancy, health-care strategies in maternal and infant health, and perinatal mortality.

The 47 research units within these six national programmes employ over 300 scientists engaged in 600 research projects, supported by 200 support staff. Twenty-seven of the units are in the medical schools and research institutes – six of these in historically disadvantaged institutes. The MRC also funds 350 short-term researchers at academic institutions throughout South Africa.

It is developing a new research grants management system, using electronic databases and software to ensure equitable and efficient disbursement of health research funding.

The MRC is increasingly 'Africanised' in terms of its research and organisational philosophy, its gender and ethnic profile, and its collaboration with other African countries. It is also increasingly internationalised through collaboration with most of the world's leading health research agencies, including the National Institutes of Health and Centres for Disease Control and Prevention in the US, the Gates Foundation, the World Health Organisation, the Wellcome Trust, the Pasteur Institute, KEMRI in Kenya and the Blair Institute in Zimbabwe.

It works with national and provincial departments of health to ensure its research findings feed into policy formulation and health-care practice.

The 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 Innovation Fund.

It operates under the tradename SA HealthInfo and is available on the Internet at http://www.sahealthinfo.org, providing a one-stop interactive forum or resource for quality-controlled and evidence-based health research information to a wide spectrum of users.

The Knowledge Network's modules serve as strategic mini-portals and information clearing houses on content-specific areas. The following modules are available: bioinformatics; chronic lifestyle diseases; ethics; evidence-based information (supporting the conscientious, explicit and judicious use of current best evidence in making health care decisions); HIV/AIDS; malaria; medical interventions: nutrition (South African Food Composition); traditional medicines; TB; and violence and injury. The Knowledge Network also provides a unique access point to online full-text publications.

Council for Geoscience

The CGS is a statutory body established on 1 November 1993, in terms of the Geoscience Act, 1993 (Act 100 of 1993), to manage the functions of the Geological Survey of South Africa. 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
- collection and conservation of all geoscientific information and data of South Africa in national collections and electronic databases
- supply of geoscientific services and advice to the national and provincial governments to ensure informed decisions regarding the optimal and efficient use of the surface of the earth.

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 without sterilising valuable mineral resources
- supply basic knowledge to ensure safe, cost-effective and environmentally acceptable urbanisation and housing development
- carry out research on raw materials needed to clothe, transport, feed and provide shelter for the nation.

In order 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 nine provinces.

To perform its functions, the following national institutions are maintained by the CGS:

- The National Geoscience Library in Pretoria is probably the most comprehensive geoscience library on the African continent. 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 in a modern facility at Donkerhoek, east of Pretoria.
- The Geoscience 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 to analyse rock and soil samples, using various specialised techniques.

The CGS plays a leading role in the SADC, and has been chairing the Geological Subcommittee for the past number of years. Several geoscience publications covering the region have been produced by this Subcommittee.

An exciting service is provided by two microlight aircraft capable of performing high-resolution aerial geophysical surveys.

This development is breaking new ground and is unique in the world.

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

An Energy Map of Africa has also been published, documenting and mapping the oil, gas, uranium and coal resources of the continent.

The latest edition of the *Metallogenic Map of South Africa*, at a scale of 1:1 000 000, has been released recently. The Map gives information on all known mineral deposits and occurrences in South Africa.

South African Bureau of Standards (SABS)

The SABS is responsible for the development and publication of standards for products and services.

This is handled by the organisation's Strategic Business Unit (SBU).

The Certification SBU of the SABS runs a product certification scheme, several quality system certification schemes such as the SABS ISO 9000 Quality Management Certification Scheme and SABS ISO 14001 Environmental Management Certification Scheme, and a consignment inspection service.

The SABS operates more than 60 laboratories connected to the Test House SBU. Goods are tested and analysed in terms of private or national voluntary or compulsory standards. Precision instruments and measuring and scientific equipment are tested and calibrated for various customers, and reference materials are supplied for test purposes.

The SABS is a founder member of the independent South African Quality Institute, which was established in 1991.

