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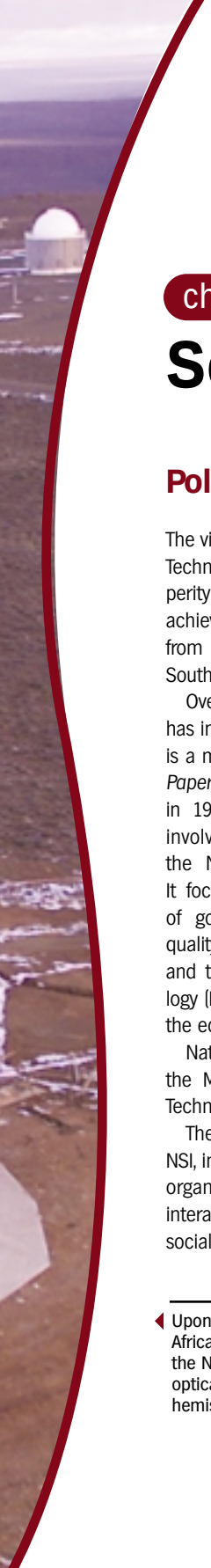

chapter 18

Science and technology

Policy

The vision of the Department of Science and Technology is to enable the creation of prosperity and well-being in South Africa, and to achieve enduring and equitable benefits from science and technology (S&T) for all South Africans.

Over the past five years, the science vote has increased by 27,6%. The Innovation Fund is a major initiative introduced by the *White Paper on Science and Technology*, published in 1996. It promotes large-scale projects, involving participation from throughout the National System of Innovation (NSI). It focuses attention on the major themes of government, namely competitiveness, quality of life, environmental sustainability and the harnessing of information technology (IT) to address the needs of society and the economy.

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

The intellectual framework for policy is the 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.

Upon its completion in 2004, the Southern African Large Telescope (SALT) at Sutherland in the Northern Cape will be the most powerful optical/infra-red telescope in the southern hemisphere.

National Research and Development (R&D) Strategy

In 2002, the Cabinet approved the Department of Science and Technology's National R&D Strategy, which allows for the enhancement of the NSI. The R&D Strategy identifies the need to pay greater attention to human resource development (HRD) as a wealth and employment creator, to bring innovation to the fore in all the Department's activities, and to facilitate S&T performance across government. Delivering increased economic growth and improved quality of life are the two key outcomes of the R&D Strategy.

National Advisory Council on Innovation (NACI)

Government has a constant need for informed advice on the development and implementation of S&T 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 S&T research and information, for the purpose of socio-economic development.

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

Public understanding of science, engineering and technology (Puset)

Getting information about science across to different sections of the population is a big challenge. The Department's efforts in this regard include the following:

- The dire need for science reporting in South Africa compelled the Department of Science and Technology, in conjunction with the American Association for the Advancement of Science (AAAS), to establish the Science Radio Journalism Fellowship Programme. The objective is to build a critical mass of science radio journalists who can communicate science to South Africans in their indigenous languages. Between 2001 and 2003, several fellowship awards were granted. During the four-week programme, fellows receive state-of-the-art training in science radio journalism at the AAAS headquarters in Washington DC, United States of America (USA). Fellows from the journalism community learn how to research, write and produce science stories, while those from the science community are taught how to communicate effectively with the media.
- The Reference Group of Women in S&T is aimed at the creation of an environment in which women contribute to, participate in, and share benefits equally with their male counterparts in the science, engineering and technology (SET) fields, whether from a policy-making or a research perspective.
- National Science Week 2003 kicked off with the launch of the Science Train. During the Week, the Train took various science exhibits with the theme *Taking Science, Engineering and Technology to Our People* to four areas. It was announced during National Science Week that the Department of Science and Technology, in conjunction with the Department of Agriculture, would invest R15 million over a three-year period for the promotion of public awareness and understanding of biotechnology.
- The Department hosted the first meeting of the International Public Communication of Science and Technology Network in Africa, and the second in the southern hemisphere, in Cape Town in late 2002.

The Minister of Arts, Culture, Science and Technology, Dr Ben Ngubane, launched a computer-literacy pilot project in the Eastern Cape in December 2002. This education project, designed to be as user-friendly and accessible as possible, is in line with government's commitment to rural development, as it affords children in rural areas access to a multimedia kiosk equipped with various computer applications, including the Internet, and an assistant to guide the children's learning processes.

International S&T co-operation

The Department of Science and Technology is committed to building strong international relations and innovatively benefiting from, and contributing to, the SET sectors of other countries. It manages over 30 S&T bilateral agreements with different countries and is a key player in many multilateral forums, including the Commonwealth; the African, Caribbean and Pacific Group of States; the European Union; and the Organisation for Economic Co-operation and Development. South Africa also played a key role in deliberations during the 2002 World Summit on Sustainable Development (WSSD).

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

The National Research Foundation (NRF) manages the implementation of the agreements, which range from 60 active projects with France to eight projects with the People's

Republic of China. Other countries in which active projects are under way include Belgium, Germany, Hungary, Sweden, Poland, Italy, India, Norway, Nigeria, the Russian Federation, the United Kingdom (UK) and the USA.

By mid-2003, preparations were under way for research collaboration with countries such as Egypt, the Ukraine, Belarus, Algeria, Morocco, Tunisia and Pakistan, subject to the finalisation of the requisite Framework Programmes of Co-operation. New agreements are also being negotiated with countries such as Chile and Brazil.

Implementing S&T policy and the objectives of the NSI

The establishment of the interdepartmental Science and Technology Co-operation Committee (SATCCOM), representing all relevant departments and with the chairperson and Secretariat provided by the Department of Science and Technology, was approved by the Cabinet. It promotes and guides the participation of government departments in international S&T co-operation.

SATCCOM is provided with an overview of the management, promotion and utilisation of R&D and S&T within government departments with an S&T component.

The Department has embarked on the establishment of a database on international co-operation in SET. Major international initiatives include the South African Coelacanth Conservation and Genome Resource Programme, launched at Sodwana Bay, KwaZulu-Natal. Research is co-ordinated by the South African Institute for Aquatic Biodiversity (SAIAB) in Grahamstown and involves several Southern African Development Community (SADC) neighbours.

Another international initiative is the establishment of a long-term ecological research site in southern Africa. This site will join an international network of ecosystem observatories, which help regions manage natural resources in a sustainable manner.

The Satellite Laser Ranging System at Hartebeesthoek, near Krugersdorp in Gauteng, is operated in conjunction with the National Aeronautics and Space Administration in the USA.

The South African Large Telescope (SALT) under construction at Sutherland in the Northern Cape is a multimillion-Rand project involving Germany, Poland, the USA, New Zealand and the UK.

Upon its completion, SALT will be the largest single optical telescope in the southern hemisphere.

Science and Technology Agreements Committee (STAC) Fund

Since its inception in 1996, STAC has, through the offices of the NRF, effectively serviced intergovernmental S&T agreements and multilateral activities.

Lead Programmes Fund

This Fund enhances existing international co-operation in the fields of biotechnology, new material, information and communications technology (ICT), environmental management, rural development and urban renewal. The Fund has successfully leveraged international R&D support and established viable consortia be-tween, among others, South African science councils, the *Centre de Coopération Inter-nationale en Recherche Agronomique pour le Développement* (France), ALCOA (USA), Rolls Royce (UK), and the IVL Swedish Environmental Research Institute.

Southern African Development Community Fund

The main priority areas include water management, cross-border pollution, food technology, indigenous knowledge systems, ICT, soil management and HIV/AIDS.

