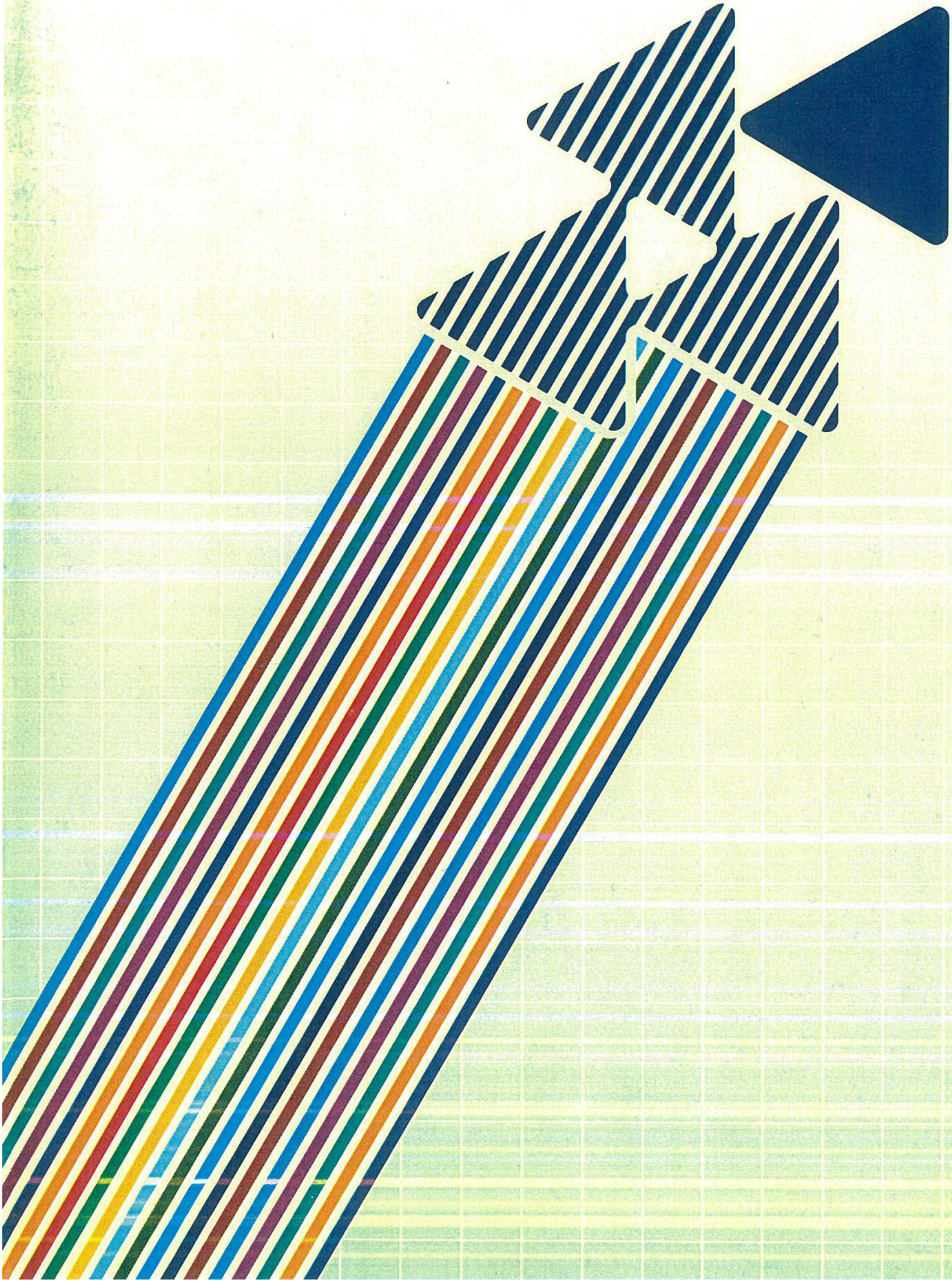
Annual Report CSIR 1988



The CSIR undertakes, fosters and manages broadly based scientific research, development and technology transfer in support of and to meet the needs of South African industry, community interests and quality of life in a cost-effective and ethical manner.

"We strive for excellence."

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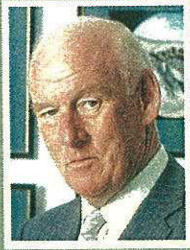
Dr C F Garbers



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12 DIVISIONS AND 1 CENTRE

- Aeronautical Systems Technology
- Building Technology
- Earth, Marine and Atmospheric Science and Technology
- Energy Technology
- Food Science and Technology
- Information Services
- Materials Science and Technology
- Microelectronics and Communications Technology
- Processing and Chemical Manufacturing Technology
- Production Technology
- Roads and Transport Technology
- Water Technology
- Centre for Advanced Computing and Decision Support

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Prof. D R Woods,	Deputy Vice-Chancellor (Research), University of Cape Town

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CHAIRMAN'S REVIEW

DR L ALBERTS
Chairman

Extensive job opportunities with reasonable remuneration for everyone constitute an indispensable cornerstone to ensure our country's survival. Considering the wide spectrum and the extent of our natural resources it is evident that a comprehensive technology programme will have to be developed to establish this cornerstone.

Technology means capability based on science and experience which can be used to produce prosperity, health and security. It forms the basis of a country's economic strength, which is in its turn an essential component of peace and stability.

The concepts of developed and developing countries are directly linked to the degree of technological development of a particular society. Analysis by Solow (1951) of the US's economic growth between 1909 and 1949 showed that expansion of capital contributed 11 per cent to the average annual growth rate and expansion of labour 38 per cent, while the remainder – 51 per cent – rested on the improvement of technology. Confirming this, Gee (1981) found that technological progress contributed between 40 and 70 per cent of productivity growth, while capital formation contributed only 15 per cent and improved education and training of the labour force only 12 per cent.

Firstly, we need a public sector technology policy to optimize technology development. A policy of this kind should take account of available manpower at the different levels of schooling, adequacy of capital, and resources and markets. The reconstituted Advisory Council on Technology, on which a number of outstanding industrial leaders from the private sector serve, is formulating a technology policy of this kind and will present it to the Minister of Economic Affairs and Technology during 1989.

We also need skills to apply as effectively as possible in a wide variety of uses ranging from agriculture to heavy industry as well as relatively high technological applications as, for instance, in the electronics industry. As far as resources of basic knowledge are concerned, CSIR has created over four decades a foundation and structure for their delivery as well as their use in the service of technology.

The most important components of such an intellectual infrastructure are physical facilities such as buildings and equipment as well as clever, well-trained, and dedicated people. Resources of this kind are not unlimited, but nevertheless a strong personnel has been built up on a magnificent campus which must make any right thinking citizen confident of our future in technology – justifiably proud.

Quantum leaps in technology improvement, such as the Tellurometer in the past and the current battery breakthrough, contribute meaningfully to CSIR's international reputation as a research organization. Combined with these somewhat sensational discoveries are the innumerable smaller incremental improvements which, in the long run, mean more for a country's economy – think of Japan. The laboratories on the Scientia campus are daily involved in incremental innovations which often mean the difference between profit and loss in a particular industry.

As already mentioned, CSIR entered a new phase of history during the past two years. This has mainly brought about a sharpened focus on practical national needs. If one makes the reasonable assumption that basic research has attained considerable sophistication at the universities over the past four decades, such work in CSIR laboratories can be replaced by more practical, problem-orientated research, focused on actual national needs. Notable results have been achieved during the past year, as reflected in the trebling of contract work carried out for the private sector.

Meanwhile, CSIR's responsibility for funding university, technikon and museum research has been expanded – but then as a totally separate task carried out parallel to its technology mission. Likewise it is continuing its function of international scientific liaison. The importance of this work at this stage in South Africa's history is self-evident. It must always be borne in mind that no country in the world can develop science and technology in isolation. In this area, the countries of the world have become one organism, with larger and smaller body parts, and no one of them can exist indefinitely on its own.

The change in CSIR was accompanied by drastic reorganization of laboratories, regrouping of personnel and reorientation of the management cadre. New conditions of service, which comply with the new philosophy, were developed and a climate of 'private-sector orientation' has been created. The large majority of the staff are coping extremely well with the 'winds of change' and are finding their professional 'sails' beginning to fill. Here and there a boat capsized, but these instances were meaningfully few.

Council change

Coupled with the reorganization was a major change to the Council of CSIR – carried out with the complete co-operation and assistance of both Council and executive management. As an outsider, I was appointed to be Chairman of the Board on a part-time basis from 1 June – previously the President also filled this role. While the President remains the chief executive officer, the Chairman, apart from his duties in that role, will also liaise with Government on policy matters. This new arrangement gives additional external support to the President in his executive task. It is closer to private sector practice and is a further evolution of the new phase in CSIR's history.

Everything indicates that out of this organization's great history a future is evolving in which still larger contributions to South Africa's progress will be made.

L Alberts

L ALBERTS

PRESIDENT'S REVIEW

DR C F GARBERS
President

CSIR, which is the largest pool of scientific and technological expertise in South Africa with a budget of R448 million, was restructured in 1988. This was the outcome of years of planning and dedication and was a team effort.

The restructured CSIR operates our newly-created Group: Research, Development and Implementation (RDI) which focuses on technological support in the public and private sectors, while our Group: Foundation for Research Development (FRD), through its extended brief, further strengthens its guardianship and nurtures research and development excellence in the sciences and engineering at universities, museums and technikons. Our Groups for Human Resources Services and Finance and Management Services ensure optimal employment of our valuable resources of manpower and money.

We gained a more dynamic role and image as our new corporate identity and management structure – planning of some aspects began in 1983 – became effective.

From January 1988, the new top management team, responsible for the restructuring, which was reduced from seven to five people, was in control. During the year, further structural and management changes became effective.

