



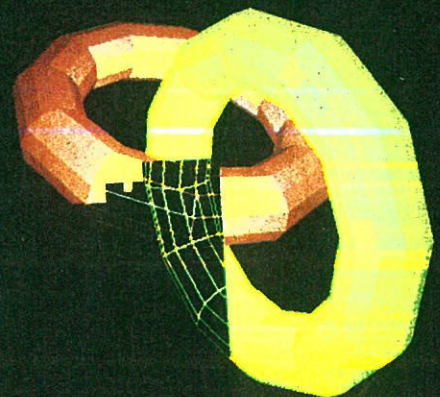
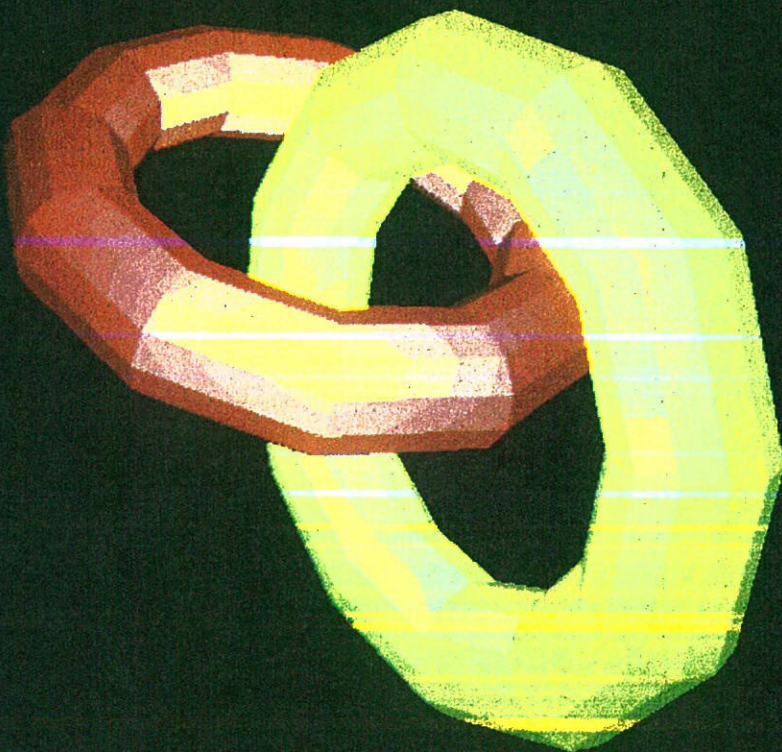
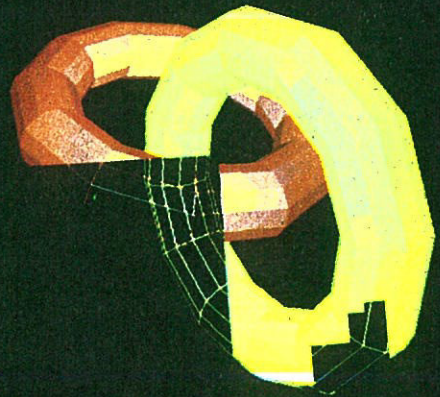
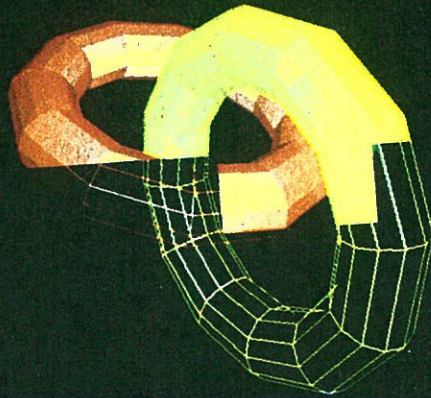
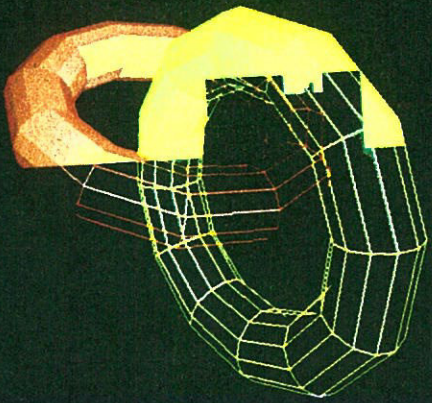
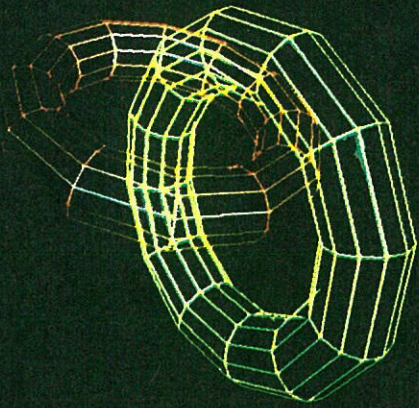
CSIR

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Annual Report

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1984





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# CSIR

Council for Scientific and Industrial Research

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## Annual Report

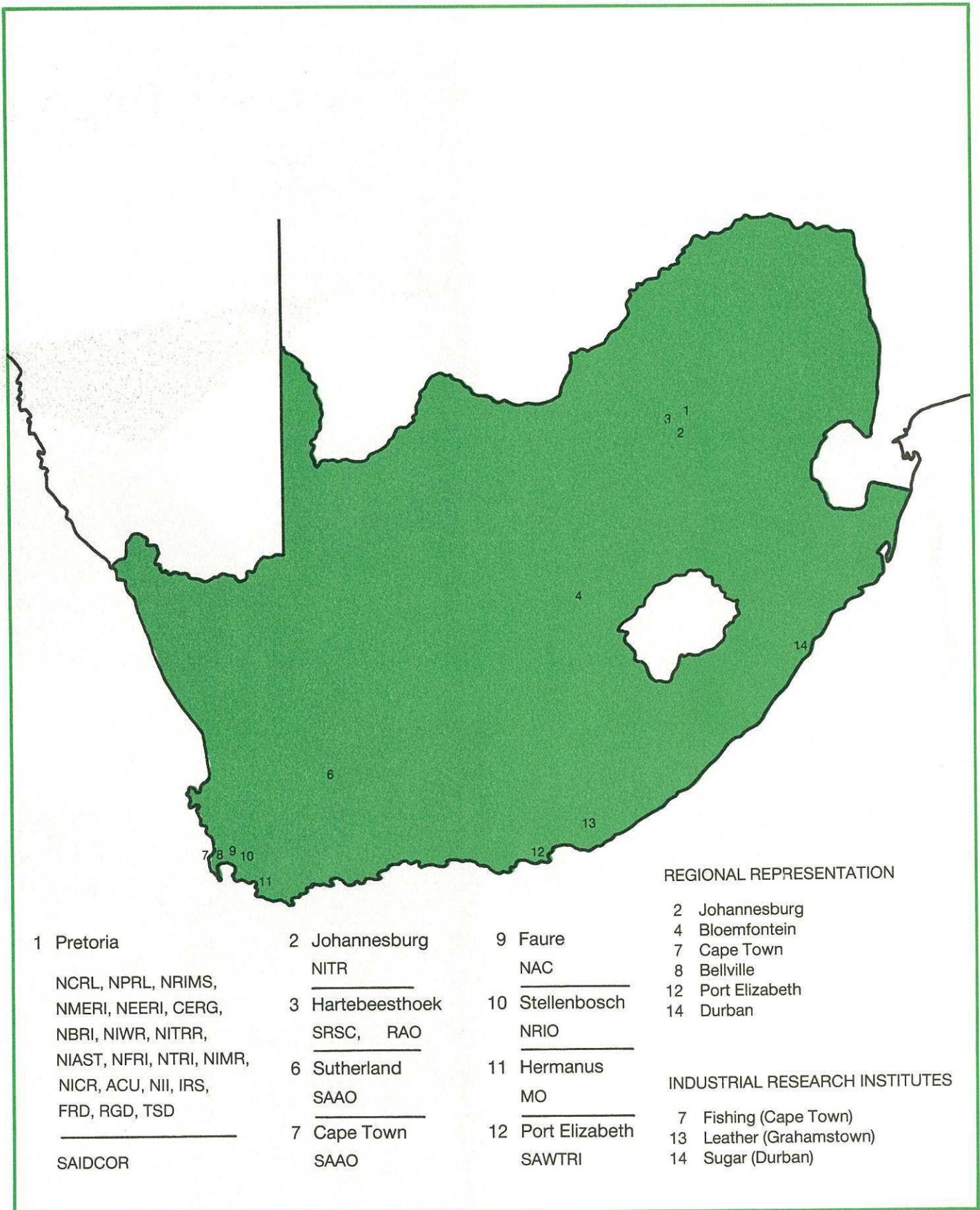
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### 1984