Technology diffusion and transfer

In September 2002, the *Tshumisano* Technology Stations Trust was launched. The Trust is

a partnership programme with the German Agency for Technical Co-operation and the Committee of Technikon Principals. The Trust was established to further the Technology Stations Programme (TSP).

The TSP provides skills-development training to small, medium and micro enterprises (SMMEs) to enhance their innovation capacity and competitiveness, while exposing university of technology (until recently technikon) students to practical situations facing businesses. It aims to address the product and process technology needs of SMME manufacturing and the service industry, through technology transfer, development and diffusion.

Seven stations are operational in the fields of electronics and electrical engineering, complemented by IT as imbedded in electronic processes and products; metals value adding, product development and rapid prototyping; chemicals (at two universities of technology); composites; automotive components; and textiles and clothing. The *Tshumisano* Trust is set to stimulate job creation, skills transfer and application, a culture of innovation, and increased social and economic investment.

In March 2003, the Deputy Minister of Arts, Culture, Science and Technology, Ms Buyelwa Sonjica, announced the launch of the South African Reference Group on Women in Science and Technology (SARG).

SARG, which consists of academics and businesspeople in the field, has two major objectives, namely, developing strategies that address identified obstacles and challenges that women face when entering the field of science and technology due to various socialisation, educational, environmental and cultural barriers; and achieving gender mainstreaming within research and development agendas, by ensuring that all these projects consider women as beneficiaries or end-users of the products generated.

National Biotechnology Strategy (NBS)

The NBS was approved by the Cabinet in 2001 and forms an important component of the R&D Strategy. It addresses new developments in biotechnology and the country's vulnerability with respect to the exploitation of South Africa's biodiversity and indigenous knowledge, and the advent of new technologies.

By February 2003, implementation of the Strategy had gained momentum with the establishment of Biotechnology Regional Innovation Centres (BRICs).

The Department received proposals by consortia comprising academic institutions, private institutions and research councils to form three BRICs representing specific regions in the country. The BRICs promote R&D, entrepreneurial services, technology platforms, intellectual-property management and business incubation. Each Centre specialises in specific areas of technology within the national development imperatives, local expertise and market opportunities.

There are three key Centres that will leverage bio-technology opportunities:

- Biopad BRIC in Gauteng focuses on animal health and industry/environmental-related biotechnology
- Ecobio BRIC in KwaZulu-Natal focuses on human health and bioprocessing, with a plant biotechnology focal area to contribute to plant biotechnology
- Cape Biotech Initiative BRIC in the Western Cape focuses on human health and bioprocessing.

These Centres combine business, academic and research capabilities to target areas that are directly relevant to South Africa's needs, as well as providing a platform for global economic participation. The key areas of activity include human health, industrial biotechnology, food security and agricultural production. These activities complement existing strategies in ICT and new developments to support the advanced manufacturing industry.

Godisa Programme

The Departments of Science and Technology and of Trade and Industry, with the support of the EU, launched the Godisa National Incubation Programme in 2001. The Godisa Programme aims at encouraging technology transfer and capacity-building to enable small business to compete in the global economy.

Godisa aims to address:

- outdated technologies employed by SMMEs
- low engagement rates of SMMEs in value-adding activities
- the high failure rate of start-up SMMEs
- poor access to facilities for testing and promoting SMMEs.

Godisa supports eight technology-transfer centres in five provinces, focusing on a multitude of technology platforms and markets, such as biotechnology, life sciences, medical devices, software, embedded systems, fine and performance chemicals, small-scale miners and hydroponics for cut-flower exports. This technology has very real local and international benefits and leads directly to job creation, increased levels of competency and enhanced international competitiveness.

By mid-2002, the following centres had been established:

- Softstart Software Technology Incubation in Pretoria (IT)
- KwaZulu-Natal Innovation Support Centre in Durban (IT)
- Zenzele Technology Demonstration Centre in Johannesburg (mining)
- Egoli Biotechnology Incubator in Johannesburg (biotechnology)
- Mbombela Horticultural Incubator in Nelspruit (horticulture)
- Arcon Technology Incubator (life science) in Cape Town
- Chemin Fine Chemicals Incubator in Port Elizabeth (chemicals).

The Godisa Programme is set to become the National Incubation Programme and a National Centre of Excellence.

The establishment of the Timbali Technology Incubator under the Godisa Programme stems from opportunities that were identified in the Mbombela Investment Strategy and the report on the South African Floriculture Cluster.

Timbali is responsible for creating the technology basis that will focus on the establishment and development of a financially feasible export-based cut-flower industry in the Mbombela region in Mpumalanga.

This will be achieved through technology transfer to flower-growers selected from the previously disadvantaged community, with emphasis on training in horticulture, business, finance and mentoring.

The Deputy Minister of Arts, Culture, Science and Technology, Ms Buyelwa Sonjica, and the Deputy Minister of Science and Technology of the People's Republic of China, Ms Wu Zhongze, signed an agreement on future scientific and technological collaboration, during the second session of the Science and Technology Joint Committee between South Africa and China, which was held in Pretoria in March 2003.

To enhance scientific and technological development, the China-Africa Engineering Association was established in 1997 in South Africa to promote engineering and scientific information exchange between the two countries. It also focused on promoting and organising exchange programmes for engineering experts and scholars from China to visit South Africa.

Poverty-Reduction Programme

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

For this reason, the Department has established a Poverty-Reduction Programme focusing on the agroprocessing area, with great potential for achieving sustainable reductions in poverty levels in rural and peri-urban areas. Its mechanism is the establishment of small and micro business ventures within targeted communities once skills transfer has taken place.

The Programme emphasises the transfer of skills, the utilisation of low-cost labour-

intensive technologies, stimulating demand and securing orders within the South African domestic market, establishing and maintaining product-quality standards, and the practice of general good business management. The Programme has established a variety of projects:

- The honeybee, widely found in South Africa, has been significantly underutilised for honey production. The Department funded the cost of training communities across the country to keep honeybees and make honey, sweets and candles from the wax. All the new production units sell their honey under the brand name.

  The Agricultural Research Council (ARC) won the *Impumelelo* 2002 Platinum Innovation Award in recognition of the Bee-Keeping for Poverty-Relief Programme, which epitomises the goals of the Departments of Science and Technology, of Social Development and of Agriculture. In addition to the revenue from honey, the Programme has also led to the production of crafts and other products, such as handcrafted containers for honey, beeswax candles, sewing and the making of protective clothing, and honey distribution and transport. The Programme was implemented in 35 rural and peri-urban areas all over South Africa. Programme implementation projects in Muldersdrift, Atteridgeville and Stinkwater in Gauteng were selected to be showcased during the WSSD as best-practice projects in the *Greening the WSSD* initiative.
- A similar project is that of small-scale and community-based oyster-mushroom farming to promote food security. This is a new initiative and is in the planning phase.
- A range of projects train people in the skills of paper-making and product development. These projects use natural fibres from the waste of large commercial farming operations or from the farming operations of small, resource-poor, emerging farmers. One of the projects involves, for instance, a group of about 15 rural women who are using sugar-cane waste and a low-cost technique for pulping it to make paper by hand. Further processing enables them to make the packaging for the crafts that they sell to tourists. The group has moved from the informal sector and selling its products on the street, to a production premises where manufactured goods are sold to tourist shops and businesses requiring paper packaging.

By February 2003, the Department had spent a total of R40 million on enabling vulnerable and impoverished communities and individuals across the country to learn useful and wealth-creating skills. A further R30 million has been budgeted for 2004.