CSIR brought into being, within RDI, 12 divisions and a Centre for Advanced Computing and Decision Support to consolidate CSIR's own R&D activities in areas of critical importance to the country and to perform as strategic business units. The areas are: aerodynamics; building; earth, marine and atmospheric sciences; energy; food; information; materials; microelectronics and communications; processing and chemical manufacturing; production; roads and transport; and water.

In its area of operation, each division is already starting to have decisive impact, focusing not only on R&D but also on the implementation of research findings. During the year each strengthened its ties with markets in both the public and private sectors and began building up a technology auditing capability.

To improve the transfer and the impact of technological knowledge, the South African Technological Information System, SATIS, was launched by the then Centre but now Division of Information Services. The system's rapid inquiry and search services are accessible electronically as well as by telephone and post and on a personal basis and are an integral component of interaction between CSIR and industry – part of the 'technology push' we seek to create.

In 1988/89, CSIR budgeted for a contract income of R158,5 million, a 49,1 per cent increase on the 1987/88 achievement. As this report went to print it appeared that at the end of the financial year in March we would be very close to target. This is all the more remarkable for the fact that – through privatization, transferring out, and scaling down, rationalization and strengthening of specific activities – there was a decrease of about 500 in our staff complement (see Figure 1; Figure 2 shows the decrease according to categories and Figure 3, relative staff turnover for 1986, 1987 and 1988).

The new system of support for research at universities, museums and technikons introduced by FRD has as its kingpins a controlling Senate and a wider Collegium of leading scientists to be the base for peer-evaluation of researchers who apply for support. The budget for this support in 1988 was R48,9 million, while our national scientific facilities – the National Accelerator Centre, the South African Astronomical Observatory and the Hartebeesthoek Radio Astronomy Observatory – had a combined budget of R36,3 million. The Magnetic Observatory at Hermanus is now also part of FRD.

FIGURE 1

Number of employees on March 31, 1988

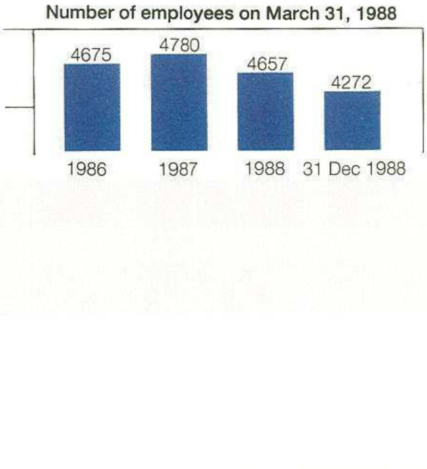
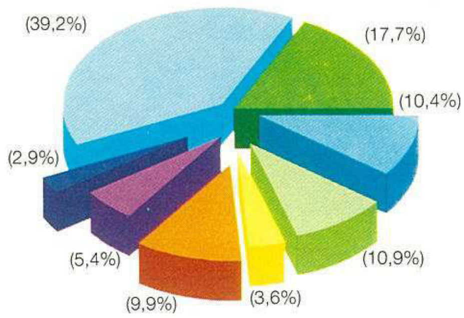


FIGURE 2

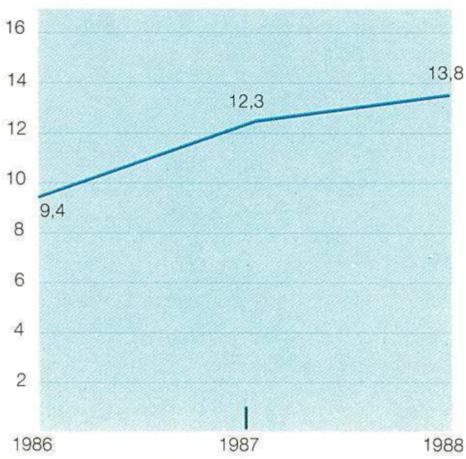


Analysis of personnel decrease by category: 1988

Administrative 151
Instrumentmakers 11
Artisans 21
Other 38
Processing 14
Technicians 42
Engineers 40
Scientists 68

FIGURE 3

Staff turnover in %



During the year CSIR's management was further streamlined when the Corporate Support Services Group was absorbed, mainly by the new Group: Finance and Management Services, and the Group: Human Resources Services came into being. The Group Executives of these new Groups joined CSIR Executive from senior positions in the private sector and are implementing new financial and personnel procedures and controls.

In 1987, the effect of the ongoing restructuring, bringing uncertainty and change, filtered through to every CSIR employee. In 1988, however, when CSIR settled into its new structure, general staff attitudes improved vastly.

The agenda for change

With our eye on the future, and eventually having the 1988 Act under which to operate, we acted as follows:

- Strengthened our capability to manage and plan strategically, and built in an ability to address changed circumstances and goals flexibly.
- Enhanced and broadened South Africa's scientific and research expertise by a 56,6 per cent real and 252 per cent nominal increase in research funding in seven years, to universities and museums.
- Increased the value of postgraduate bursaries, which brought strong growth in the number of outstanding bursars, particularly in engineering.
- Selected 12 areas of technology which are critical to this country and began concentrating not only on R&D but also the implementation of research findings in those areas. We are now geared to tackle short- to long-term projects and have the power to set priorities.
- Introduced elements of matrix management, so that we address the complex problems of our time in an optimum way while we are able to contract in – either locally or internationally – any specialized knowledge we need.
- Trained our staff to operate more effectively as interactive partners with our clients in the private and public sectors.
- Developed and introduced a new business-orientated financial policy, which would ensure the effective running of CSIR.
- Introduced new conditions of service and a new human resources policy to better reflect our market-orientation.

- Completed three multi-million-rand facilities – the National Accelerator Centre, the Medium Speed Windtunnel, and equipment for reception of Landsat thematic mapper high-resolution imagery. These are all new high-technology capabilities created for us.
- Started a technology innovation fund to improve partnership research with involved parties in our markets.
- Established, with the Industrial Development Corporation, the venture capital company, Technifin.
- Opened new avenues to international scientific collaboration.
- Began investigating the more effective use of our overseas offices to bring greater advantage to South Africa's scientific and technological communities.

In late 1987, we commissioned Business and Marketing Intelligence (Pty) Ltd to assess CSIR's performance in the marketplace. Although it was found that there has been generally a high regard for us on a number of scores, we were sensitized anew to significant perceived weaknesses – among them past failure to meet deadlines, slow response to new inquiries, and lack of commitment to and understanding of clients' needs. Needless to say, we are already working on correcting these weaknesses.

While we carried out our extensive restructuring, we continued – under some 2 500 R&D contracts – our wide-ranging collaboration with state departments, commissions and councils, other countries in Africa, and South Africa's industries.

Encouraging entrepreneurs and privatizing

As already mentioned, we set up the country's largest venture capital company, Technifin, in collaboration with the IDC. Our one-half shareholding is held through Saidcor and our R25 million contribution to the company's initial capital of R50 million stems primarily from a successful Saidcor licensing agreement based on a CSIR invention.

Under its chief executive, Mr Lourence Greyvenstein, Technifin will play an active role in the commercialization of economically viable new technology. The setting up of the company has been warmly welcomed by the business community and the Johannesburg Stock Exchange.

Among other CSIR activities privatized were:

- Our training function. This activity within the Group: Human Resources Services was taken over by Groman Consulting Group under a management service contract which assures us of ongoing access to the latest technology in human resources development. Not only do we no longer maintain a training team, but we receive royalties from the external sale of CSIR training modules.
- Our transport services. On 1 November, management of the CSIR motor vehicle fleet was taken over by Avis Rent-a-Car.
- Our drawing office. On 1 October this was taken over by Destek Designs.

How the change came about

In January 1983, Professor Jack de Wet was appointed adviser to CSIR Executive to conduct an in-depth investigation on improving and strengthening research funding and postgraduate research support in the sciences and engineering at tertiary educational institutions. This resulted in the foundation of FRD in 1984.

The period 1983–1985 also brought severe financial cutbacks, emphasizing the need for a strategic plan to, among others, identify which activities should be abandoned, scaled down, retained or strengthened and this resulted in the first closing down of certain activities in 1985.

The Kleu Report (February 1983) and the White Paper on a Strategy for Industrial Development (May 1985) identified CSIR as the vehicle to lead in 'establishing an appropriate mechanism for the transfer of technology'. Our restructuring should be seen in part as a response to that challenge.

We studied world-wide tendencies which the Chairman has described and analysed South Africa's scientific and technological situation in this light. We did so bearing in mind this country's strengths, weaknesses and opportunities and the threats directed at it, with due recognition of political, social and economic realities.

Recognizing the stultifying effect of bureaucratic control, which necessarily focuses more on inputs than outputs, our Council propounded the guiding philosophy that CSIR must earn autonomy through greater market orientation, client participation and financial self-sufficiency.

A new strategy to give effect to the change in course announced in 1985, was laid down by the Council in October 1986. This committed us to active involvement not only in research and development but also in implementation of R&D findings. We would best achieve this objective as a corporate body, concentrating on outputs rather than inputs, and using cost-benefit analysis to assess its performance.

In addition, we would consider alternatives for our funding responsibility to universities, museums and technikons and investigate the possibility of privatizing our technology development company, Saidcor.

Council approved the implementation mechanism for our 'Strategy for the Future' in March 1987 and 1 April 1988 saw the official commissioning of the restructured CSIR.

An important external breakthrough came in April 1987 when the Government granted statutory research councils greater autonomy in running their own affairs – the so-called 'framework autonomy'. This contributed considerably to CSIR being able, with the assistance of various consultants, to move into top gear in implementing change and particularly new conditions of service and policy on the remuneration of our employees.

In April 1988 the new CSIR Act was passed. This widened still further our ability to exploit new technology and as a safeguard separated the offices of Chairman and Chief Executive. Dr Louw Alberts, the retired Director-General of Mineral and Energy Affairs, became Chairman of the CSIR Board in June.