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# CSIR activities in South Africa





# Executive



## President

Dr C F Garbers

## Deputy Presidents

Dr J F Kemp

Mr J P de Wit

Dr G Heymann

Dr E N van Deventer

Prof. D H Jacobson

Prof. R R Arndt

**Back row (l. to r.):** Prof. D H Jacobson, Prof. R R Arndt, Dr E N van Deventer, Dr G Heymann.

**Front row (l. to r.):** Dr J F Kemp, Dr C F Garbers, Mr J P de Wit.

## Abbreviations used on map

ACU	- Applied Chemistry Unit
CERG	- Chemical Engineering Research Group
FRD	- CSIR Foundation for Research Development
IRS	- Information and Research Services
MO	- Magnetic Observatory
NAC	- National Accelerator Centre
NBRI	- National Building Research Institute
NCRL	- National Chemical Research Laboratory
NEERI	- National Electrical Engineering Research Institute
NFRI	- National Food Research Institute
NIASST	- National Institute for Aeronautics and Systems Technology
NICR	- National Institute for Coal Research
NII	- National Institute for Informatics
NIMR	- National Institute for Materials Research
NITR	- National Institute for Telecommunications Research
NITRR	- National Institute for Transport and Road Research
NIWR	- National Institute for Water Research
NMERI	- National Mechanical Engineering Research Institute
NPRL	- National Physical Research Laboratory
NRIMS	- National Research Institute for Mathematical Sciences
NRIO	- National Research Institute for Oceanology
NTRI	- National Timber Research Institute
RAO	- Radio Astronomy Observatory
SAAO	- South African Astronomical Observatory
SAIDCOR	- South African Inventions Development Corporation
SAWTRI	- South African Wool and Textile Research Institute
SRSC	- Satellite Remote Sensing Centre
TSD	- Technical Services Department



# Council members



Dr C F Boyce, Technical Adviser to the Postmaster General, who retired from the Council during the year.

## BACK ROW (l. to r.)

**Dr L B Knoll**

Deputy Chairman, FedMech Holdings Ltd

**Prof. D S Henderson**

Principal and Vice-Chancellor, Rhodes University

**Mr R A Plumbridge**

Chairman, Gold Fields of South Africa Ltd

**Dr J G H Loubser**

Retired General Manager, South African Transport Services

**Dr C van der Pol**

Chairman, Tongaat-Hulett Sugar Ltd

**Prof. O W Prozesky**

Department of Medical Virology, Institute of Pathology, University of Pretoria

**Mr W P Venter**

Chief Executive, Allied Technologies Ltd

## FRONT ROW (l. to r.)

**Mr M T de Waal**

Managing Director and Chief Executive, Industrial Development Corporation of South Africa Ltd

**Mr E Pavitt**

Chairman, General Mining Union Corporation Ltd

**Dr C F Garbers**

Chairman – President, CSIR

**Prof. H P van der Schijff**

Vice-Principal, University of Pretoria

**Mr D P de Villiers**

Chairman, South African Coal, Oil and Gas Corporation Ltd



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# Foreword by the President

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Nineteen eighty-four held many important lessons for Africa South of the Sahara. The effects of the continuing droughts in many regions, aggravated by the alarmingly rapid population growth, resulted in increased vulnerability of already over-stressed ecosystems. Furthermore, the global recession hampered the solving of existing problems and impeded economic recovery. Fortunately however, the Subsaharan situation has not passed beyond human control - what is needed is an honest and urgent appraisal of the future in order to treat the causes and not the symptoms of the problems.

As South Africa is an integral part of this region, it is also beset by many of these problems. Even in times of economic difficulties, a research and development programme, tailored to our needs, should not only continue unabated, but actually be enhanced. Our unique population structure, together with other extremely complex and urgent requirements, places a tremendous responsibility on our research community. The challenges facing us range from the provision of the basic necessities of life to competing in many of the most advanced technologies in the world.

## **Research strategy**

The activities discussed in this Report for 1984 should be seen not merely as a series of unrelated research projects at the CSIR, but in the overall context of the national scientific research strategy.

Broadly speaking, this strategy aims at providing the infrastructure for conducting scientific and technological research; establishing centres of excellence; assisting tertiary education institutions to conduct research and train research staff; encouraging research and innovation in industry; providing information and scientific and technical services; and developing research at cultural institutions such as museums.

Although much remains to be done, many of these aspirations have been realized, in many cases with the close involvement of the CSIR. More importantly, mechanisms have been established to mobilize South African research expertise on a nationwide basis to tackle cooperatively problems of great complexity and relevance.

The CSIR today is an organization that is not only doing a great deal for the development of industry, but has an internationally acknowledged capacity of knowledge and expertise in the fields of science and engineering. This is of great benefit to South Africa, particularly in view of the renewed emphasis on a realistic technological programme precipitated by the Kleu report.

Efforts are continually being made within the CSIR to keep pace with the realities and needs of South Africa. The major emphasis is therefore placed on the development of technological know-how and the communication of knowledge and know-how to industry. During the year under review 2515 research and development contracts were undertaken on behalf of industry.

Many of the CSIR's 25 institutes, laboratories, groups and units serve one or more particular industrial sectors. Work undertaken for outside organizations is done on a strictly confidential basis.

Other important contributions of the CSIR to industrial research are the services for the processing and retrieval of the world's scientific and technological information, the Production Engineering Advisory Service, the National Calibration Service, the maintenance of primary scientific standards and the CSIR's Conference Centre which serves as a focal point for the transfer and exchange of science and technology.

Particular reference should also be made to the initiatives of the South African Inventions Development Corporation (Saidcor), which is a wholly-owned subsidiary of the CSIR. Saidcor licenses new technology and provides venture capital for the development of new technology and products in joint ventures with



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# Foreword by the President

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industry. It currently has an interest in over 70 projects under development in collaboration with industry in the fields of medical science, chemical technology, scientific instruments, electronics equipment and mechanical engineering.

The CSIR constantly endeavours to enhance its collaboration with and assistance to industry owing to the continually growing demand for better use of our natural resources, more effective import replacement, expansion of production through export and increased employment through economic growth.

## **Finances**

The section entitled **Funds** reports in detail on the CSIR's income and expenditure. Owing to the present economic climate and the severe cuts which have been experienced, extreme care had to be taken with the apportionment of available funds so that the greatest benefit could be derived. Careful assessment of projects was made during the year to ensure project viability and maximum productivity.