Science councils

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

National Research Foundation

As the Government's national agency responsible for promoting and supporting basic and applied research as well as innovation, the NRF upholds excellence in its investments in knowledge, people, products and infrastructure. The NRF provides services and grants to support research and postgraduate research training, vital to the development of S&T in South Africa. It is the NRF's vision to be a key instrument in creating an innovative and knowledge-driven society where all citizens are empowered to contribute to a globally competitive and prosperous South Africa.

Funding from the NRF is largely directed towards academic research, developing high-level HR, and supporting the nation's national research facilities.

The South African Environmental Observatory Network (SAEON) was established in 2002/03. The NRF was mandated by the Department of

Science and Technology to develop a long-term ecological research programme for South Africa. Relevant government departments and science councils support the programme, and the Department has provided the core funding of R11,8 million over three years. The function of SAEON is to establish a network of environmental observatories/research sites and network information-management systems, to monitor long-term climate and environmental change in southern Africa.

The NRF's Research and Innovation Support Agency (RISA) invests funds, granted mainly by parliamentary vote, to institutions, teams and individuals engaged in research.

The total budget allocation from the Department of Science and Technology for the NRF for 2003/04 was R377 million. Of this, R113 million went to the national facilities; R9 million to the Foundation for Education, Science and Technology (FEST); and R221,6 million to RISA. A total of R34 million was used for departmental ring-fenced activities such as the STAC and SAEON, and for giving researchers access to the National Laser Centre.

The NRF's parliamentary grant is supplemented by joint ventures with other funding partners.

On 18 September 2003, the African Institute for Mathematical Sciences (AIMS) programme was launched in Muizenburg, Cape Town.

AIMS is aimed at strengthening scientific and technological capacity across the African continent. It focuses, among others, on a unique, intensive nine-month postgraduate course, developing a strong foundation in mathematical and computing research skills.

Some of the courses include:

- the art of scientific approximation
- mathematical problem-solving
- probability and statistics
- mathematical modelling
- methods of mathematical physics.

A total of 30 students from various African countries such as Algeria, South Africa, Morocco and Kenya, and visiting lecturers will be accommodated at the AIMS educational centre, allowing for maximum interaction.

The Square Kilometre Array (SKA) bid

South Africa, with the NRF as the lead agency, is gearing up to bid to become a host country for the mammoth SKA radio telescope, the world's largest radio-telescope project under consideration by international science bodies. South Africa is proposing to host the core array of the SKA, or part of the peripheral array.

The SKA project is an ambitious effort between institutions from 11 countries. The instrument will have multiple receiving surfaces and will provide radio astronomers with one million m^2 of collecting area, making it 100 times more sensitive than today's leading telescopes. The Northern Cape is considered to be one of the best potential locations for the SKA.

The South African SKA Steering Committee submitted a preliminary bid proposal in May 2003. The bidding process is expected to take two or three years to finalise. The International SKA Steering Committee hopes to choose the site for the SKA in 2005. Construction will hopefully start in 2010 and the SKA should start operating in 2015. The SKA is expected to cost US$1 billion, with the USA, Europe and the rest of the participating countries contributing a third each.

Technology for Human Resources for Industry Programme (THRIP)

The THRIP is a joint initiative between industry, research and educational at institutions, and the Department of Trade and Industry. The Programme is managed by the NRF on behalf of the Department of Trade and Industry. During 2003, some R404 million was invested in R&D activities designed to improve the competitiveness of the South African industry. This was 32% more than the amount in 2002. Of this investment, R158,5 million came from the Department of Trade and Industry (through THRIP) and the remainder, from industry (47% large and 53% SMMEs).

Some 266 THRIP projects were supported in 2003, with an average value of almost

R600 000 each (THRIP investment only). The projects cover a wide range of technology areas in the natural sciences and engineering. Some specific areas include agriculture and forestry, bioprocessing, food, healthcare, new material, mining, manufacturing and power.

The THRIP supports interventions focusing on improving the industry's competitiveness. In addition to supporting focused research and technology development with well-defined output, THRIP funds contributed towards the training of more than 2 651 students in 2003. Of these, more than 1 000 (39%) were black students, and more than 750 (28%) were women.

Innovation Fund

The Innovation Fund is designed to encourage large-scale, collaborative research and technology-development programmes; a multidisciplinary approach to problem-solving; and application-based research. The Fund's economic and S&T policies recognise the process of innovation, one of the agents driving technological change. Many countries believe innovation is primary to economic growth. The Innovation Fund is an investment by government that gives effect to this concept.

Under the management of the NRF, the Fund directs large grants (between R1 million and R5 million per year) to consortia of researchers for the final-stage research process in which knowledge is translated into new or improved products, productivity processes and services. The Fund assists in the conversion of research ideas into commercially useful end-products, by funding necessary items such as equipment, R&D expertise, access to managerial skills, the securing of intellectual-property rights, and the construction of prototypes.

The Innovation Fund is a policy instrument to lever economic and social resources. It seeks to address socio-economic challenges by harnessing South Africa's S&T competencies to simultaneously develop and maintain cutting-edge global competitiveness and address the needs of citizens unable to assert themselves in the marketplace.

The Fund has focused on ICT, biotechnology, new material and fauna and flora in its previous calls for proposals. The Innovation Fund will support projects to the value of R161 million over the next three years.

Research and Innovation Support Agency

The NRF's RISA has a suite of funding programmes that are in line with South Africa's priorities and needs. They are:

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

Collectively, these themes form the conceptual landscape within which most of the granting activities of RISA take place.

Research Capacity-Development (RCD) programmes

Institutional RCD programmes focus on boosting historically black universities and universities of technology that are committed to the research process. In addition, the *Thuthuka* Programme supports individual researchers.

It comprises the subprogrammes Researchers in Training, Women in Research, and Research Development for Black Academics. All the NRF's RCD initiatives aim to boost the output of high-level black HR (both academics and research students at all

higher education institutions); develop a postdoctoral research culture; strengthen weak, yet critically important disciplines; improve gender equity; and renew outdated research equipment.

Student support

The NRF provides two complementary types of postgraduate student support, namely:

- free-standing bursaries, scholarships and fellowships
- grantholder-linked bursaries.

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

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

Knowledge management

The NRF's research-information programme comprises:

- NEXUS, a set of research and knowledge networking databases containing information about South African research projects, professional associations, researcher networking, conferences and research organisations
- the South African Data Archive, an archive of computerised raw quantitative data of large-scale regional, national and international research projects
- the South African Network of Skills Abroad, which connects skilled people living abroad, who wish to make a contribution to South Africa's economic and social development, with local experts and projects.

International Science Liaison (ISL)

The ISL aims to forge and maintain strategic and intellectual alliances between individuals, institutions and organisations in the national and international science-research community, to support the international competitiveness of the country. The NRF manages some 19 S&T agreements signed between South Africa and other countries.

The South African International Council for Science (ICSU) Secretariat, which is administered by the NRF, serves the South African scientific community and most of the ICSU unions and affiliates. The ISL maintains contact with ICSU and similar bodies to facilitate South African participation in relevant and important international scientific activities.

Through the Africa Interaction Programme, the ISL expands scientific co-operation between scientists in South Africa and their counterparts in the rest of Africa.

Foundation for Education, Science and Technology

FEST's mission and mandate are to promote public understanding of science among all South Africans through open and constructive dialogue between the scientific community and society. Its vision is to give effect to the African Renaissance, by empowering people with knowledge of SET to help them improve their lives.

As of December 2002, FEST was incorporated into the NRF. Its products include the popular science magazines *Archimedes* and *EasyScience*, and it houses the Museum of Science and Technology. FEST is responsible for a range of other activities and events aimed at the youth, including science weeks and science and language olympiads. FEST was selected by the Department of Science and Technology to launch a programme on the public understanding of biotechnology, which the Department will fund for three years.