The right leadership

Throughout its history, CSIR has used psychological evaluation in selecting staff with exceptional capabilities. In addition, the complexity and multidisciplinary nature of modern R&D and its implementation process, need enhanced competence in management science. It is also accepted world-wide that management of R&D is critically dependent on leadership.

Accordingly, great care was taken in selecting the new leadership corps of CSIR – including the men appointed to strengthen management in FRD and to head the 12 divisions and one centre in RDI and their numerous research programmes. The men appointed to the corps were provided with further training in effective leadership and management science skills to enhance their natural abilities and confidence.

As I have said already, we emerge from 1988 – which saw the greatest discontinuity in CSIR's 43-year existence – leaner in personnel. Inevitably, some members of staff could not be accommodated in the new structure. In all such cases, we went to great lengths to ensure fair and equitable severance and it is gratifying that, throughout, mutually acceptable arrangements were made. We place on record our gratitude to those employees for their contribution to building CSIR, enabling it to be restructured with confidence.

CSIR is now firmly on its new course thanks to a major team effort throughout the organization.

Operations reviews, value-for-money audits

To help them render effective and cost-effective service, managers of strategic business units have to receive correct management information in time and regularly. This is supported among others by corporate audit and legal services.

As only limited funds are available, constant attention is being paid to the effectiveness of services rendered and divisions are subjected, on a structured basis, to operations reviews and value-for-money audits. Consequently a great deal of rationalization has already taken place apart from the privatization of services already mentioned.

Financing of CSIR

CSIR's largest source of funding is still the Parliamentary Grant. As the commercialization of technology gains momentum and the large market for it is exploited in a businesslike way, external income in the form of fees, royalties and dividends will represent a rising proportion of revenue.

Interpretation of our audited statements for the financial year to 31 March 1988 (see page **25**) shows that income from investigations and services grew by 16,9 per cent in real terms to 28,3 per cent of total income (Figure 4). CSIR's total Parliamentary Grant (68,7 per cent of all income) showed real growth of 1,6 per cent.

Total expenditure (fixed assets and operating costs) rose 8,8 per cent in real terms and mainly in remuneration of personnel and purchase of supplies and services. Current expenditure showed a real increase of 8,8 per cent. The largest component, staff costs, showed real growth of 3,3 per cent, but decreased to 54 per cent of total costs compared with 57 per cent in the previous financial year. Real growth of 28,2 per cent in expenditure on supplies and services was due mainly to higher expenditure on non-CSIR equipment and on professional research and other services.

Completion of various special facilities meant that capital expenditure fell in real terms by 14,3 per cent. Only investment in land and buildings grew – by 25,8 per cent in real terms.

An analysis of total expenditure after deduction of awards and subsidies (Figure 5) shows that the greatest part (65,6 per cent) of total expenditure after deduction of awards and subsidies was devoted to research and development, the rest going to other scientific and technological activities. In the latter category are included supply and development of South Africa's infrastructure for research and also provision of scientific and technological services to industry. The most noteworthy components are shown in Figure 6 and allocation of R&D expenditure in the most important research areas in Figure 7.

FIGURE 4

Total Income (1975 - Prices)

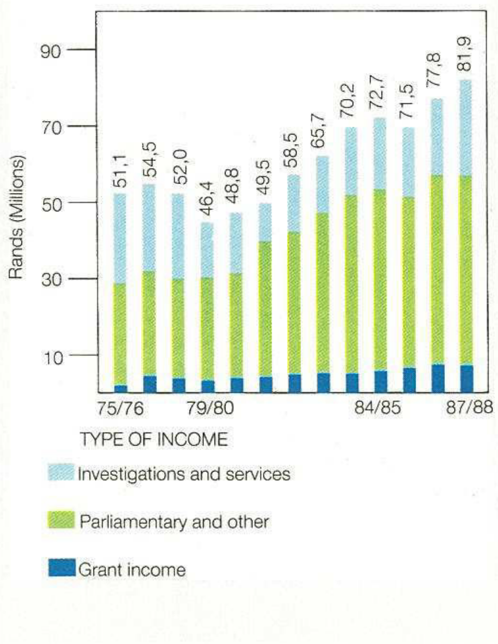
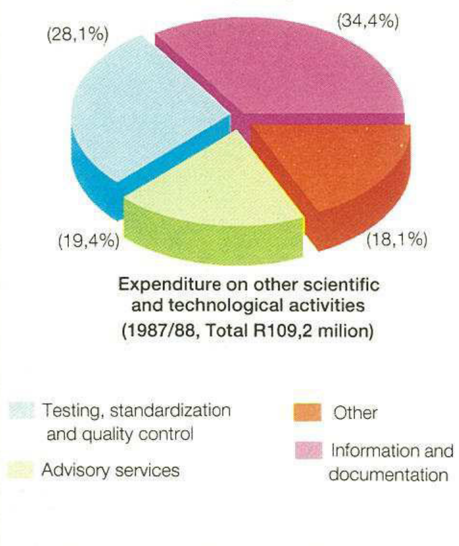
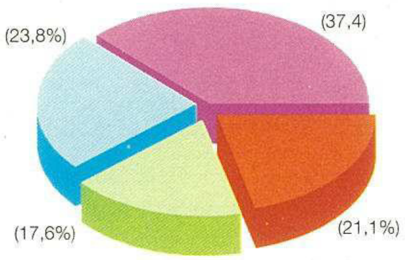


FIGURE 5



Expenditure on other scientific and technological activities (1987/88, Total R109,2 milion)

FIGURE 6

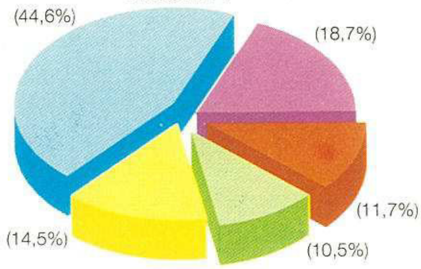


Expenditure on research and development according to field of research (1987/88,Total R208,3 million)

Physical sciences | Other
Technological sciences | Engineering

An analysis of socio-economic sectors which drew benefit from R&D (Figure 8) shows CSIR's involvement in branches of science which are vital to the technological development of the country's infrastructure and to industry.

FIGURE 7



Expenditure on research and development according to socio-economic sector (1987/88, Total R203,3 million)

Community development | Advancing knowledge
Other economic activities
Infrastructure | Manufacturing

Acknowledgements

My task as President has been greatly eased by the wise counsel and leadership of CSIR Board and by the dedication and support of my Executive, Dr Rein Arndt and Dr Brian Clark in particular. During the year, Mr Albert Michau and Mr Fred Camphor joined the Executive from the private sector, and in a short time their expertise in finance and human resources matters respectively has brought a new dimension to CSIR affairs.

Two stalwarts of the Executive, Dr Koos Kemp and Dr Neville van Deventer, retired on pension during the year and another departure was that of Dr Gorra Heymann. All of them left a lasting stamp on our organization. Special tributes are also due to Mr George Donaldson, Dr Naudé van Wyk, and Mr Raymond Vice, who also retired, for many years of dedicated and creative service.

Dr Gideon Louw (from the University of Cape Town) and Professor Daan van Wyk (from the Rand Afrikaans University) joined the FRD Executive, and CSIR stands to gain handsomely from their research expertise and standing in the area of tertiary education.

From the private sector we also gained our Corporate Marketing Executive, Mr Glen Mansfield.

To finalize the restructuring of a major national asset called for a number of policy decisions at the highest level. I would like to record our appreciation to the Minister, Mr D W Steyn, and the Deputy Minister, Dr T G Alant, for their support and for steering the new CSIR Act through Parliament. In addition, we would like to extend our thanks to the new Director-General for Trade and Industry, Dr S J Naudé, for his guidance and assistance.

During the year many CSIR employees, various operational units and CSIR itself were honoured for outstanding achievements in many fields of endeavour. We were greatly encouraged by these much appreciated acknowledgements – an example of which is the choice of CSIR as 'Business of the Year' by *Engineering Week*.

Finally, I would like to pay special tribute to our many clients, who, by means of collaboration and constructive criticism, helped us in our drive to become a more successful and interactive partner.

C. F. Garbers

C F GARBERS

REVIEW – RESEARCH, DEVELOPMENT AND IMPLEMENTATION

DR J B CLARK
Group Executive,
Research, Development
and Implementation

A new era arrived for CSIR and in particular for the young Research, Development and Implementation (RDI) Group in 1988, as we geared ourselves to carry out not only research and development, but also to ensure implementation of the products of R&D.

In April, 11 divisions or strategic business units came into being, consolidating the 21 previous research institutes of CSIR. And following the June Board meeting, the Centre for Information Services, the Centre for Advanced Computing and Decision Support (CACDS), as well as an integrated corporate marketing and communication services function – previously all part of the Corporate Services Group – became part of RDI. Repositioning of the centres followed their inclusion in RDI.

For the first time in CSIR's history, information dissemination was advanced from being a support to becoming a line function. The Centre for Information Services became a division (Division of Information Services, DIS), consolidating external information support to South African industry and internal services to CSIR staff. All divisional libraries were incorporated into DIS on 1 November 1988 – forming a massive resource for countrywide comprehensive scientific, technological and business information services.

At the same time, the management information services function of CACDS was transferred to the Finance and Management Services Group and in future CACDS will operate in a more focused brief. In particular, it will concentrate on providing an internal scientific computer and data communications/processing infrastructure. This will include supportive computing, telematic and expert consulting services, and software development and implementation, all based upon knowledge and techniques of modern applied mathematics, operations research, statistics, economics and computer science.

RDI is a market-orientated group whose innovative scientists, engineers, technologists and support staff undertake a blend of short, medium and long term R&D programmes, leading to effective involvement in implementation of findings. On following pages we report on the 1988 activities of each of our strategic units.