It is important to note that the major portion of Government's contribution to the research budget is allocated to the statutory research councils. A significant proportion of the funds allotted to the CSIR is made available to research workers participating in national programmes outside the CSIR, for strengthening the research infrastructure and for the establishment and maintenance of national facilities such as the National Accelerator Centre and the South African Astronomical Observatory, as well as radio astronomy and satellite remote sensing, etc. With inflation taken into account, it was found that growth was modest from 1975, which is a matter of concern.

## **International collaboration in science**

The CSIR attaches great importance to the promotion of international collaboration in science.

In accordance with its mandate, the CSIR is responsible for membership of international scientific bodies, particularly in its capacity of adhering body to the International Council of Scientific Unions. Joint international research programmes in which the CSIR coordinates the South African contribution include oceanographic studies; astronomy; Antarctic research; weather, climate and atmosphere research; geology and ecology. The CSIR administers a number of bilateral agreements and is very active in the management of international scientific conferences, eleven of which were held in South Africa in the past two years. Visits to South Africa by foreign delegates have benefited South African science immeasurably, and South African scientists are encouraged to attend conferences abroad and to make contact with scientists working in similar fields.

The CSIR also maintains five scientific liaison offices abroad in Washington, Los Angeles, London, Paris and Bonn. Headed by well-qualified, trained scientists, these offices play a vital role in the international scientific collaboration of South Africa in general and the CSIR in particular. To be effective these offices must be maintained at full operating strength. This has become an exceedingly costly operation owing to the strengthening of other currencies as well as the general economic climate.

## **Events of 1984**

The year under review was marked by some special tributes in the form of awards to researchers, by important organizational changes and by certain remarkable scientific and technological achievements.

After extensive consultation, the National Institute for Personnel Research, one of the founder institutes of the CSIR, was transferred to the Human Sciences Research Council (HSRC). This Institute, which is internationally known for its major contributions to the human sciences, particularly those concerned with



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# Foreword by the President

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improving industrial performance, will continue to collaborate with the CSIR on a contract basis so that ties between the HSRC and the CSIR will be strengthened further.

The former Centre for Scientific and Technical Information and the Centre for Computing Services were amalgamated to form the new National Institute for Informatics. This was done in recognition of the increasing importance and future interdependence of information science and computer technology.

In order to consolidate the CSIR's research collaboration with, and sponsorship of, outside organizations, particularly universities, museums and technikons, the Foundation for Research Development was formed in April of the year under review. It combines the functions of the former Cooperative Scientific Programmes and the Research Grants Division, two CSIR activities which received wide recognition for mobilizing and developing research expertise on a national basis.

Control of the Richards Bay Coal Laboratory of the National Institute for Coal Research was transferred formally to the South African Bureau of Standards (SABS) with effect from 1 June in the year under review. The Laboratory is responsible for the quality certification of coal consignments exported through the Richards Bay coal terminal, and because this involves little or no research input, the Laboratory's activities are considered to be more consistent with the objectives of the SABS. However, the National Institute for Coal Research remains in close touch with the Laboratory to assist with the incorporation of the latest research findings into the analytical techniques.

Another important contribution in the field of energy is the research sponsored by the CSIR's National Programme for Energy Research, which involves *inter alia* the fluidized-bed combustion and gasification of coal. A national fluidized-bed combustion facility was commissioned by the National Institute for Coal Research for combustion studies of high-ash coals, coal discards, coal fines and desulphurization of flue gases.

## Conclusions

Nineteen eighty-five will mark the 40th anniversary of the establishment of the CSIR. It will be a year in which to pause and reflect on past achievements, successes and trends, and to heed the lessons of our history, short though it may be. It will also be a year in which to anticipate our direction in the future, especially in view of the current financial constraints.

Since the beginning, the CSIR has been able to select from a pool of high-quality manpower: the creative thinkers who have been employed here over the past four decades have helped to establish the CSIR as a nationally and internationally respected scientific and industrial research organization. In carrying out its mandate, the CSIR was ably assisted by the contributions and collaboration of the educational, public and private sectors. It also benefited greatly from its association with organizations overseas.

On behalf of the CSIR, I would like to express my sincere thanks to all the individuals and organizations who have assisted in the search for solutions to many difficult and pressing problems. I would also like to thank the staff members who, often under very difficult circumstances, managed to make 1984 a year of major achievements through their conscientious efforts.



PRESIDENT

April 1985

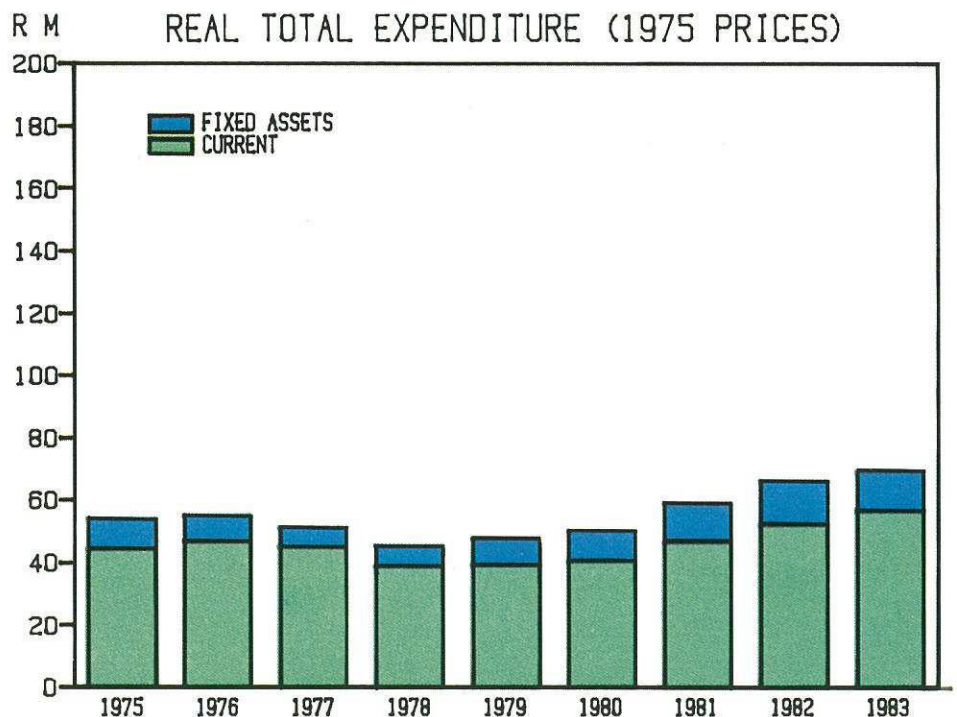
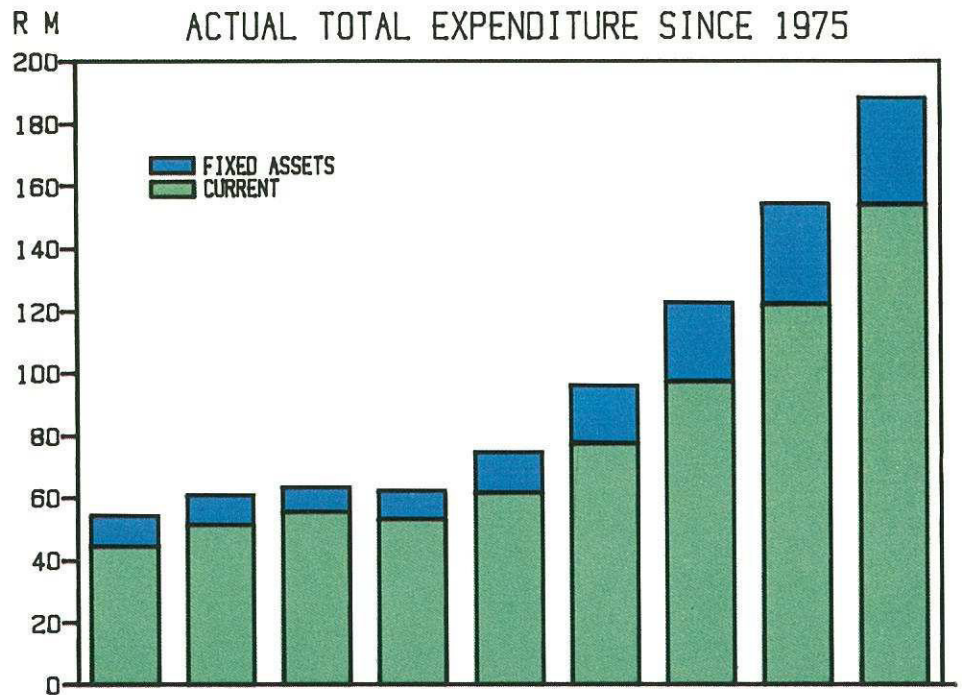