National research facilities

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

These are the:

- Hartebeesthoek Radio Astronomy Observatory (HartRAO)
- SAIAB in Grahamstown

- iThemba Laboratory for Accelerator-Based Sciences in Faure, Western Cape
- South African Astronomical Observatory (SAAO) in Cape Town, Western Cape, and Sutherland in the Northern Cape, and SALT
- Hermanus Magnetic Observatory (HMO).

Hartebeesthoek Radio Astronomy Observatory

HartRAO is South Africa's national research facility for radio astronomy and space geodesy. It operates, maintains and develops internationally recognised research facilities for local and international astronomers and scientists. The Observatory's unique geographic location is pivotal in a variety of global programmes.

The Observatory's 26-metre (m) telescope operates as a single dedicated instrument in a variety of fields, while participating in global networks of radio telescopes. The facility takes part in global geodetic projects to study the dynamics of the earth's crust and the rotation and orientation of the earth in space.

The Space Geodesy Programme has been expanded to include the operation of a regional network of global positioning system (GPS) stations as part of the International GPS Service, and a sophisticated satellite laser-ranging system. The Observatory is one of only six fundamental stations for space geodesy in the world, and the only one in Africa.

HartRAO will invest heavily in new equipment over the next three years. The SKA, an International GPS Service station, and a high-performance microwave telescope are some of the equipment needed to effectively continue the work of the facility in future.

South African Institute for Aquatic Biodiversity

The SAIAB is a leading centre for the study of fish and biodiversity in Africa and the surrounding seas. The Institute 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.

In 2002, the South African Coelacanth Conservation and Genome Resource Programme was launched at Sodwana Bay. The SAIAB co-ordinates the research project, which promotes co-operation in marine biodiversity conservation, environmental education and capacity-building. Countries such as Mozambique, Tanzania and Madagascar are participating in the Programme. The International Coelacanth Conference was held in South Africa in October 2003.

The Institute's educational programmes include illustrated lectures and guided tours of, among others, the experimental fish farm.

Exciting developments at the SAIAB include the expansion of the Coelacanth Programme beyond South Africa, the setting up of incubator groups through the Coelacanth Programme, and the development of a cryogenic tissue-storage facility.

iThemba LABS

iThemba LABS provides modern research facilities to users in science, medicine and industry. iThemba LABS has established itself as a major commercial centre for radiation medicine and is forging strategic partnerships with the private and public sectors to leverage capital, skills and the expertise required for an initiative of this magnitude.

By establishing a major oncology centre, iThemba is creating more space for training in physics and radiation sciences. The Major Radiation Medicine Centre (MRMC), as the proposed oncology centre is known, was endorsed by leading international oncologists during a visit to iThemba LABS during 2002.

The MRMC will become the centrepiece of cancer control in southern Africa and an internationally recognised centre of excellence in cancer treatment, research and training. iThemba LABS will invest in equip-

ment for therapy, while initial 'seed money' funding of R10 million is required for the MRMC project.

A good example of iThemba LABS boosting its income sources is its radionuclide sales, which achieved record levels of over R6,5 million in 2002. The income generated from such initiatives is ploughed back into research, infrastructure and HRD in radiation science.

South African Astronomical Observatory and Southern African Large Telescope

The SAAO in Cape Town and Sutherland 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.

The US$30-million SALT, an 11-m optical telescope, is currently under construction at Sutherland and will be commissioned during 2004. SALT will be managed by the SAAO on behalf of the SALT Foundation, an international consortium with partners from South Africa, Germany, New Zealand, Poland, the UK and USA. It is being funded by the five international partners and the South African Government, which has committed R50 million over five years.

SALT will collect light and infra-red rays with a mirror mosaic of 91 hexagonal segments, each 1 m wide, making it the largest single optical telescope in the southern hemisphere. During 2002, the SAAO was extensively involved in the establishment of a postgraduate astronomy/space-science programme. The completion of the SALT in 2004 makes it imperative that the next generation of South African and African astronomers and astrophysicists is produced and appropriately prepared. The scholarship programme in astronomy and astrophysics is an initiative designed to meet this challenge. It is focused on accelerating the development of astronomers and astrophysicists from historically disadvantaged communities.

A SALT Collateral Benefits Plan was designed to maximise benefits from the investment of public funds in the construction and operation of the project. The main thrusts are industrial empowerment, educational empowerment, public outreach, direct educational benefits, science education visitor centres, and SALT as an African facility.

Hermanus Magnetic Observatory

The HMO is of strategic importance as a player in space and earth sciences, as well as geospatial information.

The HMO comprises the:

- Space Physics Group, which conducts fundamental and applied research of the earth's magnetic field and space environment
- Geomagnetism Group, responsible for the continuous monitoring of the geomagnetic field and providing models and information
- Technology Group, which provides quality-controlled magnetic-field and sensor-related services and carries out commercial contract work
- Education and Science Awareness Group, which focuses particularly on school children.

In November 2002, the HMO was awarded accreditation as an Aircraft Processing and Testing Organisation, as well as an Aviation Training Organisation, by the South African Civil Aviation Authority. This opens doors to the wider aviation fraternity in southern Africa. At present, the HMO is the only local organisation with the infrastructure to do magnetic compass calibrations, aircraft compass swing base surveys and magnetic-effect tests on avionics equipment.

Agricultural Research Council

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

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

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

Rural development

The ARC collaborates with government and the Independent Development Trust in the development of government's Integrated Sustainable Rural Development Strategy (ISRDS).

The ARC advises the M-17 group of Ministers under the chairpersonship of the Deputy President on the development of a planning tool, based on geographic information systems (GIS).

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 Agricultural Georeferenced Information System (AGIS) was launched during the WSSD. This marked the establishment of an official information system for agriculture in South Africa.

The AGIS is cross-sectional and delivers information for natural resource use and management to provide decision-support systems for effective planning and management to ensure sustainable development.

The organisational website is also linked to AGIS, which was developed by the ARC in collaboration with the national Department of Agriculture and the nine provincial Departments of Agriculture. Agricultural information is made available to all users via the Internet and other electronic media.

The impact and wide scope of the ARC's sustainable rural development thrusts are evident in all provinces. The ARC empowers people through research, information and appropriate training that address 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 S&T, health and nutrition, food safety, education, the environment and natural-resource conservation.

Partnerships

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 other science councils.

By mid-2003, the ARC had 36 competitive bidding projects on which institutions collaborated with a range of local, regional and international research partners – six Innovation Fund projects; seven THRIP projects; one EU project; 11 projects funded by donor and international organisations; six regionally funded projects, mainly in association with the Consultative Group for International Agricultural Research research centres; and five binational projects, one each with Poland, India and Sweden, and two with Hungary.

At a regional level, the ARC is involved in the agricultural research activities of the SADC, with links to other African role-players in the Special Programme for African Agricultural Research.

The ARC is active in over 65 regional networks and has 137 research projects with international partners, involving one or more countries.

The ARC is also active in international collaboration, especially with universities in the USA, UK, Europe, Australia, New Zealand and Africa. It has Memoranda of Understanding with numerous scientific role-players in other countries.

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

ARC-Institute for Soil, Climate and Water

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

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

ARC-Institute for Agricultural Engineering

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

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

The Agricultural Research Council (ARC) developed an improved method for combating the foot-and-mouth disease (FMD) virus and preparing the FMD vaccine. The ARC patented the method in both India and Brazil. The ARC patent for a vaccine for Newcastle disease is limited to South Africa. Two other patents in the pipeline are related to a lactate-utilising bacterium for the prevention of lactic acidosis in ruminants, and a new dosing system.