One-stop research service

We are a 'one-stop' research service providing the technological support and 'technology push' to which our President has referred. The aim is always to do the work within budget, on time, and with urgency and commitment.

We know that our success depends heavily on the quality of our people and their ability to perform as part of a customer-orientated culture, in which the primary preoccupation is with outputs. If we provide our customers and partners with a competitive technological edge in their businesses, we shall also make a real difference to the prosperity of South Africa.

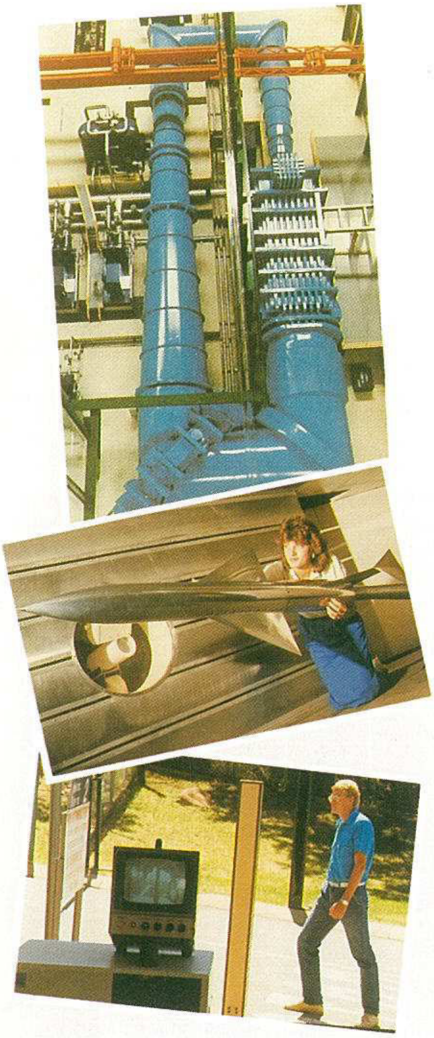
Our mission reads as follows:

The multidisciplinary RDI Group of CSIR takes pride in its contribution to the welfare of all South Africans. We are South Africa's leading source of comprehensive scientific and technological expertise.

We enable South African industries to exploit the power of technological innovation for competitive advantage. In this endeavour, we serve our customers in the private and public sectors as an interactive partner, both in identifying and responding to scientific and technological market needs. We provide timely and cost-effective solutions by innovative research and development and by actively participating in the implementation of research findings.

Recognizing that motivated people are a highly valuable resource, we will utilize and develop our human resources to meet both personal and organization objectives.

Our customers range from companies to public sector bodies such as government departments, regional services councils, marketing boards and so on. They make use of our services through a single strategic unit, a



combination of strategic units (in a 'corporate programme') or a combination of a corporate programme and research undertaken at one or more universities.

When a corporate programme is used, the customer gains access to a broader base of technology, although the approach to his needs remains integrated and focused. Companies in the motor industry, for instance, are potential users of such programmes and an RDI 'relationship manager' has been appointed for this industry.

'Technology push' is likely to evince itself not so much in corporate programmes as in programmes led by a single division which subcontracts the expertise it requires from others. Fields in which such 'interaction' could become common are membrane, sensor and laser technology and biotechnology and expert systems.

The divisions within RDI should ensure balanced portfolios of research programmes. On the one hand contract research is undertaken for customers in the public and private sectors to meet specific needs. On the other hand, each division undertakes a set of contracts with CSIR Executive which are designed to provide future products, expertise and services. The latter work is necessarily of a longer term, higher risk nature and includes a significant amount of directed fundamental research. To encourage innovation by individuals, a seed money scheme is managed to which each division devotes between 2 and 3 per cent of its sale budgets to small projects carried out by innovative people with bright, new ideas.

What I have already said in this review shows that RDI, the 'engine room' for CSIR's own research, has moved determinedly into 'market mode'. While much remains to be done in ensuring the high standards we have set, the highlighted examples from the 1988 activities of strategic units, confirm the progress made.

Technology audits

Recently we launched a further service for industry – a technology audit service, co-ordinated by the Division of Information Services. The need for it has been established by means of several technology audits already carried out, and being carried out, by CSIR. A technology audit examines the technical strengths, weaknesses, opportunities and threats of a company's production processes in relation to trends in the appropriate technological environment.

Partners in establishing the service have been identified and a request for an audit may be made directly to RDI or to a consultant. CSIR is the obvious source of the technical expertise required.

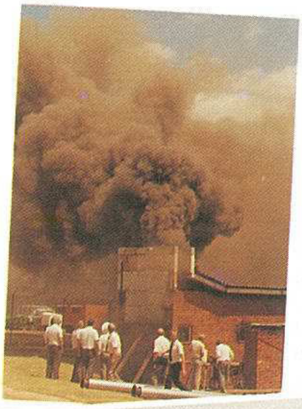
Highlights

It has been recognized for some time that South Africa – which ranks high in the world for its number of registered civil aircraft – lacks advanced aerodynamic test facilities. Until now, CSIR has had only 2,1 m x 1,5 m and 7 m x 7 m low-speed wind tunnels and a small (0,45 m x 0,45 m) trisonic blow-down wind tunnel.

As part of CSIR's mandate to provide directed basic and applied research for the promotion of industrial growth, the Division of Aeronautical Systems Technology has built an R80 million medium-speed wind tunnel.

The tunnel, requiring 20 MW of power, will come into service early in 1989. It will expand research in the important area of near-sonic speeds – in which most jet airliners operate. At these speeds, theoretical aerodynamics are at present not capable of predicting the airflow situation.

Experience in related fields enabled the Division to design (within six weeks), a security fence carrying modular infrared sensors sensitive to movement at 250 metres – whereas previously sensors were required to be not more than 100 metres apart. The fence, which has built-in intelligence, discriminates between actual intruders and, for example, birds flying through it. It also interprets climatic conditions and reports when rain, mist, or other conditions are likely to reduce performance so that it can no longer operate effectively.



The Division of Building Technology has helped the mining industry by investigating fire hazards involved in the use of wall, pipe and cable insulating materials it uses in mines. Tests involving realistic simulations of fire situations were carried out and recommendations made for fire-safe products and practices. In addition suppliers were assisted in developing fire-safe insulating materials.

The first chapter of a set of guidelines has been written describing various levels of engineering services and other amenities suitable for developing communities which have been set out for housing authorities. Various levels of road construction, provision of water supply, sanitation, waste disposal and other amenities are described. The manual made use of contributions from several RDI divisions and authorities outside CSIR.

Design and consulting engineers from many parts of the country attended training seminars on the Design of Stiffened Raft Foundations (SRF) – for houses built on heaving clay and other types of problem soils. Steel reinforced concrete beams give the rafts rigidity and this, combined with a superstructure which derives flexibility from simple movement joints at the corners, connections between interior and exterior walls and above doors, provides an effective solution. The SRF design technique is supplied on a PC-based program for those attending training courses.

Expertise in the evaluation of the properties of concrete aggregates was put to good use for the designers of the Katse Dam in the Lesotho Highlands Water Project, which will need 2 million tons of locally quarried aggregate. These evaluations have increased the designers' confidence in their concrete mixes. Geotechnical engineers of the Division took part in slope stability design investigations for the dam.

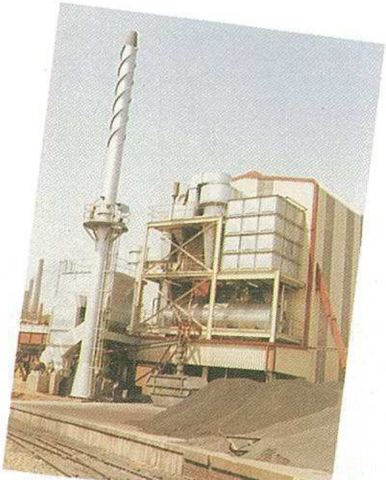
Against international competition, the Division of Earth, Marine and Atmospheric Science and Technology won the contract for modelling the Katse Dam in the Lesotho Highlands Water Project and it is erecting the largest dam model ever built in Southern Africa. It has further contracts to provide geomechanical information on rock formations around the dam, which is needed to construct connecting tunnels and associated hydroelectrical schemes.

The Division provided major input for a definitive statutory report on air pollution in the Eastern Transvaal, published in July. This will have a great impact on future industrial development in this area, where 80 per cent of the country's electrical power is produced.

An active participant in the exploration and exploitation of gas and oil resources in South Africa's coastal areas, the Division made a significant contribution towards the optimum design of offshore structures for the Mossgas project. For this, wave, current and wind conditions had to be analysed and the analysis has been accepted by Lloyds of London.

The Division of Energy Technology's annual Bulletin of Coal Analyses continues to be highly regarded by the international mining industry and a computerized version of the 1988 issue has been produced in the Republic of China. An image analysis system which was also developed by the Division, determines the type of South African coals, and is particularly suitable for the quality control of single coals and coal blends.

Research at the world's largest experimental fluidized-bed plant near Pretoria has demonstrated that coals with up to 70 per cent ash and 8 per cent sulphur content can be burned cost-effectively. The Division's campaign to



position fluidized-bed technology as a direct competitor to conventional combustion systems, will ensure that the technology is marketed throughout South Africa and is not limited to source areas of discard coal.

The Division was awarded a R1 million contract to supply, install and commission a fluidized-bed hot gas generator for Slagment (Pty) Ltd, which is capable of drying 65 tons of slag per hour. The system is designed to burn coal with an ash content of up to 50 per cent.

A survey carried out for a large mining company identified areas of coal degradation within the company's coal production and handling systems. Recommendations made have been implemented and indications are that the degradation can be minimized. The findings also give a new perspective to the design of coal handling systems, and to the use of specific mining equipment and procedures.