# Funds

## Introduction

It is important for the sustained economic growth of any country to invest money in scientific and technological research activities. As all other economic activities, expenditure on scientific research and related activities is also subject to constraints arising from inflation, unfavourable exchange rates and various cutbacks. In the 1983/84 financial year the CSIR concentrated on increasing its contribution towards knowledge and scientific and technological services within the limitations of available funds.

The total expenditure of the CSIR on current items and fixed assets increased by 24,2 per cent during the past year, as shown in diagram 1. The diagram also shows that the increase in the total real expenditure (i.e. the expenditure expressed in 1975 prices to exclude the effect of inflation) was only 6,9 per cent. The actual increase arose chiefly from the provision for improved conditions of service, as well as the incorporation of the former Fuel Research Institute into the CSIR as the National Institute for Coal Research, and the incorporation of the former Southern Universities Nuclear Institute as the Van de Graaff Laboratory of the National Accelerator Centre. The remaining portion of this increase can be ascribed to the further development of the National Accelerator Centre and to the expansion of a few other research and research support activities. Apart from staff expenditure items, insufficient funds were therefore available to provide adequately for the effects of inflation and unfavourable exchange rates. The curtailment of some activities was therefore unavoidable in order to accommodate cost increases and to





# Funds

provide for other new activities reported elsewhere. Such cutbacks inevitably have a detrimental effect on the development of technology, knowledge, and the infrastructure of the CSIR. The ability of the CSIR to carry out investigations and provide services, and therefore to supplement its income from this source, is accordingly seriously hampered.

Despite the increase in total expenditure, the proportion of the CSIR's total parliamentary grant (the funds provided by the Department of Finance) in relation to the total expenditure of central government dropped slightly during the year to 0,60 per cent, as indicated in diagram 2. The diagram also shows that the total expenditure of the CSIR kept pace with the gross domestic product (GDP). The increase in this proportion over the past three years can be largely ascribed to the small growth in the GDP.

## Total income

*Investigations and services* (25,2 per cent of the total income in 1983/84) again provided an important source of income. This item significantly supplemented the parliamentary grant, which is the largest source of income (diagram 3). Contract research and other scientific and technological services were carried out for a large variety of government institutions, the private sector and other research institutions. The development of knowledge required to solve specific problems in many fields, the exploitation of opportunities and the provision of a wide variety of scientific and technological services contribute directly to the economic and other development in South Africa and its neighbouring states.

The *parliamentary grant* amounted to 70,1 per cent of the total income of the CSIR. It is used for the acquisition of knowledge and know-how through basic, directed and high-risk research, as well as for the

Diagram 2:

## % COMPARISON WITH GOVERNMENT EXPENDITURE AND GDP

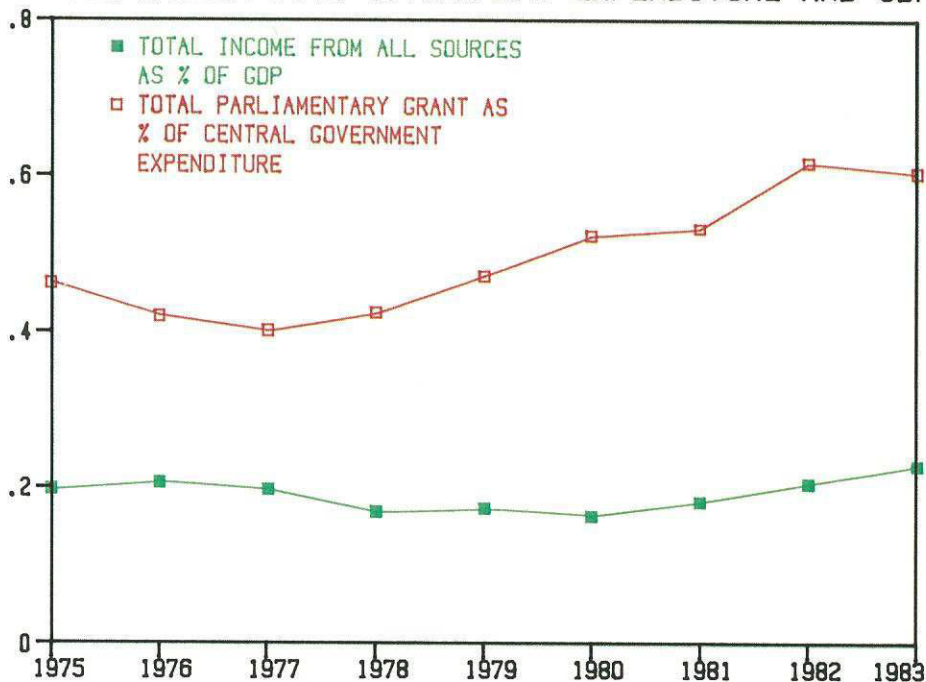
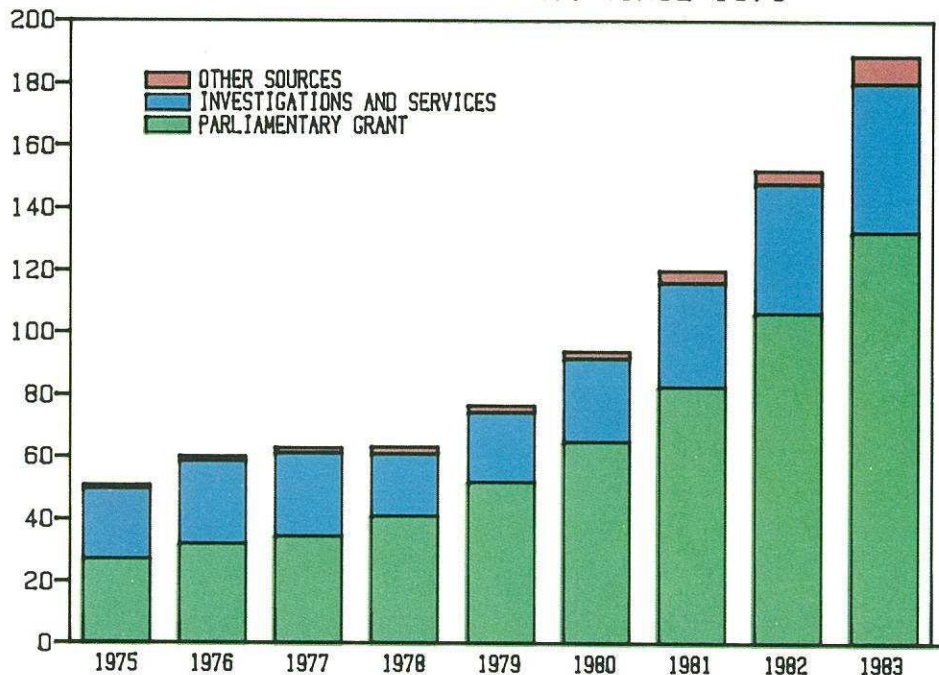


Diagram 3:

## R M ACTUAL TOTAL INCOME SINCE 1975





# Funds

development of technological infrastructure and services which are made available to users. A significant contribution is made in this way to the identification of and solution to operational problems, and the development, adaptation and improvement of products and processes. This work provides the basis for continued technological innovation, especially by the South African manufacturing industry, as emphasized by the Kleu report as essential for sustained economic development, and also in other economically oriented sectors.