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

By mid-2003, the ARC held registered plant-breeder's rights on 291 cultivars of the major plant types 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-Plant Protection Research Institute

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

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

The Institute also houses the Plant Genetic Resource Unit.

ARC-Grain Crops Institute

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

ARC-Small Grain Institute

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

ARC-Institute for Industrial Crops

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

ARC-Institute for Tropical and Subtropical Crops

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

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

ARC-Roodeplaat Vegetable and Ornamental Plant Institute

Situated outside Pretoria, this Institute concentrates on a wide range of horticultural crops. Research is conducted on commercial vegetables such as onions, potatoes, tomatoes and sweet potatoes. Traditional and indigenous vegetables receiving attention include amaranthus, cassava, plectranthus, Zulu round potato, pigeonpeas, cowpeas and bambara.

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

ARC-Infruitec/Nietvoorbij

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

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

ARC-Animal Improvement Institute

The ARC-Animal Improvement Institute at Irene, 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.

ARC-Animal Nutrition and Animal Products Institute

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

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

ARC-Onderstepoort Veterinary Institute

The ARC-Onderstepoort Veterinary Institute, north of Pretoria, is responsible for 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.

ARC-Range and Forage Institute

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

Council for Scientific and Industrial Research (CSIR)

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 60% of the CSIR's income is funded externally.

The CSIR's functions are centred in eight market-orientated business units:

- Food, Biotechnology and Fine Chemicals Technology
- Building and Construction Technology
- Defence Technology
- Water, Environment and Forestry Technology
- ICT
- Manufacturing and Materials Technology
- Mining Technology
- Roads and Transport Technology.

The CSIR-based South African National Cleaner Production Centre (NCPC), an initiative financed jointly by the Swiss and Austrian Governments to enhance the competitiveness and productive capacity of the national industry, through the adoption of cleaner production techniques and the transfer and development of environmentally acceptable technologies, was officially inaugurated in February 2003. The Centre is hosted at the CSIR's Process Technology Centre, which is part of the CSIR Manufacturing and Materials Technology business unit. The NCPC was launched during the WSSD.

The activities of the business units are aimed at:

- 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.

The CSIR focuses on team work, building relationships, forging strategic alliances and working with consortia. It is strongly committed to serving the national imperatives of crime prevention, HIV/AIDS, HRD, job creation, regional integration, rural development and urban renewal. In these endeavours, it draws on skills from across the organisation and collaborates with partners in science councils and other agencies, including local, provincial and national government.

The CSIR is empowered by the Measuring Units and National Measuring Standards Act, 1973 (Act 76 of 1973), as amended by the Measuring Units and National Measuring Standards Amendment Act, 1998 (Act 24 of 1998), 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 R&D organisations and companies, and is a registered consultant with the World Bank, the African Development Bank, United Nations Development Programme and others.

The CSIR is well-positioned to provide services to Africa in support of the New Partnership for Africa's Development (NEPAD). The combination of its scientific and technical expertise, its understanding of the African continent, and its developing strategic-relationship network with key African private, public and official development-assistance sectors, make the organisation an ideal partner to support Africa's economic development through specific interventions. These are primarily aimed at the environment, ICTs, infrastructural services and manufacturing. The CSIR also supports the utilisation of indigenous knowledge systems as well as capacity-building to secure Africa's position in the knowledge economy.

Long-term relationships with multinational companies and knowledge-intensive organisations have resulted in five-year compound growth of almost 26% in international external income.

The CSIR and the South African San Council reached an agreement in March 2003 to share

the benefits that are anticipated to arise from the potential commercial success of a CSIR patent that followed the R&D of a new technology relating to the Hoodia plant. Clinical trials continue internationally on the product (dubbed P57), which – if successful – will form the basis of a new obesity treatment.

In terms of the agreement, the CSIR will pay the San 8% of all milestone payments it receives from its licensee, UK-based Phytopharm plc, as well as 6% of all royalties that the CSIR receives once the drug is commercially available. Milestone payments are subject to agreed technical-performance targets of P57 during its clinical development over the next three to four years, and royalties are based on sales, which are not set to commence before 2008. This benefit-sharing model ensures that the San will receive equitable benefits if the drug is successfully commercialised, and is based on established international benefit-sharing models for the pharmaceutical industry.

The potential income stream will be deposited into a San Hoodia Benefit Sharing Trust, established by the CSIR and the San.

Mintek

Mintek, South Africa's national mineral research organisation, was established in 1934 to ensure the sustainability and growth of the minerals industry through technology development and transfer. This role has expanded internationally, and today Mintek is one of the world's leading technology organisations specialising in mineral processing, extractive metallurgy and related areas. Working closely with industry and other R&D institutions, Mintek provides service-test work, process development, consulting and innovative products to clients on six continents.

Mintek is an autonomous statutory organisation and reports to the Minister of Minerals and Energy. About 37% of the annual budget of R220 million is funded by the State, with the balance provided by contract R&D, sales of services and products, technology-licensing agreements, and joint-venture operating companies. Mintek has some 500 permanent staff members, over half of whom are scientists, engineers and other technical R&D personnel.

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

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

Specific goals include:

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

Mintek achieves its objectives in the following ways:

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

- developing the HR potential of the region through educational and training activities.

Mintek offers a complete range of process development services, from preliminary bench-scale investigations to large-scale piloting and integrated flowsheet development in support of bankable feasibility studies. Engineering design, plant construction and commissioning are carried out in conjunction with international partners. Comprehensive laboratory and piloting facilities for sample preparation, milling, flotation, physical separation, smelting, leaching, pressure leaching, and metal recovery and purification are supported by internationally accredited analytical laboratory and mineralogical services.

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

- The Gold industry Programme focuses on developing and introducing improved technologies, such as biotechnology and ion-exchange processes, to simplify processing and increase recoveries, particularly from ores that are difficult to treat. A major joint venture with industry and other research groups is exploring new industrial uses of gold.
- The Platinum-Group Metals (PGMs) Industry Programme aims to increase the cost-effectiveness of PGM production and stimulate industrial demand for the PGMs.
- The Ferrous Metals Industry Programme develops products and technical services to increase the cost-effectiveness of steel, stainless steel and ferro-alloy production, as well as improved alloys.
- The Non-Ferrous Metals Industry Programme includes the processing of aluminium, cobalt, copper, lead, magnesium, nickel and zinc. A major emphasis is on the introduction of cleaner technologies.
- The Industrial Minerals Industry Programme includes a major R&D effort towards the beneficiation of titaniferous raw materials, which constitute one of the country's most significant mineral resources. Mintek's research into waste management and environmental problems also fall under this programme.

Promoting industrial growth

Mintek is promoting a number of major new industrial projects based on mineral beneficiation, and utilising both existing and newly developed technologies. These include the production of hot briquetted iron from Sishen ore fines utilising natural gas, the recovery of PGMs from chromite tailings, the production of ferronickel and electrolytic manganese dioxide, and the establishment of a local magnesium industry using a novel thermal-production route being developed in conjunction with industry partners.

Regional development

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

Mintek is a founder member of the National Steering Committee (NSC) of Service-Providers to small mines, which assists artisanal and small-scale miners on matters such as mineral rights, better technology, raising finance for equipment, and marketing. A Technology Demonstration Centre, Zenzele, established in co-operation with the EU and the Department of Science and Technology, assists with the implementation of mineral-beneficiation techniques, hosts workshops and seminars, and assesses likely deposits for small-scale exploitation.