By means of its focused training programmes, the SABS actively assists industry in creating an overall awareness of quality and the environment. It provides a country-wide service in training quality system and environmental auditors.

The SABS is also involved in the promotion of design in South Africa through the SABS Design Institute. The mission of the Institute is to foster the economic and technological development of South Africa through the promotion of design, and to establish it as a centre of design promotion in southern Africa. It focuses on industry, education and information.

Other research organisations

Sasol

Although the Sasol Group is best known for its petrol, diesel, kerosene, liquid petroleum gas, power paraffin, illuminating paraffin, fuel oils and gas, it is also a major producer of ethylene, propylene, ammonia, phenols, sulphur, road tar, pitch, creosote, alcohols, ketones, solvent blends, alpha olefins, fertilisers, explosives and waxes.

Sasol Technology's Research and Development Division is responsible for the research and development function of the Sasol Group.

Sasol's unique technology, which produces both fuel and chemical components from coal in a single step, provides it with a significant cost advantage in the production of petrochemical feedstocks. The recovery of the high-value chemical components and placing them in high-value chemical markets is thus an ongoing priority.

Continuous research and development in recent years has enabled Sasol to launch two major, more cost-effective technological innovations: the Sasol Advanced Synthol Process and the Sasol Slurry Phase Distillate (SSPD) Process. The SSPD process technology evolved from Sasol's extensive expertise in the field of low-temperature FischerTropsch process technology.

Besides the production of high-quality and more environmentally friendly diesel, the proprietary technology can also manufacture high-quality kerosene and naphtha from natural gas.

Iscor

The technology arm of the minerals and metals company, Iscor Limited, ITEC, provides technical and research support for the company.

Areas of operation include minerals beneficiation, new extraction methods, and high-temperature metallurgical processes. ITEC is also involved in environmental control through research into novel warp recycling and effective use of waste material.

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.

South African Institute for Medical Research (SAIMR)

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

The SAIMR came under full State health control in January 1999. It has approximately 2 000 employees and consists of four divisions: research, diagnostic laboratory services, production (serum and laboratory reagents), and teaching and training. The SAIMR conducts medical research as well as pathology laboratory tests for all provincial hospitals, excluding those in KwaZulu-Natal. Research is done 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 rendering 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 at Tzaneen in the Northern Province is responsible for the ongoing assessment of the malaria control programmes carried out by various authorities in South Africa.

Control methods are assessed, and recommendations made to the appropriate authorities with regard to 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

Antarctic research

Research on this southern continent is undertaken by the South African National Antarctic Programme (SANAP) through the Directorate: Antarctica and Islands of the Department of Environmental Affairs and Tourism.

South Africa has been involved in Antarctic research since 1957, and is one of 12 original signatories to the Antarctic Treaty. The country also ratified the Madrid Protocol on Environmental Protection to the Antarctic Treaty, which was implemented on 14 January 1998.

The South African National Antarctic Expedition (SANAE) IV base at Vesleskarvet can accommodate 20 over-wintering team members and 60 summer take-over personnel.

The main research conducted from the base is Antarctic magnetosphere, ionosphere groundbase observations and Antarctic research into cosmic rays. SANAP also conducts research activities on Marion Island, which cover the whole spectrum of the Island's ecology, and operates a meteorological station on Gough Island.

The 40th SANAE team departed for Antarctica from Cape Town on board the *MV SA Agulhas*, in December 2000. They will return early in 2002.

The team will start constructing a ramp on the ice shelf, remove the Grunehogna field base, and paint test panels of the SANAE IV base, which is still in the colours of the old

South African flag. It will be repainted during the next season. The team will also remove the general waste and building material stored at the site, install and service an automatic weather station at the SANAE emergency base, and take on a weather buoy deployment programme.

Mine-safety research

The activities of the Safety in Mines Research Advisory Committee are aimed at the advancement of the safety of the approximately 412 000 workers employed on South African mines. The Committee is a statutory tripartite subcommittee under the Mine Health and Safety Council. It has a permanent research management office under the control of an executive manager with three directors managing the three 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 a variety of organisations in the private sector. Provinces are responsible for farm management and technological development. These activities are aimed at improving management efficiency on farms.