The development of scientific knowledge and services by the CSIR with government support is also essential for the maintenance and improvement of the quality of life, the conservation of the environment, the utilization of available resources, and the overcoming of resource deficiencies. In addition, support for the general advancement of research and science in South Africa and for the expansion of knowledge provides the basis for sustained and effective technological development.

The actual increase in the *parliamentary grant* since the previous year was 24,6 per cent. More than three quarters (83,0 per cent) of this increase resulted from the income components of the National Institute for Coal Research and the Van de Graaff Laboratory which were formerly contributed by government, as well as from provisions for improved conditions of service, further development of the National Accelerator Centre, and for the establishment of a few other new activities reported elsewhere. The rest of this increase only amounted to 4,2 per cent over the parliamentary grant of the previous year. This increase was therefore not sufficient to make provision for normal staff and other cost increases in existing government-financed activities. However, for activities financed from other sources, these cost increases were satisfactorily covered by the increase of 23,5 per

Diagram 4:

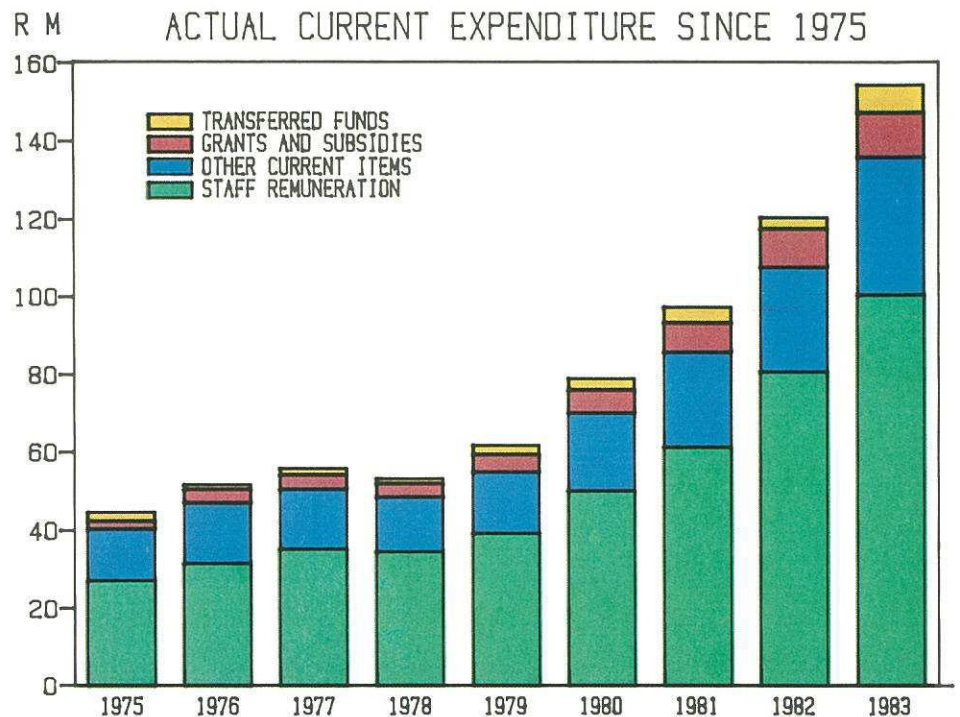
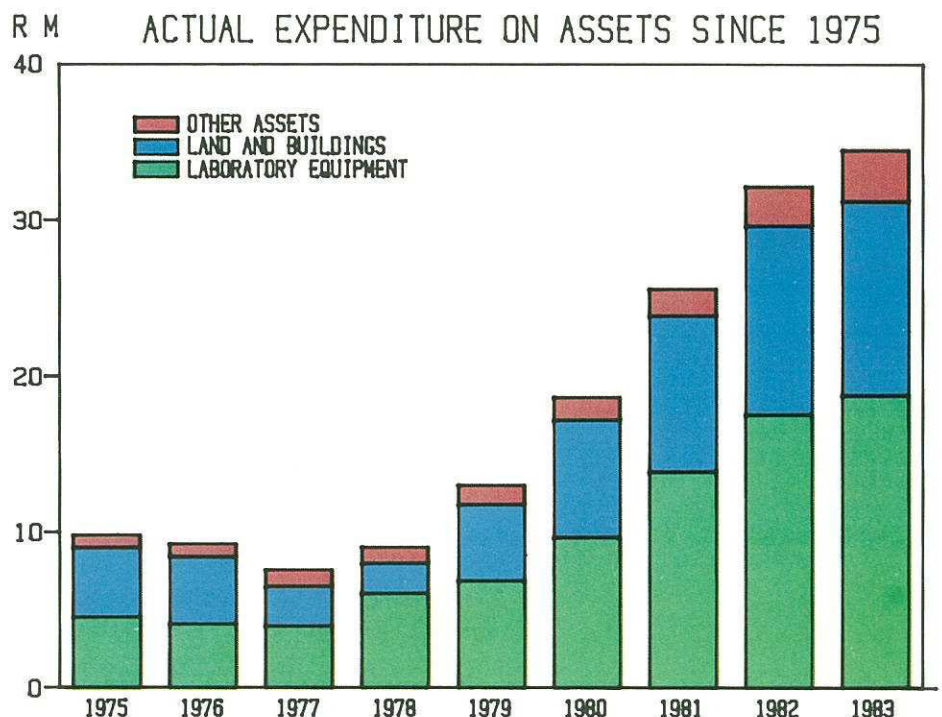


Diagram 5:





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# Funds

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cent in the actual total income from all other sources.

## **Current expenditure**

Diagram 4 shows that *staff remuneration* (salaries, wages and allowances) was the largest part (65,1 per cent) of the CSIR's current expenditure owing to the labour-intensive nature of scientific activities. The real increase of 7,2 per cent in this item was a result of the previously mentioned improvement in service conditions and a slight increase in the staff complement. The increase in real expenditure on staff remuneration was, however, significantly smaller than in the previous year. The improved conditions of service, in conjunction with the economic recession, had a favourable effect on the retention and recruitment of suitable staff. Undergraduate bursaries also help to ensure that the CSIR's demand for young graduates is met.

*Grants and subsidies* is a further important component (7,3 per cent) of the CSIR's expenditure. The support by the Foundation for Research Development (FRD) of basic and non-directed research projects at universities, technikons and museums was substantially reviewed during the year under review. Grants for research at universities and other research institutions with specific national objectives are also administered by the FRD. Specific research by and for industry is supported by subsidies to three industrial research institutes and also to a lesser extent by grants to individual undertakings (in the form of industrial research bursaries and grants for the technological development programme).

*Consumable supplies and services* (13,5 per cent) was again the second

largest expenditure item and is shown in the diagram with subsistence and transport and general expenditure items as *other current expenditures*. The low real increase of 3,3 per cent during the year resulted entirely from the additions to the CSIR discussed previously.

The real increase of 8,9 per cent in other expenditure items (subsistence and transport, general expenses) was higher than in the previous year. However, this increase amounted to only 10,4 per cent of the real increase of 8,0 per cent of the total current expenditure, and also resulted primarily from the previously mentioned additions to the CSIR.