Environment

Mintek continues to focus on the develop-

ment of environmentally responsible technologies for the recovery and recycling of metals from metallurgical residues. A major programme is in place to monitor cyanide species after discharge in various locations around gold plants, from both an environmental and a processing point of view. Mintek's environmental technologies and services are provided to industry via a co-operative agreement with an established environmental consulting group.

Education

There is a shortage of engineers and scientists within Mintek's field of expertise in South Africa.

The undergraduate bursary scheme assists in supplying Mintek with a steady stream of suitable new graduates and also in fulfilling Mintek's commitment to promote education in the mineral-related engineering disciplines. The postgraduate bursary scheme is a source of researchers at MSc, MTech and PhD levels.

The EngTrain and TechTrain programmes focus on university and university of technology students who require in-service training to complete their qualifications. Mintek continues to support pre-tertiary activities to encourage young people to pursue careers in S&T. The two primary efforts in this regard are Minquiz, the annual national competition for secondary schools, and the Edumap Programme at the College of Education, University of the Witwatersrand, which affords young people from disadvantaged educational backgrounds the opportunity to prepare for tertiary education in engineering and commercial subjects.

Mintek's Adopt-a-School initiative, from which Kwadeba High School in Soweto benefits, was launched in 2001. Mintek supplies surplus laboratory equipment, and assists in ensuring that the school's science laboratories are functioning. Winter tutorials in mathematics and science are organised during school vacations. In 2002, the school's matriculation pass rate was 81%.

Human Sciences Research Council (HSRC)

The HSRC of South Africa is a statutory body established in 1968. It supports development nationally, in the SADC, and in Africa. It primarily conducts large-scale, policy-relevant, social-scientific projects for public-sector users, non-governmental organisations and international development agencies.

Over the last couple of years, the HSRC has undergone major restructuring, aligning its research activities and structures with South Africa's national-development priorities, notably poverty reduction through economic development, skills enhancement, job creation, the elimination of discrimination and inequalities, and effective service delivery.

It also seeks to contribute to the R&D Strategy of the Department of Science and Technology, especially through its mission to focus on the contribution of S&T in addressing poverty.

With its new structures and greatly expanded research complement of more than 130 top researchers and 100 support staff in five different centres, the HSRC is well-equipped to respond flexibly and comprehensively to current and emerging needs. Its 10 multidisciplinary research programmes, focused on user needs, are spread across five centres in different parts of South Africa.

Research programmes

The HSRC is responsible for the following research programmes:

Assessment Technology and Education Evaluation (ATEE)

The ATEE provides assessment, evaluation expertise and information aimed at improving the development and utilisation of resources (human and physical) in the education and training system, with the primary focus on schools and the industrial sector.

The programme focuses on school reform and change; science, mathematics and tech-

nology education; psychological assessment and methodology; modelling; and analysis. Future plans include addressing language-policy and implementation issues.

Democracy and Governance (D&G)

The D&G focuses on the two broad areas of democratic consolidation and local-government development and delivery. Projects falling under the ambit of democratic consolidation include work on electoral systems, intergovernmental relations and civil society, good governance, and issues relating to human rights and non-racialism.

Future projects in this area will include a democratic auditing project, intended as a response to NEPAD initiatives such as the African Peer Review Mechanism. Projects planned for 2003/04 deal with issues such as community-based information systems, determinants of non-payment of service delivery in the Tshwane metropolitan area, service delivery to farm workers in the Free State, and municipal land management.

Employment and Economic Policy Research (EEPR)

The EEPR focuses on themes that will contribute to the development of know-how in constructing an employment-planning framework for policy co-ordination.

The focus is not only on the labour market. The ultimate purpose is to enable government to address the growing crisis of unemployment and underemployment that are contributing to unacceptable levels of poverty and inequality in the middle-income economy.

The research programme has established a number of strategic partnerships that will add value to the work undertaken by the programme. Research projects in this programme are strongly aligned with the National Human Resource Development Strategy, as well as the Integrated Manufacturing Strategy of the Department of Trade and Industry.

Current and completed research projects in the EEPR address strategic aspects of sustainable development and quality of life, including public-private partnerships, SMME development, small-scale mining and the jewellery sector. Central research themes in the EEPR programme include labour-market analysis and HIV/AIDS in industry.

Human Resource Development

HRD undertakes research on the supply-side of strategic HRD planning by focusing on the provision of post-school education and training, particularly in the further and higher education and training bands, including public and private institutions.

Research on the demand-side examines the characteristics of skills in demand, those in short supply and those that will be needed in future. Linked to this is the research on the State's new science and industrial policies, aiming to identify the implications of new knowledge and innovation requirements on the education and training system. The programme also aims to develop appropriate analytical models to enable the matching of demand- and supply-side perspectives without falling short of the limitation of previous models of HR planning.

Integrated Rural and Regional Development (IRRD)

The IRRD emphasises poverty reduction as an overarching research theme. A multidisciplinary and multi-institutional task team prepares research proposals to support the mission *S&T for Poverty Reduction*, while the Southern African Regional Poverty Network provides a platform for policy-relevant discussions among key stakeholders and decision-makers in the region.

Other areas covered in the IRRD research programme include agrarian reform, rural non-farm development and regional resource flows. The programme also focuses on priorities articulated in the agendas of NEPAD, the WSSD and the ISRDS.

Knowledge Management (KM)

The KM provides key research input to the national R&D Strategy, with particular reference to strategic planning and capacity-development issues.

The programme has three main thrusts:

- NSI, which entails both policy and evaluation studies of the way that the system operates
- Government and Knowledge Economy, which considers the way information is managed and used across government, including the necessary enabling and regulatory environment
- Becoming an Innovative Research Organisation that considers how the work processes of the HSRC must and will change.

Social Aspects of HIV/AIDS and Health (SAHA)

The SAHA focuses on studying key socio-cultural, political, economic and demographic determinants that increase or reduce vulnerability to HIV-infection, through facilitating or hindering change in risky behaviour; enable or retard progress towards care; and prevent or enable mitigation of the impact of HIV/AIDS in South Africa and the SADC region. The public-health component of the programme focuses on health-system issues necessary for disease control within a social development context. The SAHA research programme has succeeded in attracting substantial funding for research, networking and grant-management purposes.

Following a commissioned situation analysis of HIV/AIDS in six countries, the SAHA made recommendations on appropriate, co-ordinated and research-based intervention programmes in the SADC region, focusing on orphans and vulnerable children. The HSRC has subsequently been appointed to manage a multi-year, multimillion-Rand research-based intervention programme.

Surveys, Analysis, Mapping and Modelling (SAMM)

The SAMM is a cross-cutting entity that brings together the HSRC's capacity in surveys, quantitative and qualitative analyses, GIS, statistical and econometric modelling, and data management. It assists other research programmes to meet their development research needs in a flexible and user-driven way. The HSRC's survey work has gained a clear competitive advantage following the strategic investment in the development of a master sample, funded by a grant from the Swedish Development Co-operation.

Social, Cohesion and Integration is a science and humanities research programme devoted to the promotion of excellence, leadership and public discourse in the arts, sports, religion, media, history and sciences. The programme is pioneering debates on the significance of the international Human Genome initiative for Africa. A major international conference on the human genome was held in March 2003.

Cross-cutting research initiatives

The majority of research projects housed in the 10 research programmes are multidisciplinary, multi-year projects. The interdisciplinary nature of these projects encourages collaboration between the different research programmes, as well as with researchers and research institutions outside the HSRC.