The year saw the Division of Food Science and Technology score world firsts in characterizing the fumonisins, a group of potent fungal toxins, and in developing an immunoassay for biotin, a B-group vitamin. Chemists at the Division elucidated the structures of the fumonisins ahead of at least three research groups in North America.

The fumonisins are produced by the fungus *Fusarium moniliforme*, which is one of the most important pathogens of maize, and these toxins can induce leukoencephalomalacia (hole-in-the-head syndrome) in donkeys and horses. Now that the structure is known, scientists can devise analytical methods for detecting the fumonisins in maize products and can study possible detoxification methods.

Biotin is one of the lesser known, but most stable, of the B-group vitamins. A new assay technique was developed which is rapid, very sensitive, highly reproducible and relatively inexpensive, compared with other available methods.

Another success concerns aflatoxin B_1, one of the most potent naturally occurring carcinogens. The ingestion by lactating cows of aflatoxin B_1 from contaminated feeds, leads to the excretion of a toxic substance, aflatoxin M_1, in milk. Analysis of aflatoxin M_1 in milk is required by law in many countries.

Methods were developed to obtain aflatoxin M_1 in tens of milligram quantities and we are in a position to supply overseas and local research scientists with the standard. The price at present is $1 200 per milligram.

New technologies were developed for the effective control of *Byssochlamys fulva* – a mould which may cause spoilage in fruit juices and pureés. On behalf of the Wheat Board, Maize Board and Grain Sorghum Board, microbiologists are carrying out extensive research into microbial contaminants on grains.

The Division, in collaboration with the Grocery Manufacturers' Association, is to establish a databank of food components which can cause food intolerance. A nutrition labelling service has been added to the Division's comprehensive analytical service for the food and fermentation industries, so that the nutritional value of foods may become better known.

An alternative process for the expelling and refining of olive oil has been developed, and also an extrusion process for the cooking of brewing adjuncts – which has been successfully implemented on production scale in a sorghum beer brewery. Depending on the particular application, these processes reduce energy costs, increase the yield from raw materials and improve the use of capital equipment, while enhancing the consistency of product quality.

The Information needs of industry are channelled through the Division of Information Services' SA Technology Information System (SATIS), for which the Government gave approval in 1987. This provides a clear-

ing-house for the transfer of technology information between sources and users. In this way it helps local industry, the public sector and the broader research community to become competitive internationally, and to promote technological development and import replacement.

Some 2 000 manufacturing and engineering companies are already subscribers to the service and, as this represents less than 10 per cent of these concerns, there is great potential for growth. The service can be accessed electronically through SATIS's Techline on Beltel or Saponet, by hotline telephone, by post or in person, at either CSIR's main campus or its regional offices.

During the year, no fewer than 100 000 documents, covering all aspects of science, technology and business management, were requested by means of SATIS's INFOPAK order forms, posted weekly. In addition more than 3 000 local and 800 overseas on-line data base searches were carried out for users. Several thousand referrals to experts in and outside CSIR were also made to assist industries in solving technical problems.

Using South Africa's first moving-segment integral die, developed jointly by the Division of Materials Science and Technology and the Division of Aeronautical Systems Technology, it has been possible to produce wax preforms of components of a radial-flow turbocharger in a single operation with high productivity. This has allowed the former Division to cast these superalloy components successfully by using its in-house precision casting technology.

Strong market demand for rapid 'trouble-shooting'investigations by the Division of Materials Science and Technology, generated over 130 successfully completed jobs for industrial clients in the first seven months of the 1988/89 financial year. These were primarily in the areas of metallurgical failure, wear and corrosion, and advice on materials selection.

A Moving Beam Measuring (MBM) system represents a breakthrough in measuring the alignment of guide rails in mine shafts. The system enables engineers to establish the condition of mine shaft steelwork quickly, to locate misaligned sections and to take remedial action with minimum interruption of production.

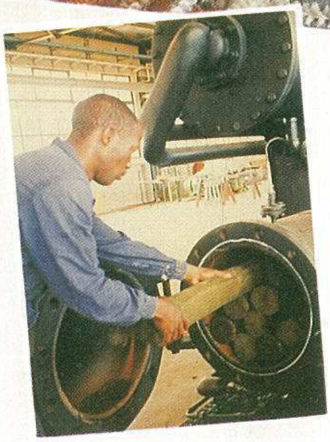
A design and coating process for thrust bearings in underground drilling accessories (specifically drill core stabilizers) was perfected. The work was sponsored by a local engineering company, TransBor, for super deep-hole (15 km) drilling.

In collaboration with Boart International, the Division is securing patent rights for novel ceria-zirconia ceramics in ten countries. These ceramics have considerably improved mechanical properties delivered through appropriate microstructural and process control. In addition, alumina-zirconia two-phase ceramics have been fabricated. Produced more simply and cheaply than competing international materials, they have properties which match the best achieved by international groups.

Another move of the Division was the establishment of an injection moulding facility for advanced ceramic components. Although primarily aimed at investment-casting core technology, the expertise base may also be applied to many near net shape sintered products.

High definition X-radiography has been used to improve ceramic processing development by the detection of defects during the early stages of processing. This has been particularly successful in the development of investment-casting ceramic-shell technology and in ceramic injection moulding.

An interferometric fibre-optic sensor which measures dynamic displacements down to 0,1 angström units was developed. It is being applied in the post-processing characterization of piezoelectric ceramic materials and ultrasonic transducers manufactured for clients. This unique device has given us a significantly competitive advantage in consistently producing high-quality piezoelectric ceramic materials and acoustic devices.



The Division of Microelectronics and Communications Technology has developed a high-performance, superfast computing cluster comparable to the world's most advanced. The cluster can be coupled to a personal computer, mini-computer or mainframe to speed up software execution. The appropriate level of computational power can be flexibly obtained by utilizing a single card, a small cluster (of cards), a big cluster or even a number of clusters linked together.

The computing cluster uses parallel (concurrent) processing to reach the extremely high performance level rated at 24 million floating point operations per second (depending on configuration).

A compact, high-frequency (250 MHz) Emitter Coupled Logic (ECL) chip which radically reduces the size of printed circuit boards, and also power consumption, was developed during the year. This is the first South African-designed and processed semi-custom ECL chip with a speed capability of up to 1 GHz. The chip, which consumes 3 W of power, replaces an entire PC board which consumes 30 W, and is important for applications where power consumption and space are critical.

The development of a small custom analogue chip (2,5 mm^2) has resulted in a R200 million export contract for South Africa. Volume production of this chip by the Division makes the end product, of which it forms a vital part, competitive overseas.

The Division's established infrastructure enables it to undertake custom digital and analogue integrated circuit design. The comprehensive capabilities include computer-aided design, maskmaking, and manufacturing and testing of integrated circuits.

In November 1988 the Satellite Applications Centre at Hartebeesthoek played a crucial role in the launching, deployment and final positioning of TDF, the first French geostationary direct-broadcast satellite ever launched. The satellite can transmit information directly to TV viewers, and receive signals from a wide area on earth.

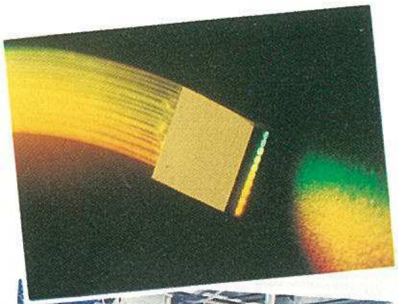
The Division has completed upgrading the Centre, and it is now receiving the first Thematic Mapper high-resolution imagery directly from the Landsat satellite. Applications range from geological survey and exploration to cartography.

The Division of Processing and Chemical Manufacturing Technology's Textile Programme has developed South Africa's first chenille-type yarn made of coarse mohair (35-36 microns), which, although plentiful and cheaper than fine mohair, is under-utilized.

This wear-resistant new yarn has a high cover value and is very suitable for furniture, automotive upholstery, curtains and knitwear. The additional market it promises is important for a product in which the price is vulnerable to fluctuations in fashion and other end-use markets.

An improved process for preserving poles and structural timber with CCA (copper, chromium, arsenate) earned the Division an NPI bronze award during the year. The process practically eliminates sludge formation in the treating solution and increases plant throughput by about 50 per cent. It also saves the treating industry about R1,5 million per year on chemicals, and pole users such as Eskom and the Post Office save about R1 million per year in replacement costs.

A range of equipment to stress-grade SA Pine structural timber mechanically has been developed. The latest addition is a proof-grading machine for testing battens, purlins and structural timber up to 55 x 125 mm in section. It has a continuous feed and stresses the timber in cantilever mode. This requires smaller forces and ensures that pieces which break do not jam the machine. Another feature is a selection over-ride which causes pieces of



low stiffness to be rejected without being broken. The machine is simple, inexpensive and, at 30 metres per minute, relatively fast.

A prototype cheque printer was developed for a private company by the Division of Production Technology, and will be marketed to banks. Completely portable and capable of being carried in briefcase or pocket, it prints name, amount and date on a cheque to be issued – and will also update the user's bank balance.

Local industry is showing great interest in fibre-optic sensors. Only a few millimetres in diameter, they make sensing possible in previously inaccessible places, and also where the presence of flammable or explosive gas or chemical mixtures makes the use of conventional sensors hazardous.

In collaboration with the Department of Community Dentistry at the University of the Witwatersrand, and with the sponsorship of Colgate-Palmolive, the Division developed a mobile dental unit. This is a self-contained trailer which opens up to become two small dental surgeries (and combined educational/waiting area), work-ready within 45 minutes and requiring no support infrastructure at all. The first of the units is already in use and a second is under construction. Interest in the concept is being shown by South American countries.

An infrared diagnostic test station was developed and is being manufactured and marketed by a private company. It uses infrared thermography techniques to test populated circuit boards and show up circuit faults on a thermal image display. Being versatile, its significant advantage is the ease with which it can be set up to test new types of circuit board.