## **Capital expenditure and income**

The continued unfavourable trend in exchange rates led to further increases in prices of laboratory equipment and other fixed assets, which are essential to scientific research. As indicated in diagram 5, *laboratory equipment* accounted for 54,4 per cent of the total capital purchases in 1983/84. Expenditure on *land and buildings* amounted to 36,1 per cent of all fixed asset purchases. The total real expenditure on both these items, however, decreased by 9,3 per cent since 1982/83. Existing shortcomings in the facilities for many activities will, however, not allow sustained reductions of this extent. The facilities of the CSIR are often available to other users in the country, and provide the basis for all the research activities of the CSIR itself. Owing to the rapid technological advances in laboratory equipment, continued investment in improved equipment and facilities is necessary.

The real increase of 10,4 per cent in expenditure on all *other types of fixed assets* (books and journals, furniture, office equipment and vehicles), which



# Funds

together amounted to only 9,5 per cent of the total expenditure in 1983/84 on fixed assets, resulted from cost increases that were substantially higher than the inflation rate due especially to disadvantageous exchange rates.

Purchases of fixed assets were chiefly funded by the *parliamentary grant* (84,1 per cent) (diagram 6). The percentage contribution of this source of funds was, however, lower than in any of the preceding five years. *Investigations and services* contributed 6,8 per cent. The real increase in the total capital income was only 2,5 per cent.

## Activity pattern of the CSIR

The CSIR's current and capital expenditure (R156 million after payments of grants and subsidies) is used directly or indirectly for research and development (68,0 per cent) and for other scientific and technological activities (32,0 per cent).

Diagram 7 shows the allocation of the *research and development* (R&D) expenditure (R106 million) to various research fields (or disciplines).

*Engineering sciences* received the largest allocation (29,7 per cent), followed by *physical sciences* (22,8 per cent) and *technological sciences* (20,1 per cent). The *chemical sciences* (8,2 per cent) and *earth sciences* (6,6 per cent) constitute another group shown together in the diagram. *Astronomy and surveying* (3,4 per cent) and *mathematical sciences* (3,2 per cent) are shown together, with *biological and related sciences* (3,2 per cent) and the *human sciences* (2,8 per cent) shown as *other sciences*.

It is clear that, as indicated elsewhere in this report, considerable

Diagram 6:

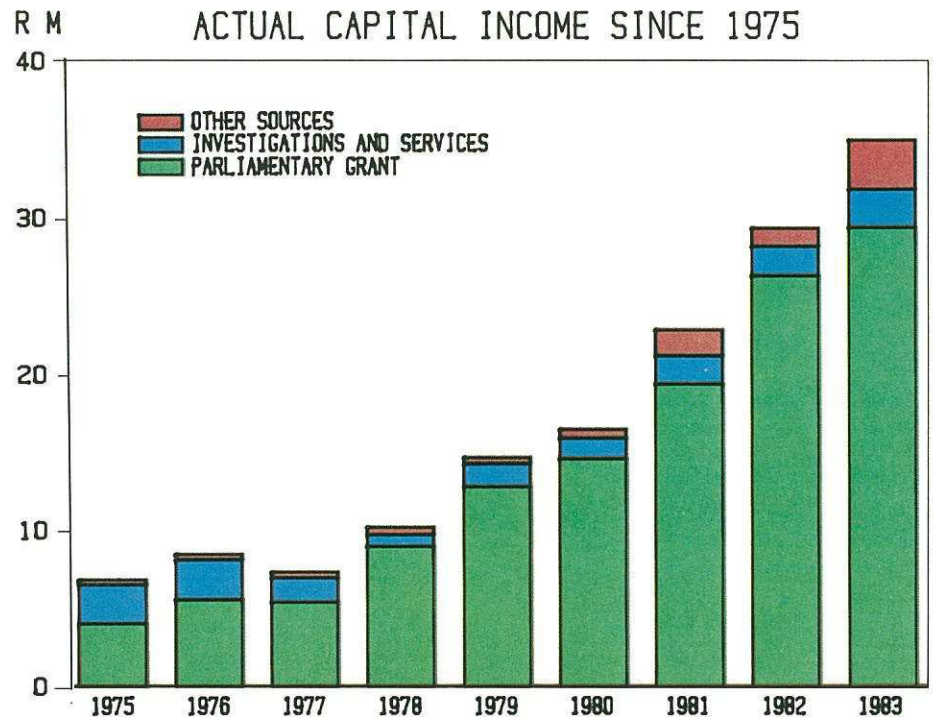
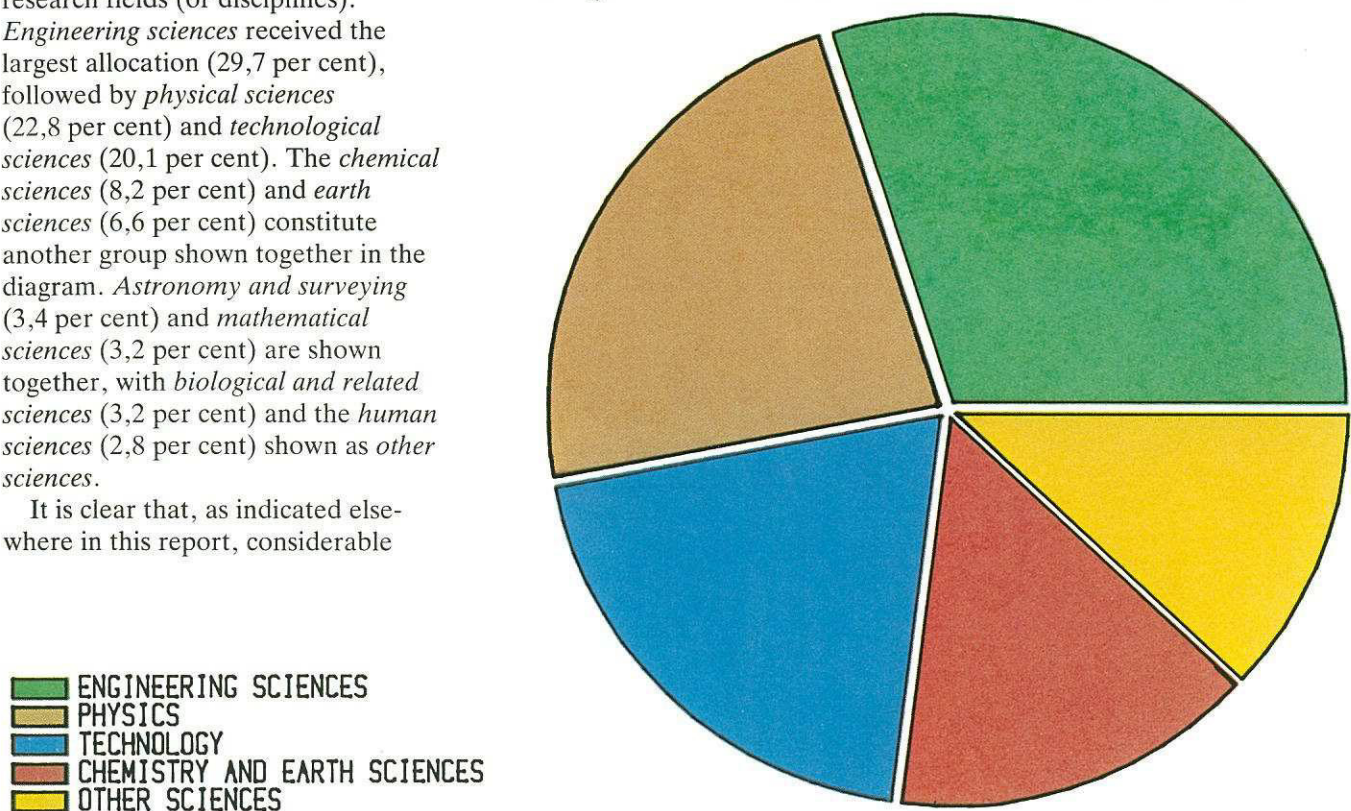


Diagram 7: R&D EXPENDITURE BY MAIN RESEARCH FIELD



- ENGINEERING SCIENCES
- PHYSICS
- TECHNOLOGY
- CHEMISTRY AND EARTH SCIENCES
- OTHER SCIENCES



# Funds

- CIVIL ENGINEERING
- ELECTRONICS
- MECHANICAL ENGINEERING
- ELECTRICAL ENGINEERING
- OTHER ENGINEERING SCIENCES

attention is given by the CSIR to those sciences (the engineering, physical, technological, chemical and earth sciences) that are essential for the technological development of the South African industry and infrastructure. However, the CSIR also contributes significantly to the development of other disciplines.