The output of the HRSC's research projects includes reports for users, occasional papers and scholarly articles in peer-reviewed journals or books. These are disseminated in print through an online bookshop, and published electronically on the HSRC's website *www.hsrcpublishers.ac.za*

Medical Research Council (MRC)

The MRC was established in 1969 by an Act of Parliament. Its mission is to improve the nation's health status and quality of life, through relevant and excellent research aimed at promoting equity and development.

The MRC is an autonomous body, but reports to the national Department of Health.

It receives 60% of its budget from the Department of Science and Technology. Its Head Office is in Cape Town, with provincial offices in Pretoria and Durban.

The MRC's research activities are aligned with the health priorities of the nation, in line with the national S&T Imperatives and the health priorities defined by the Department of Health under the philosophy of Essential National Health Research. Activities are grouped into the following 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, oesophageal cancer, molecular hepatology, microbacteriology, and liver and bone disease.

National Programme for Health Systems and Policy Research

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

National Programme for Infection and Immunity Research

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

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

National Programme for Non-Communicable Disease Research

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

National Programme for Environment and Development Research

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

National Programme for Women and Child Health Research

The MRC's 47 research units within these six national programmes employ over 300 scientists engaged in 600 research projects, supported by 200 support staff members.

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

Twenty-seven of the units are situated at medical schools and research institutes – six of these in historically disadvantaged institutions. The MRC also funds 350 short-term researchers at academic institutions throughout South Africa.

It has a new research-grant management system, using electronic databases and software to ensure equitable and efficient disbursement of health-research funding.

The MRC is becoming 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 becoming increasingly

internationalised through collaboration with most of the world's leading health-research agencies, including the National Institute of Health and Centre for Disease Control and Prevention in the USA, the Gates Foundation, the World Health Organisation, the Wellcome Trust, the Pasteur Institute, the Kenya Medical Research Institute, 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 healthcare practice.

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 (*www.sahealthinfo.org*), providing a one-stop interactive forum or resource for quality-controlled and evidence-based health-research information.

This Internet portal caters for three types of audiences: health researchers and healthcare professionals, health consumers and related organisations, and policy-makers. It also serves as a gateway to other trusted health resources.

A new portal for HIV/AIDS in southern Africa, *www.afroaidsinfo.org,* was launched on World AIDS Day 2002 and serves South African researchers, health professionals, educators, policy-makers and the general public. The project has secured external funding from the XIII International AIDS Conference organisers and BMS Secure the Future. The HIV/AIDS portal is endorsed by the Department of Health.

In response to the needs of researchers, and in line with government's biotechnology focus, as well as NEPAD, the MRC has initiated a process to establish an African Biotechnology Information Centre in collaboration with a consortium of universities.

The Knowledge Network also provides a unique access point to online full-text publications.

Council for Geoscience (CGS)

The CGS is a statutory body established 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
- the collection and conservation of all geoscientific information and data on South Africa in national collections and electronic databases
- the supply of geoscientific services and advice to the national and provincial governments, to ensure informed decisions regarding the optimal and efficient use of the earth's surface.

The objectives of the CGS are to:

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

To accomplish these functions and objectives, the CGS maintains a specialised workforce, consisting of earth scientists supplemented by technical, support and administrative staff at its headquarters in Pretoria, as well as branch offices in the 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 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 geoscience information and services provided by the CGS are particularly important for sustainable development. In South Africa's arid region, the management of groundwater resources (both the quantity and quality thereof) is aimed at providing enough clean water to communities.

A new map series, the 1:50 000 geotechnical map series, covering the rapidly developing areas of South Africa, can be used to locate land that is geotechnically suitable for development, and free of geohazards such as sinkholes. These maps also show the locations of building-material resources.

Through its membership of the NSC, the CGS helps mining entrepreneurs, particularly those from previously disadvantaged groups, to exploit South Africa's mineral resources in a cost-effective and environmentally friendly way.

The CGS plays a leading role in the SADC and has been chairing the Geological Subcommittee for several 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.

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 the Congo, Mozambique, Gabon and Morocco have been produced.

A map indicating seismic activity in sub-Saharan Africa has also been produced, as well as a publication on the gold deposits in the SADC region.

A digital edition of the Metallogenic Map of South Africa, at a scale of 1:1 000 000, was recently released. A metallurgic map of Africa, at a scale of 1:5 000 000, is being printed, and a digital version of this map will also be available in CD-ROM format.

The CD-ROM supplies information on all known mineral deposits and occurrences in South Africa.

South African Bureau of Standards (SABS)

The core business of the SABS is the production, maintenance and dissemination of standards. In terms of the Standards Act, 1993 (Act 29 of 1993), the objectives of the SABS include:

- promoting standardisation in industry and commerce
- undertaking educational work in connection with standardisation
- administering compulsory standards on behalf of the State

- collaborating with relevant international organisations to protect and advance South Africa's interests
- assisting government departments, public bodies, and provincial and local government in the preparation of any specification or code of practice they require.

The SABS provides standardisation services that improve South Africa's competitiveness. It consists of Standards, Regulatory, R&D and the Design Institute. It is further split into SABS Holdings, which comprises seven revenue-generating companies. The support rendered to government includes testing certification for local manufacturers and their products destined for overseas markets, to avoid double testing.

The Certification Strategic Business Unit 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 extensive state-of-the-art testing capability of the SABS forms the backbone of the organisation's commercial activities and contributes a significant portion of turnover. Goods can be inspected, tested and analysed against private, voluntary or compulsory standards, while precision-measuring and scientific equipment can be tested and calibrated for clients in both the public and private sectors.

Consequently, most of the 66 testing laboratories within the SABS are accredited by the South African National Accreditation System for the competent performance of tests in accordance with ISO/IEC Guide 25, the general requirements for the competence of calibration and testing laboratories.

The SABS is a founding 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 countrywide service in training quality-system and environmental auditors.

The core business units of the SABS are financed by monies allocated for that purpose under the science vote and administered by the Department of Science and Technology. Inspections and tests, which are carried out for the private sector, industry, national, provincial and local government, as well as the certification of products and systems, are funded on a commercial basis by fees charged for services rendered.

The Regulatory Divisions' prime objective is to align South Africa's requirements with international requirements, and to become actively involved in the creation of international standards. The Division has jurisdiction in the following areas:

- legal metrology: it ensures consumer protection in the area of measurement as it controls the accuracy of measuring instruments and the quantity of contents in prepacked goods
- automotive: the Division sees to the safety of the public by ensuring that vehicles meet legal requirements
- electrotechnical: the Division is primarily concerned with the safety of the public in electrotechnical fields by ensuring that they meet legal requirements
- food and associated industries: it ensures that fish products and canned-meat products are safe for human consumption.

Other scientific and research organisations and structures

Biotechnology Partnership for Africa's Development (Biopad)

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

Sasol

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 R&D Division is responsible for the R&D function of the Sasol Group.

Continuous R&D 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.

R&D and demonstration in Eskom are focused on supporting sustainable development. In 2002, investment in technical research, development and demonstration projects amounted to R625 million, which represented 1,2% of total revenue. It is estimated that in 2002, research provided a return of 5:1 in terms of avoided costs and direct-costs reduction. In addition, non-quantifiable benefits in social, environmental and customer satisfaction were realised.

During 2002, highlights of R&D and demonstration activities included the final commissioning of both the first sub-Saharan wind farm in the Western Cape, and the first solar dish stirling system outside of the USA, in partnership with the Development Bank of Southern Africa.