A high-speed video camera developed at the request of the Division of Roads and Transport Technology is being tested. It costs a fraction of the price of the only other available system, which is from the USA.

In laser technology – an area in which industry and medicine are showing increasing interest world-wide – the Division has proved itself a world leader in Raman technology. The Division has built a complete laser-machining station, including a state-of-the-art 2 kW CO_2 laser, and a battery-operated, pulsed CO_2 system capable of generating peak output powers of more than 1 MW at a 1 Hz repetition frequency.

A variety of specifications for wearing-course materials for unpaved roads are currently being used in Southern Africa, but these are not suitable for all geological materials. The Division of Roads and Transport Technology has now developed suitable performance-related specifications for all materials, based on the results of a large-scale experiment in which 110 sections of unpaved road were monitored for 11 different performance criteria.

The behaviour of cemented road surfaces under heavy loads has been analysed and quantified by the Division, using the Transvaal Provincial Administration's heavy vehicle simulator developed by the Division. Results show that excessive tyre pressure and contact tension can granulize a weakly cemented road near the surface and render it unstable. This occurs despite the fact that the remainder of the road structure is of high quality and has load-carrying capability.

South Africa's harsh environmental conditions – long hours of sunshine, high temperatures and high levels of ultraviolet radiation – cause traffic signs to deteriorate rapidly. The Division has proposed new specifications for materials used for signs which will ensure longer life and thus more enduring visibility of the signs.

During 1988 the Division developed a road collision location system using the node/link

concept to identify short, hazardous sections of roads. This is ideally suited for use by developing countries as an interim measure for improving road safety until more sophisticated collision-reporting systems can be implemented in developing African states.

The Division of Water Technology developed a PC-based decision support system for better decision-taking in the control of phosphate pollution of surface water. The system enabled the Department of Water Affairs to relax requirements for phosphate removal from effluents produced in certain catchments, thereby saving many local authorities unnecessary expense.

A technology to remove sulphate from waste waters biologically was developed to pilot-scale level during 1988, and a pilot plant was erected at a Gencor mine. Sulphates are usually removed from waste water through chemical or membrane filtering processes, which are both costly. The biological process is potentially cheaper and has the added bonus that sulphur is a by-product and brine is not.

A hydraulic study of the tunnel outlet structures on the Ash River, in the Lesotho Highlands Water Project (LHWP) helped develop design criteria for the structures. Mathematical models were used to simulate physical, chemical, biological and ecological aspects of the project's Katse Dam, the largest in the LHWP. This contributed to design criteria for the dam.

There are several water industry products which are in the commercialization phase. One, a dissolved organic carbon (DOC) analyser, earned Dr Ronald van Steenderen an Industrial Design Award. The analyser, locally manufactured and cheaper than imported equivalents, allows industrial users to monitor effluent discharge and effect substantial savings – since levies are paid on organic carbon (pollution) in effluent.

A computerized component layout system developed by the Centre for Advanced Computing and Decision Support has reduced raw material wastage at a Port Elizabeth shoe plant, Fashcom, by 9 per cent and improved production process time and costing accuracy. Of the system's three sub-systems the first digitizes shoe components so that pattern shapes may be entered into a computer and the second and third lay out patterns of components. The components are shown graphically on a computer screen and the cutter can position them on an image of the normal rectangular sheet of synthetic leather.

A project for wire-rope maker, Haggie Rand, was aimed at the redevelopment of its in-house computer-aided design system. This contract followed on the Centre's development of a mathematical model accurately describing the design geometry of wires in a round strand. It is important to be able to prevent gaps between adjacent wires becoming too large and which are then prone to 'birdcaging', or too small and thus prone to becoming solid and fracturing under load.

The model was implemented as a program module within Haggie Rand's in-house CAD system and the company believes it is now at the forefront of wire rope design worldwide.

For the National Energy Council the Centre developed a system dynamic model for the analysis and forecasting of final energy demand in South Africa and for showing the most efficient way of meeting it. The system, accounting for five economic sectors and various energy carriers, has its origins in a US model – extensively adapted and developed to match the local energy scene. For analysis on the supply side, another US model is being customized for South African needs.

J B CLARK

REVIEW – FOUNDATION FOR RESEARCH DEVELOPMENT

DR R R ARNDT
Group Executive, Foundation for Research Development

The year 1988 saw the finalization of a new FRD strategy and its implementation. At the heart of this strategy is peer-evaluation, which is now being applied throughout FRD's activities, from research funding programmes to national research facilities and service activities.

The following are subsequent exciting developments in the positioning of FRD within South Africa's scientific community:

- Inauguration of the FRD Collegium and FRD Senate.
- Launching of the academic and research computer network, Uninet and the Scientometric Advisory Centre.
- Receiving responsibility for the four South African Offices for Science and Technology abroad.
- Taking over the Magnetic Observatory at Hermanus, which is the fourth of our National Research Facilities.

New management system – Collegium, Senate and Executive

The FRD Collegium, on which 45 distinguished scientists, technologists and engineers have accepted invitations to serve, comprises 'men of excellence' in many different disciplines and fields. Collegium members serve on a three-year rotation basis on 12 committees which deal with animal sciences, physics, engineering, plant sciences, mathematical sciences, pharmaceutical sciences, earth sciences, biochemistry, chemistry, microbiology, research equipment and technikon research support.

In these committees, they act as assessors for the FRD executive during peer-evaluation of candidates and research programmes and, within their areas of expertise, recommend needs and priorities for FRD funding to FRD's Senate.

In November, the 14 members of the FRD Senate met for the first time. As policy advisers and opinion formers they have the responsibility of advising the FRD Executive on matters like FRD's programme composition and budget structure. Members are nominated for three-year terms, and the Senate has an equal number of members and non-members of the Collegium.

The FRD Executive will be complete as from 1 January 1989 and comprises the Group Executive, Dr Rein Arndt, and two executive directors, Professor Daan van Wyk, Engineering Faculty at the Rand Afrikaans University (seconded on a part-time basis to FRD), and Dr Gideon Louw, previously Professor of Zoology at the University of Cape Town.

The special role of the new headquarters

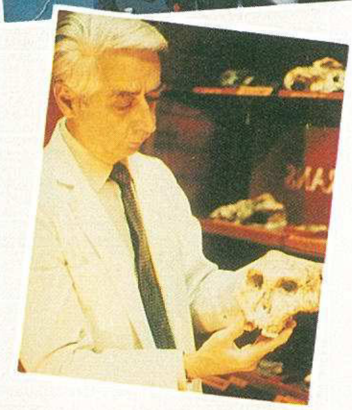
FRD will receive a further image boost in 1989 when we take occupation of our new headquarters building from February. The building will be officially opened on 4 April by the Chairman of the CSIR Board, Dr Louw Alberts, who was himself once a director of a research unit supported by the predecessors of the FRD.

The opening will be preceded by a prestige lecture series with the title: *Science: the Endless Frontier*. The participants will be the winner of the Nobel Prize for Chemistry in 1982, Sir Aaron Klug of Cambridge University, Professor John Baldeschwieler of the California Institute of Technology, and four prominent South African scientists. The latter are Professor Wouter de Wet (biochemistry, Potchefstroom University for CHE), Professor Dave Woods (microbiology, University of Cape Town), Professor Frank Nabarro (physics, University of the Witwatersrand) and Professor Brian Warner (astronomy, University of Cape Town).

The new building, apart from providing the first combined accommodation for all the staff of FRD (some 90 people), will be particularly important in our role of facilitating interaction between individual as well as groups of scientists and technologists. It will serve as a home and college for our programme participants and other interested groups.

Improving South Africans' quality of life

The new FRD structure and our headquarters building are to be major tools in the fulfilment



of our mission, which reads as follows:

The mission of FRD is to develop qualified manpower under able leadership in the natural sciences, engineering and technology, and is primarily directed at students and leading researchers at universities, museums and technikons. The ultimate aim is to improve the quality of life of all South Africans.

The FRD has three groups of activities:

- Research Funding Programmes
- National Research Facilities
- National Service Activities

Peer-evaluation is central to all funding.

The evaluation process

The peer-evaluation system of research support seeks to establish able leadership in science and excellence in self-initiated research, and to develop high-level scientific manpower through Core and Special Programmes. It has become a permanent part of the various funding programmes – participants always being evaluated before funding is granted – and forms the basis of FRD's success.

Peer-evaluation of FRD Special Programmes has been approved in principle and these programmes will be phased into the new system during 1990, while the current National Programmes will be phased out

RESEARCH FUNDING PROGRAMMES

43 international leaders

During 1988 researchers who were evaluated when FRD came into existence in 1984, were the first to be re-evaluated. Generally, the re-evaluations showed an improved standard of research by these staff of universities and museums.

Out of 1 400 individuals evaluated before May 1988, 43 were in the A category – that is, they were recognized by their peers as international leaders in their fields.

FRD research units and centres, to which funding was awarded during 1984/85, were also re-evaluated during 1988. A new FRD Research Centre was awarded under the directorship of Professor John Martin, Dean of Engineering at the University of Cape Town. The FRD Research Centre headed by Professor Claus von Holt, Department of Biochemistry, University of Cape Town, will continue to operate until 1993.

As he has been appointed to the full-time position of Vice-Principal of the University, Professor Friedel Sellschop's term as Director of the FRD-Schonland Research Centre for Nuclear Sciences at the University of the Witwatersrand, ended on 31 December 1988.

The status of director of FRD research units has been extended for a further five-year support period in the case of: Professor Jan du Preez, Department of Chemistry, University of Port Elizabeth; Dr Mary Seely, Transvaal Museum; Professor Hannes van Staden, Department of Botany, University of Natal; and Professor Piet Stoker, Department of Physics, Potchefstroom University for CHE. Two directors of FRD units were appointed to posts of Vice-Principal: Professor Chris Creswell at the University of Natal and Professor Dave Woods at the University of Cape Town.