The Directorate: Agricultural Water Use Management of the national Department of Agriculture co-operates with provinces to steer research in the engineering aspects of agriculture.

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.

Basic and applied research functions in respect of animal and crop production as well as agricultural mechanisation, irrigation engineering and natural resource management, are undertaken by the ARC. Research activities are governed by five research programmes in line with the *White Paper on Science and Technology* as well as the Government's national agricultural priorities.

Research initiatives have been integrated among the various industries in line with the overall objectives of that particular branch of the agricultural sector.

Water research

Water research in South Africa is coordinated and funded by the Water Research Commission (WRC) in Pretoria. The Water Research Act, 1971 (Act 34 of 1971), provided for the establishment of the Water Research Fund, which derives income from levies on water consumption. The funds are collected for the WRC on a commission basis by the Department of Water Affairs and Forestry.

The WRC does not undertake research itself, but enters into agreements with other specialist organisations, such as various university departments and institutions, the CSIR divisions, water boards and government departments to carry out the research projects.

In terms of the Water Research Act, 1971, the WRC has a responsibility not only to promote research, but also to encourage the application of research results. In 2000, the WRC financially supported 318 different research projects at an amount of R62,1 million.

The WRC also financially supports the development of the Waterlit bibliographic database as well as the Computing Centre for Water Research in Pietermaritzburg, KwaZulu-Natal.

The organisations most active in water research are universities (51,57% of the total number of contracts), consultants (21,97%), the CSIR (11,32%), water boards (3,77%), the ARC (4,14%), technikons (2,83%), government departments (3,46%) and municipalities (1,26%).

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 transfer of information and 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, as well as 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 covering a wide field.

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, and others are undertaken on behalf of the Department by the CSIR. Universities also carry out research on behalf of the Department.

Research on human-environment interaction sponsored by the Department is coordinated 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 – environmental and population data. The Atlas also identifies possible conflict areas in the utilisation of natural resources.

The South African Weather Service functions under the Department of Environmental Affairs and Tourism.

The Weather Service 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).

The Act provides for two distinct services, namely the public good services which are funded by government, and commercial services for which the user-pay principle applies. The public good services include weather and climate forecasting, a weather disaster warning system for the public good, 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.

The Weather Service operates the Global Atmosphere Watch (GAW) station, situated at Cape Point in the Western Cape. The GAW is an initiative of the World Meteorological Organisation, and serves as an early warning and forecasting system for changes in the background chemical composition and related physical characteristics of the atmosphere.

Atmospheric ozone monitoring at Irene, near Pretoria, is maintained throughout the year.

The NRF directs a 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 the 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 a growth of 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, the South African Network for Coastal and Oceanic Research, and the Savanna Ecology Forum.

Fisheries research

Research into South Africa's fish resources, 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 *inter alia* to provide parameters for estimates of stock sizes and sustainable yields for the different fisheries.

The Branch: Marine and Coastal Management Coordination commissioned a large-scale study on the socio-economics of the fisheries industry through the NRF, acting as its research management agency.

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 information and monitoring of 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 of the organisation.

The NRF supports marine and coastal research in partnership with the Department of Environmental Affairs and Tourism and the South African Network for Coastal and Oceanic Research.

Mariculture, or salt-water aquaculture, a growing industry that could contribute significantly to reducing the pressure on marine resources and uplifting coastal communities at the same time, is included in the research programme.

Private-sector involvement

South Africa's gold-mining industry works at deeper levels and under more difficult circumstances 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, and covers, among other things, 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 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 materials); 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); 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).

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Ministry of Minerals and Energy
Eskom
Estimates of National Expenditure 2001, published by the National Treasury
Human Sciences Research Council
Iscor
Medical Research Council
Mintek
National Department of Agriculture
National Research Foundation
Sasol
South African Bureau of Standards
South African Institute for Medical Research
Water Research Commission

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