National Health Laboratory Service (NHLS)

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

The NHLS was established on 1 October 2001 to form a single public health laboratory service in South Africa. The NHLS comprises about 240 laboratories countrywide, including the former South African Institute for Medical Research, the National Institute for Virology, all provincial diagnostic pathology laboratories (excluding those in KwaZulu-Natal), and tertiary laboratories used by universities' medical schools. It has approximately 4 000 employees and consists of four divisions: Research, Diagnostic Laboratory Services, Production (serum and laboratory reagents) and Teaching and Training. The NHLS conducts medical research as well as pathology laboratory tests for all provincial hospitals, excluding those in KwaZulu-Natal. Research is conducted on diseases and health dangers that are of specific importance to South Africa.

Bureau for Economic Research

The Bureau for Economic Research at the University of Stellenbosch, Western Cape, is an independent and objective economic research organisation rendering a service to organi-

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

National Institute for Tropical Diseases

The National Institute for Tropical Diseases in Tzaneen, Limpopo, is responsible for the ongoing assessment of 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

South Africa has been involved in Antarctic research since 1957. It is one of the 12 original signatories to the Antarctic Treaty and plays an active role in Antarctic matters. The South African National Antarctic Programme (SANAP), which is run by the Directorate: Antarctica and Islands of the Department of Environmental Affairs and Tourism, provides logistical support to the annual science programme that is conducted in Antarctica and on the islands. It manages three bases, one on a mountain top at Vesleskarvet in Dronning Maud Land, Antarctica; a second on Marion Island in the south Indian Ocean; and a third on Gough Island, a British territory in the South Atlantic Ocean.

The country also ratified the Madrid Protocol on Environmental Protection to the Antarctic Treaty, which was implemented on 14 January 1998.

Relief voyages, which bring new over-wintering staff and supplies to the South African National Antarctic Expedition (SANAE) IV base, Marion Island and Gough Island, were all successfully carried out during 2002. SANAP continues to support the South African Weather Service by maintaining stations at all three bases. The Programme also assists with the deployment of weather buoys and the servicing of an automatic weather station at the South Sandwich Islands.

The Minister of Environmental Affairs and Tourism, Mr Mohammed Valli Moosa, led a multidepartmental delegation to Antarctica in January 2003. This was the first time that a South African Cabinet Minister had visited the Antarctic and SANAE IV base. Accompanying the Minister was a Norwegian delegation, led by that country's Minister of the Environment. A letter of intent, which heralds closer co-operation between South Africa and Norway in the Antarctic, was signed by the two Ministers at the Norwegian Antarctic station, Troll, during the four-day visit.

The purpose of the Minister's visit was to assess the research programmes and the scientific infrastructure in place at SANAE IV, and investigate the possibility of improved international co-operation, parti-cularly in the areas of cost sharing, revenue generation, and joint projects and activities. A clear understanding of the complexities of supplying and operating the Antarctic operation was achieved during the visit.

The SANAE IV base at Vesleskarvet can accommodate 20 over-wintering team members and 60 summer take-over personnel.

The main research conducted at the base is Antarctic magnetosphere, ionosphere ground-base observations, and research into cosmic rays.

A research base was established on Marion Island shortly after its annexation in 1947, and since then the base has been expanded and changed on an *ad hoc* basis. The base is used for collecting weather data, as well as for research into the exceptional biodiversity and natural systems.

The buildings on Marion Island have deteriorated to such an extent that they can no longer be economically maintained and repaired. The Directorate: Antarctica and Islands therefore proposed that a new modern research base be built to cater for the safe accommodation of personnel and for scientific research.

To ensure that the environmental impact of the new base is minimised, the Directorate has appointed independent environmental consultants to carry out environmental scoping.

Approval to rebuild the research station at Marion Island has been obtained, and an environmental-impact assessment was completed in 2002. Construction of the new base was expected to begin in the 2003/04 financial year.

The lease agreement between the UK and South Africa to build, maintain and staff a permanent base on Gough Island was to be renewed in 2003/04.

During 2002/03, the Departments of Environmental Affairs and Tourism and Science and Technology agreed to form a partnership and work together in the areas of Antarctic science, research support and funding. The objective is to broaden the scientific base, increase participation by historically disadvantaged individuals in SANAP, and revitalise Antarctic research.

As part of the Department's goal of exposing the Antarctic Programme to the South African public, 16 learners, including nine from historically disadvantaged backgrounds, accompanied the SA *Agulhas* on a voyage to the Antarctic in February 2003.

Mine-safety research

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

Energy research

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

Agricultural research

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

The Directorate: 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.

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

Water research

Water research in South Africa is co-ordinated and funded by the Water Research Commission (WRC) in Pretoria. The WRC was established in 1971 through the Water Research Act, 1971 (Act 34 of 1971), following a period of water shortage. It was deemed to be of national importance to generate new knowledge and to promote the country's water research purposefully, owing to the view held that water would be one of South Africa's most limited resources in the 21st century.

Being a water-stressed country, South Africa progressively needs to find innovative ways of managing water resources to ensure that the basic needs of its citizens are met, that social and economic development is not restricted through a lack of or a poor quality of water, and that sustainability of water resources and of water-dependent ecosystems is achieved.

The WRC has the mandate to perform the following functions:

- promote co-ordination, co-operation and communication in the area of water research and development
- establish water research needs and priorities
- stimulate and fund water research according to priority
- promote effective transfer of information and technology
- enhance knowledge and capacity-building within the water sector.

The Water Research Act, 1971 provides for the establishment of the Water Research Fund which derives income primarily from levies on water consumption.

The WRC funds R&D under contract with other organisations. In view of the broad scope of water research, a wide spectrum of research-providers are involved in WRC research contracts. They are drawn from universities, universities of technology, statutory research agencies, government departments, local authorities, non-governmental organisations (NGOs), water boards, consultants and industry.

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

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

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

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

The organisations most active in water research are:

- universities (51,57% of the total number of contracts)
- consultants (21,97%)
- the CSIR (11,32%)
- water boards (3,77%)
- the ARC (4,14%)
- universities of technology (2,83%)
- government departments (3,46%)
- 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 the transfer of information technology.

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

Environmental research

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

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

and marine environment, and the atmosphere.

Some programmes are conducted in collaboration with the NRF, while others are undertaken on behalf of the Department by the CSIR. 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, namely 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 public-good services are funded by government while commercial services are paid for by the user. The public-good services include weather and climate forecasting, a weather disaster warning system, services to subsistence farmers and fishers, the provision of information and advice to government, meeting regional and international treaty and agreement obligations, maintaining a national meteorological library, technical and scientific training in meteorology, and undertaking research to improve services.

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 the multidisciplinary Conservation and Management of Ecosystems and Biodiversity Focus Area, primarily in collaboration with universities and museums, to promote and support research on living resources and 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 (SANCOR) 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 to provide parameters for estimates of stock sizes and sustainable yields for the different fisheries.

Coastal and marine research

The Chief Directorate: Marine and Coastal Management advises on the utilisation of marine living resources and the conservation of marine ecosystems, by conducting and supporting relevant multidisciplinary scientific

research and monitoring the marine environment. Sustainable use and the need to preserve future options in the utilisation of marine ecosystems and their resources are guiding objectives in the research and advice of the organisation.

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

Private-sector involvement

South Africa's gold-mining industry works at deeper levels and under more difficult 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 includes 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 material), Johannesburg Consolidated Investment Company (metallurgy, mineralogy, chemistry and chemical engineering), National Chemical Products (chemistry, microbiology and animal nutrition), Metal Box Company of South Africa (corrosion mechanism and microbiology), Tellumat (development of electronic instruments), Rembrandt Group (development and improvement of tobacco and liquor products), South African Pulp and Paper Industries (wood technology, paper manufacture and water treatment) and Standard Telephones and Cables SA (long-distance transmission of information and lightning protection).

Acknowledgements

Agricultural Research Council
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