R32 million in support grants and bursaries

FRD research funding programmes will, as FRD strategy is implemented in 1989/1990, fall under the headings Core Programmes, Manpower Provision Programme, Research Equipment Programme (all formerly part of the Main Research Support Programme), Technikon Programme and Special Programmes/National Programmes.

Core Programmes

These are focused on development of high-level manpower and expertise in particular fields. They aim at optimization of research through funding of leading scientists at uni-

versities and museums for self-initiated research and funds cover personnel, running expenses, equipment, attendance at conferences, sabbaticals and international liaison through exchange of top scientists.

The programmes are a dynamic system in which researchers are measured against regular evaluation, and funding offers are renewed or phased out.

In 1988 some R17,7 million devoted to research support grants went to 189 holders of comprehensive support grants, 295 holders of partial support grants, and nine holders of the prestigious President's Award. This award has proved most successful and in the first round of re-evaluations one of the first holders – Professor Wouter de Wet of Potchefstroom University – was placed in the A category of researchers.

New President's Awards for 1988 were made to Professor Lodewyk Kock (University of the Orange Free State), and Dr Peter Linder (University of Cape Town). Dr Arnold Knopfmacher (University of the Witwatersrand), and Professor Mike Wingfield (University of the Orange Free State), have been singled out for this prestigious award as from 1989.

Manpower Provision Programme

This programme's aim is to identify potential manpower for science and technology. A particular effort has been made to ensure that no human potential, including students from non-technical backgrounds, goes to waste.

Special task groups under convenors Professor Bob Seretlo (University of Fort Hare), Professor Teuns Erasmus (University of Pretoria), and Dr Johannes Geldenhuys (Technikon Witwatersrand) will advise FRD on action to be taken at primary, secondary and tertiary education levels.

During 1988, 1 253 local postgraduate bursaries with a total value of R9,6 million were awarded, compared with 1 164 the previous year, as well as 43 bursaries for study abroad. Much of FRD's additional funding had to be devoted to raising bursary values, which have not kept pace with inflation – a serious problem still to be addressed.

Research Equipment Programme

Research equipment support is operated in concert with other programmes. However, where support for multi-user equipment has been requested, the need is evaluated according to national priorities and the equipment sited at a scientific centre which has the necessary infrastructure to ensure the best possible use. This programme is playing an important role in the process of rationalization at universities.

In 1988, some R4,98 million of FRD's budget was spent on research equipment. This includes the inter-university radiogenic isotope facility at the University of Cape Town, for which R1,4 million was provided by FRD and which should become fully operational during 1989.

Technikon Programme

This is aimed at developing research and a research culture at technikons and covers the costs of personnel, running expenses, equipment and travel. During 1988 the number of active researchers at technikons virtually doubled, as did the number of students and staff applying for bursaries to pursue advanced studies.

Special Projects

During 1988, new research support programmes – one in engineering process control and another in electromagnetics and signal-processing – were launched. Preliminary planning for the launching of a programme on manpower training for advanced engineering materials was completed and should be ready in 1989.

NATIONAL RESEARCH PROGRAMMES – HIGHLIGHTS

Antarctic ichthyology

At the beginning of 1988, the J L B Smith Institute of Ichthyology completed its report on the taxonomy and biology of marine fishes of the Antarctic region. The resulting book, *Fishes of the Southern Ocean* – containing accounts of 50 fish families and reviews of their origin and evolution – will be published in 1989.

A monograph guide to the otoliths of Southern Ocean fishes, published in the *South African Journal of Antarctic Research* in 1988, and representing the culmination of three years' research, received international acclaim.

Managing geelbek

A study completed by the Marine Linefish Programme shows that the heavily exploited geelbek, or 'Cape salmon', spawns off Natal and matures off the South West Cape to migrate back to Natal for spawning – young fish are found off the Eastern Cape coast. This highlights the need for managing the resource along the entire eastern coast of South Africa.

Other studies in the same series – on musselcracker, bronze bream and red steenbras – showed that these fish attain ages of 30 years, compared with the 20 years of Roman and dageraad. This explains their slow reaction to management measures – as also that of a related species like the seventyfour.

Forestry map

Under the auspices of the National Programme for Remote Sensing, a comprehensive set of forestry maps of southern Africa was compiled from Landsat satellite imagery and field data. On a scale of 1:250 000, the maps depict four classes of forest and form the basis of a national forest inventory.

Monograph on Highveld atmospheric pollution

The National Programme for Weather, Climate and Atmosphere Research prepared and released a monograph on atmospheric pollution and its implications in the Eastern Transvaal Highveld. This will be the main reference work on the subject for several years to come.

The study concluded that tall stacks at power stations and factories may have to be subjected to more stringent controls.

Waste disposal success

Technology and expertise developed within the Waste Management Programme is being exploited commercially on a large scale for waste management utilization. An example is the large scheme coming on stream in Johannesburg for the recovering of methane to defray disposal costs. Many of the parameters required for its planning were provided by experiments carried out in Grahamstown.

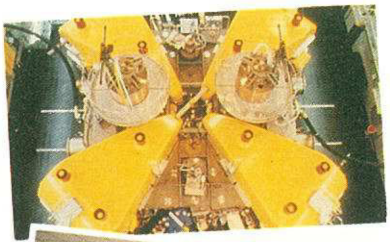
In August, a well-attended winter school on waste management featured five world leaders in the field – Mr D Louwman of the Netherlands, Mr K Knox of the UK, Professor R Ham of the US, and Professors E de Fraja Frangipane and R Cossu of Italy.

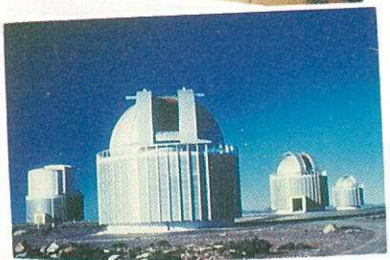
Sharptooth catfish as crop

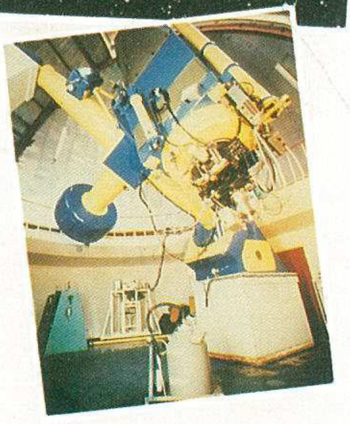
Techniques for the culture of sharptooth catfish, *Clarias gariepinus*, are now so advanced in South Africa – thanks to FRD's Aquaculture Research Programme – that there are no major scientific constraints to the development of an industry.

Geotransects of African continent

Drafts of the first two geotransects of the African continent, completed by the National Geosciences Programme in 1988, were a milestone in the South African contribution to the Global Geoscience Transects Project. Presented at an international conference in Belém, Brazil, they were the Cape Fold Belt Geotransect and the Limpopo Belt Geotransect.







Geotransects integrate all available geological and geophysical data to construct sections which show the tectonic make-up and history of the crust of the earth. In Southern Africa this reaches depths of more than 40 km.

NATIONAL RESEARCH FACILITIES – ACHIEVEMENTS

Neutrontherapy for cancer patients

The National Accelerator Centre at Faure won the National Award of the Associated Scientific and Technical Societies (AS & TS) for the design and construction of its new separated-sector 200-MeV cyclotron. This new machine is now in routine operation 24 hours a day, its beam availability comparing favourably with that achieved at any other large cyclotron in the world.

Beams are used for some 25 projects each in the physical and biophysical sciences, which are being conducted respectively by 60 and 30 scientists. In addition, the neutrontherapy facility for cancer patients was finally calibrated and licensed and the first two patients were treated there in September.

Routine production of radioisotopes for nuclear medicine began towards the end of the year and various hospitals receive regular supplies.

In November the Centre closed its 32-year-old cyclotron in Pretoria and its radioisotope production and research in radiobiology and radiation physics will be continued at Faure.

A role in world astronomy

In 1988 some 30 overseas astronomers visited the South African Astronomical Observatory (SAAO) at Sutherland to participate in more than 20 projects in optical and infrared astronomy and astrophysics. Projects varied from studies of stars in our own galaxy to studies of extra-galactic objects such as quasars.

Once again, SAAO took part in international programmes for the uninterrupted photometric and spectrometric observation of objects of particular interest. This requires co-operation between well-equipped observatories widely dispersed, and the SAAO is indispensable in the Southern Hemisphere.

In 1988 an SAAO group combined observations from the Infrared Astronomical Satellite (IRAS) with groundbased ones made at Sutherland. This led to the discovery that three otherwise normal hot stars are surrounded by extensive cool shells of small dust grains – with temperatures of only 60 K. The total diameter of the shells is 50 000 times the earth-sun distance.

Distance to centre of Milky Way

In searches for emission from dust clouds surrounding new and ageing stars, using the antenna of the Hartebeesthoek Radio Astronomy Observatory, strong radio emission has been detected from hydroxyl and methanol molecules. In a joint project with the University of Manchester, monitoring of the variations in such emission from old, pulsating stars near the centre of the Milky Way, enabled their distance to be measured, using a new technique.

Astronomical and geodetic very long baseline interferometry (VLBI) has been conducted with observatories in the US, Europe and Australia, and yielded many new results. The technique enabled the radio emission from diverse objects such as quasars and Supernova 1987A in the Large Magellanic Cloud to be studied on angular scales down to 0,001 arc seconds.

The position of the telescope has been measured relative to observatories on other continents to an accuracy of 5 cm, using VLBI. The telescope is now being used as a fixed reference point for the measurement of ocean levels at tide gauges round the coast.

NATIONAL SERVICE ACTIVITIES – HIGHLIGHTS

New national service activities were instituted and others extended to help FRD in carrying out its function effectively and to serve the broader scientific community.