The allocation of the R31,7 million spent on R&D in the engineering sciences is illustrated in diagram 8.

*Civil engineering* (19,3 per cent of all engineering R&D) received the largest percentage, followed by *electronics* (11,9 per cent), *mechanical engineering* (10,4 per cent) and *electrical engineering* (7,3 per cent). *Chemical engineering* (6,8 per cent), *metallurgical engineering* (2,8 per cent), *mining engineering* (1,5 per cent), *building-related disciplines* (3,1 per cent), as well as a wide variety of other engineering sciences, are shown in the diagram together as *other engineering sciences*.

Diagram 9 shows the allocation of total expenditure on R&D according to the expected use of the results by specific socio-economic sectors. The contribution to the *manufacturing sector* was 21,3 per cent of expenditure on R&D. Support of *other economic activities* includes *agriculture* (1,3 per cent), *mining* (5,1 per cent), *construction* (4,1 per cent) and *other business activities* (4,0 per cent). The *development of the infrastructure* includes *energy* (4,1 per cent), *water sources and utilization* (4,5 per cent) and *transport, storage and communication* (3,7 per cent). *Community*

- MANUFACTURING
- OTHER ECONOMIC ACTIVITIES
- INFRASTRUCTURE
- COMMUNITY DEVELOPMENT
- OTHER

Diagram 8: R&D EXPENDITURE ON ENGINEERING SCIENCES

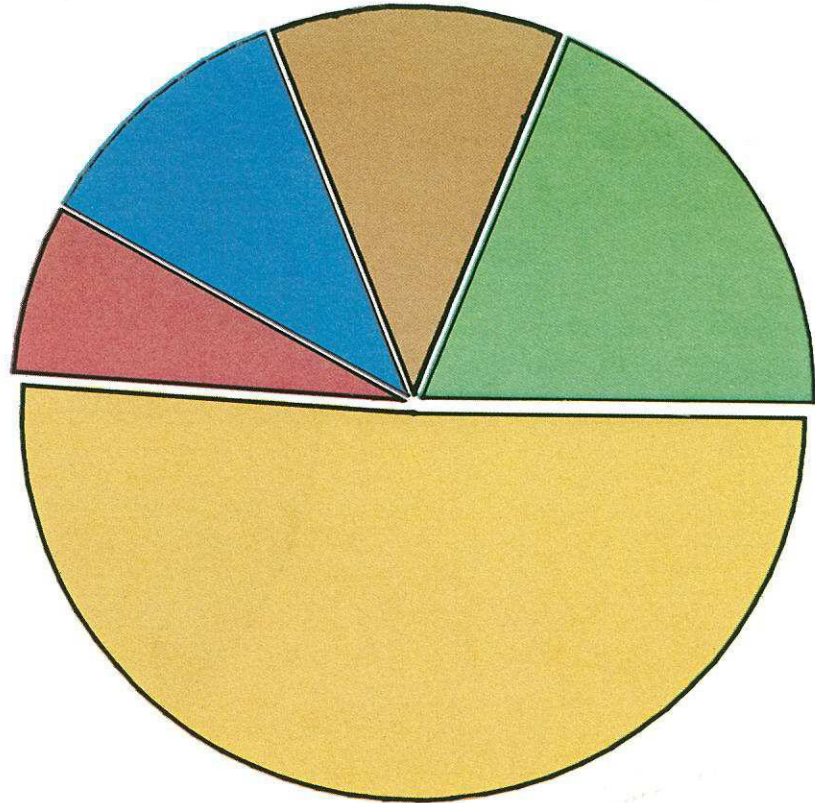
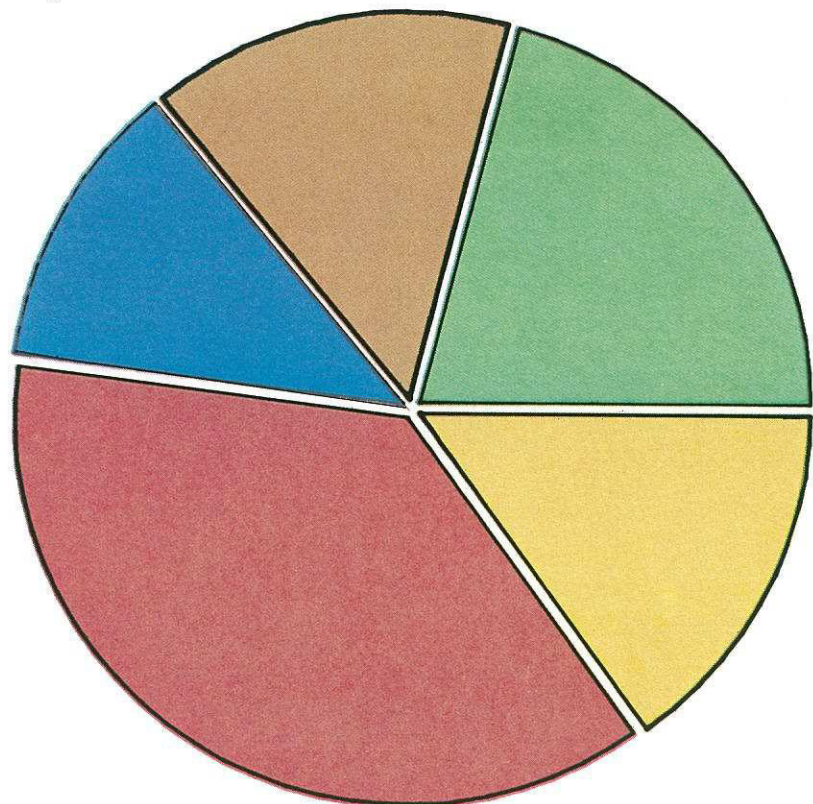