FRD's service activities are the academic and research computer network Uninet, the Scientometric Advisory Centre, national and international liaison, the South African Science and Technology Offices overseas and the South African ICSU secretariat.

Computer network

Planning began in 1986 to develop a national academic and research network, Uninet, to link up other national networks like Sabinet and Govnet. Intended for academic researchers, it arises from collaboration between FRD, the computer subcommittee of the Committee of University Principals and other interested organizations.

Science policy digest

The Scientometric Advisory Centre was established in April to provide independent, technically competent, policy-related advice to FRD's Executive. It advocates the introduction of a form of systems engineering in dealing with broad issues involving large segments of national science and technology resources, and will become a point of strength in FRD.

Monitoring and evaluating scientific activities locally and abroad is an integral part of the Centre's activities. It is involved in cross-national, cross-discipline comparisons, organizational assessments, science domain evaluations, and the assessment of productivity and the impact of scientists in various fields.

The Centre produces the quarterly, *Science Policy Digest*, which keeps scientists, planners and decision-makers informed and has been welcomed by the FRD community and decision-makers in government and at the universities.

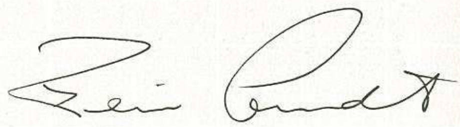
Delegation in Beijing

In September, a four-man national delegation attended the 22nd general assembly of the International Council of Scientific Unions, convened in Beijing by the China Association for Science and Technology. Members of the delegation consisted of CSIR's President, Dr Chris Garbers, the Group Executive of FRD, Dr Rein Arndt, and the Dean of Science at the University of Fort Hare, Professor Bob Seretlo, accompanied by the head of the South African ICSU secretariat, Mrs Enid du Plessis.

During the year funds were provided for visits by 24 other South African scientists to general assemblies of these ICSU bodies:

International Astronomical Union (IAU), International Union of Biochemistry (IUB), International Union of Biological Sciences (IUBS), International Geographic Union (IGU), International Union of Psychological Sciences (IUPsyS), Committee on Data for Science and Technology (CODATA), Scientific Committee on Antarctic Research (SCAR), Scientific Committee of Biotechnology (COBIOTECH), Scientific Committee on Problems of the Environment (SCOPE) and Scientific Committee on Oceanic Research (SCOR).

In addition, South Africa was visited by the secretaries-general of two unions – the International Union of Pure and Applied Chemistry (IUPAC) and the International Union of Microbiological Sciences (IUMS).



R R ARNDT

FINANCIAL STATEMENTS 1987–88

Financial statements

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH — **STATEMENT 1**

BALANCE SHEET AT 31 MARCH 1988

	General Fund R	Building Fund R	1988 R	1987 R
Accumulated funds:				
Balance brought forward	294 325 317	122 546 761)	416 872 078	330 392 326
Additions:	87 228 593	13 623 807)	100 852 400	89 068 814
Income over expenditure	18 345 804	—	18 345 804	10 428 586
Transfer of funds	4 294 916	(4 294 916)	—	—
Capital income (Note 1)	64 568 414	17 918 723)	82 487 137	77 452 138
Assets and funds received	19 459	—	19 459	1 188 090
Reductions:	5 279 914	1 121 358)	6 401 272	2 589 063
Assets and funds relinquished	2 529 831	—	2 529 831	284 183
Assets written off	2 750 083	1 121 358	3 871 441	2 304 880
	R 376 273 996	135 049 210	511 323 206	416 827 077
Contract reserves:	4 248 036	—	4 248 036 [3a]	—
Total	R 380 522 032	135 049 210	515 571 242 [1]	416 827 077
Utilization of funds:				
Fixed assets (Note 2)			471 986 495	390 337 987
Balance brought forward			390 337 988	303 060 488
Net additions			81 648 507	87 277 499
Investments			5 000 000	5 060 177
Shares in SA Inventions Development Corporation			5 000 000	5 000 000
Stocks and shares			—	60 177
Net current assets			38 584 747	21 473 913
Current assets			93 921 496	72 989 870
Saleable stock			533 274	428 306
Work in progress			2 936 480 [3b]	—
Debtors and debit balances			17 967 606	14 325 228
Advances and deposits:				
Research grants			960 440	386 222
Other			10 590 844	14 278 369
Cash:				
Corporation for Public Deposits			53 796 280 [2]	38 250 764
SA Reserve Bank			6 654 831	4 977 036
Other banks			384 491	262 142
Petty cash imprests			97 250	81 803
Current liabilities			55 336 749	51 515 957
Advances for investigations and services			38 486 261	36 291 370
Creditors and credit balances			16 850 488	15 224 587
Total			R515 571 242	416 872 077

[1] At 31 March 1988 contractual obligations against the General and Building Funds were R33 482 098 and R7 365 819 respectively. Legal actions being contested by the CSIR involves an amount of R75 000.

[2] Savings on capital expenditure resulting in higher deposits with the Corporation for Public Deposits. Also includes Stabilization Fund in respect of Department of Transport (National Road Fund) R393 620.

[3a en 3b] Contract reserves and work in progress were not previously shown separately. The work involved in obtaining comparative figures is deemed to be out of proportion to the value of presenting them.

PRETORIA
26 October 1988

(Sgd.) **A L MICHAU**
Group Executive

(Sgd.) **C F GARBERS**
President

The above Balance Sheet has been audited in accordance with the provisions of section 42(4) of the Exchequer and Audit Act, No 66 of 1975, read with section 16(1) of the Scientific Research Council Act, No 82 of 1984, and, in my opinion, reflects a true and fair view of the financial affairs of the Council for Scientific and Industrial Research.

CAPE TOWN
23 January 1989

(Sgd.) **J H DE LOOR**
Auditor-General

NOTE 1 : CAPITAL INCOME

	General Fund R	Building Fund R	1988 R	1987 R
Parliamentary grant	56 665 000	13 354 000	70 019 000	64 008 000
Donations	—	—	—	—
Contributions	299 840	—	299 840	500 580
Interest	—	3 835 280	3 835 280	4 306 764
Sale of assets written off	402 774	—	402 774	523 741
Investigations and services	6 886 800	729 443	7 616 243	7 807 297
Sale of land and buildings	—	—	—	3 756
Coal levies	314 000	—	314 000	302 000
	R64 568 414	17 918 723	82 487 137	77 452 138

NOTE 2 : FIXED ASSETS (AT COST OR VALUATION)

	Land and Buildings R	Books and Journals R	Furniture and Equipment R	Prefab. Structures R	Laboratory Equipment R	Vehicles R	Stores Stock R	Total R
Balance brought forward	113 391 161	11 853 741	12 147 282	96 158	245 339 593	5 389 688	2 120 365	390 337 988
Purchases:								
CSIR	17 294 054	2 537 621	2 049 814	—	64 173 513	946 102	—	87 001 104
Grants	—	19 133	334 149	—	340 072	—	—	693 354
Adjustments previous year:								
CSIR	—	—	13 311	—	—	—	—	13 311
Grants	—	—	—	—	—	—	—	—
Received:								
CSIR	—	—	—	—	16 819	—	—	16 819
Grants	—	—	—	—	—	—	—	—
Stores increase	—	—	—	—	—	—	338 501	338 501
	R130 685 215	14 410 495	14 544 556	96 158	309 869 997	6 335 790	2 458 866	478 401 077
Less: Reductions	1 121 357	152 352	209 236	—	4 045 215	886 422	—	6 414 582
Relinquished:								
CSIR	—	—	138	—	281 487	—	—	281 625
Grants	—	—	—	—	2 248 206	—	—	2 248 206
Written off:								
CSIR	1 121 357	152 352	182 720	—	1 193 885	886 422	—	3 536 736
Grants	—	—	26 378	—	308 326	—	—	334 704
Adjustments previous year:								
CSIR	—	—	—	—	13 311	—	—	13 311
Grants	—	—	—	—	—	—	—	—
Stores decrease								
Balance	R129 563 858	14 258 143	14 335 320	96 158	305 824 782	5 449 368	2 458 866	471 986 495

STATEMENT OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31 MARCH 1988 **STATEMENT 2**

	Grants R	CSIR R	Total R	1986/87 R
Income				
Parliamentary grant	—	196 762 332	196 762 332	162 613 000
Contributions to CSIR projects	43 320	1 348 947	1 392 267	1 641 517
Coal levies and penalties	—	2 669 847	2 669 847	2 573 152
Investigations and services	11 739 725	90 659 822	102 399 547	73 447 047
Publications	8 891	998 900	1 007 791	752 739
Sundry	76 213	1 435 668	1 511 881	1 524 494
Total	R11 868 149	293 875 516	305 743 665	242 551 949
Less: Expenditure	41 703 799	245 694 062	287 397 861	232 123 363
Salaries, wages and allowances	3 580 610	161 909 748	165 490 358	138 337 196
Consumable stores and services	6 089 219	86 208 110	92 297 329	64 865 970
Subsistence and transport	321 611	6 808 623	7 130 234	6 777 533
General expenses	681 965	19 367 179	20 049 144	17 162 871
Extraordinary expenses	—	13 307	13 307	11 763
Grants	31 641 131	1 371 433	33 012 564	27 851 852
Subsidies: Research by Industry	—	1 617 056	1 617 056	1 499 236
Levies and depreciation	—	26 616 709	26 616 709	23 944 480
	42 314 536	303 912 165	346 226 701	280 450 901
Less: Income internal services	610 737	58 218 103	58 828 840	48 327 538
Income over expenditure	R(29 835 650)	48 181 454	18 345 804	10 428 586

PRETORIA
26 October 1988

(Sgd.) **A L MICHAU**
Group Executive

(Sgd.) **C F GARBERS**
President

Details of CSIR's technological achievements are contained in the accompanying publication, TECHNOLOGY IMPACT (obtainable from the address below).

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