Diagram 9: R&D EXPENDITURE BY SOCIO-ECONOMIC SECTOR

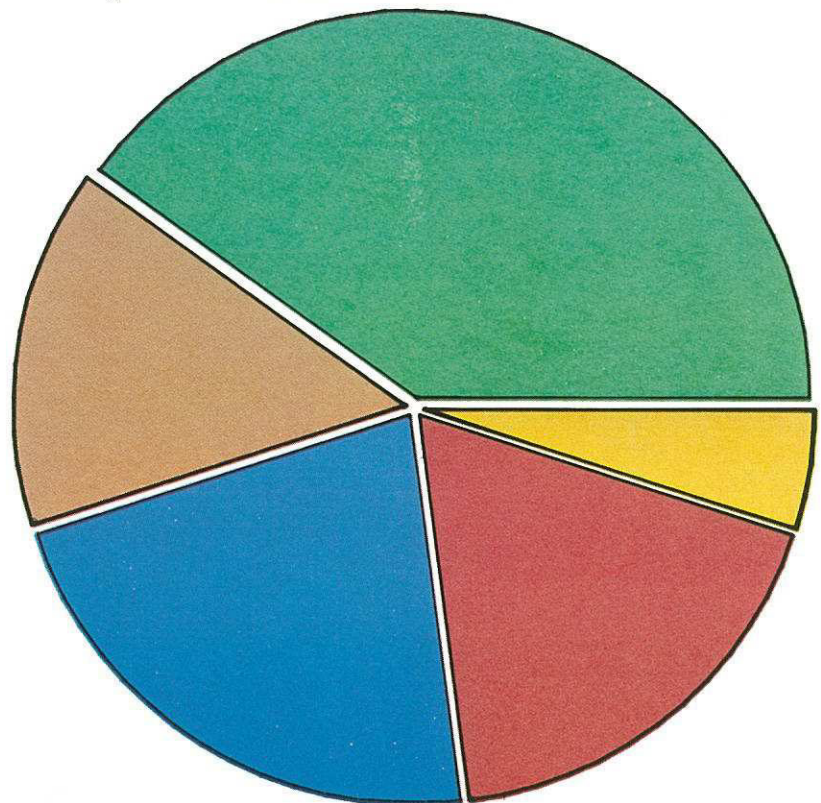




# Funds

- RESEARCH RELATED
- INFORMATION AND DOCUMENTATION
- OTHER RESEARCH RELATED
- NON-RESEARCH RELATED
- TESTING
- ADVISORY SERVICES
- OTHER NON-RESEARCH RELATED

Diagram 10: EXPENDITURE ON OTHER ACTIVITIES



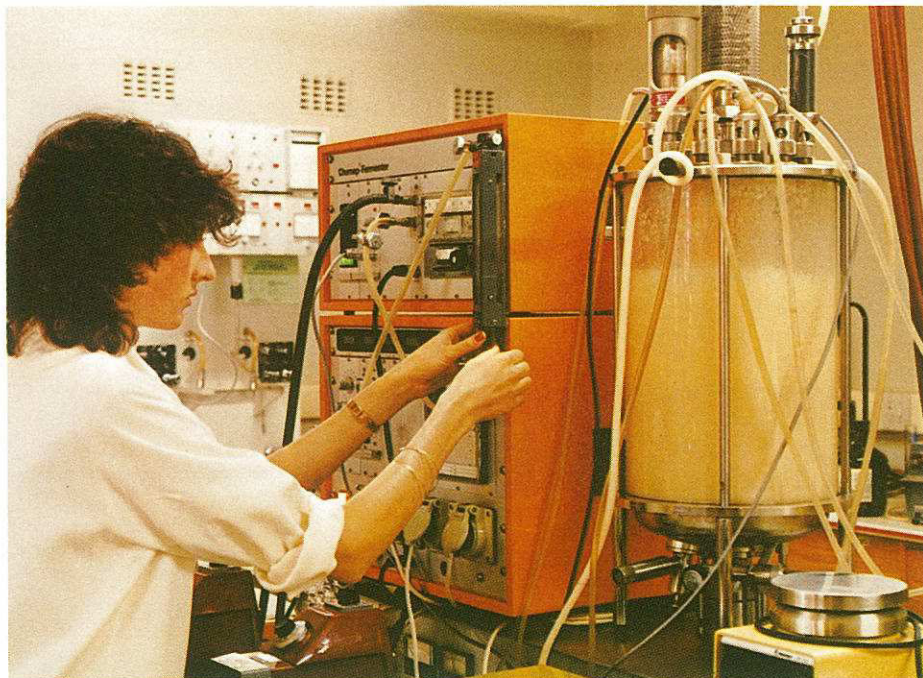
*development* consists mainly of *social development and services* (18,7 per cent), *health services* (13,3 per cent) and *protection of the environment* (3,8 per cent). *General advancement of knowledge* (12,2 per cent), *exploration of the earth, sea, atmosphere and space* (2,5 per cent) and other applications (0,5 per cent) are shown together as *other*.

The expenditure (R50 million) on other scientific and technological activities (other S&T) of the CSIR is divided into two groups (diagram 10). *Research-related activities* (55,4 per cent of other S&T) are chiefly directed at the creation of the essential R&D infrastructure for the country and the CSIR, but also include services for non-research purposes. The most important activities in this regard were *information and documentation*

(40,2 per cent of other S&T). *General data collection* (10,8 per cent) and *training and education* of the research and technical manpower of the CSIR and other organizations (4,3 per cent) are shown with smaller activities as *other research-related activities*.

*Non-research-related activities* (44,6 per cent of other S&T) are aimed at the provision of technical services to external users and the CSIR. The largest amounts were spent on *testing, standardization and quality control* (22,3 per cent of other S&T) and *advisory services* (18,0 per cent). *Other non-research-related activities* were *policy-related activities* (3,4 per cent) and the *patent and licensing activities* of the CSIR, excluding the South African Inventions Development Corporation (0,9 per cent).





Cellulase production by a cellulolytic fungus *Trichoderma reesei* growing on sugarcane bagasse in a laboratory-scale fermenter. The cellulase powder produced is supplied to other researchers for use in their projects. Cellulase can be used in the ethanol production process, and there are many other applications in the food and pharmaceutical industries.

#### Evaluation of proteins for ruminants.

Research done at the National Chemical Research Laboratory on the degradation of feed proteins in the rumen showed that the incubation of protein samples in nylon bags in the rumen is not a completely reliable method of determining the degradability of the protein. It appears as if all the protozoa and bacteria found in the rumen of an animal may not penetrate the mesh of the type of bag used by researchers elsewhere.

When the proteins in a feed tested in this way are not degraded in the bags, degradation may nevertheless occur in the rumen itself and the feed may therefore not be a suitable supplementary feed for highly productive animals.

**Bacteria for lysine production.** The National Food Research Institute has developed bacteria with a high lysine production capacity from selected wild bacteria.

The amino acid L lysine is an essential nutrient for monogastric animals such as poultry and pigs. Fish meal, a good source of lysine, is therefore often added to cereal feeds, but when fish meal is scarce, lysine obtained through the fermentation of

bacteria is used instead. Most of this lysine is imported from Japan.

If the preparation methods developed by the Institute could be applied by industry, a product containing 25 per cent lysine could be manufactured locally.

**Determination of fruit juice quality.** A rapid and efficient method of determining the amount of 5-hydroxymethyl 2-furfuraldehyde (HMF) in fruit juices by means of high-pressure liquid chromatography has been developed by the National Food Research Institute.

The compound HMF is formed during heat treatment of fruit juices during concentration or pasteurization. In Europe the HMF content of fruit juice is used as a quality criterion.

The usual methods of determining the HMF content of food are often unreliable as a result of the presence of inhibitors. The new method is a reliable way of determining whether our fruit juices are of export standard.

**Data bank for protein values.** After extensive investigation into the protein values of foodstuffs, the National Food Research Institute is

now equipped to run a data bank on the protein values of South African foods.

The protein value of different foodstuffs varies considerably and can be affected by processes such as heat treatment. Data on food value are obtained from experiments on young rats. On the basis of these results, the price of foodstuffs can be checked against their protein value and it can be calculated how much of a particular food will meet human protein requirements.

The Institute has already been providing a protein evaluation service to food researchers, industry and government organizations for some time.

**C20:5 isolated from fish oil.** The Fishing Industry Research Institute began work on the isolation and concentration of eicosapentaenoic acid (C20:5) from local fish oil. The two methods used to concentrate the methyl esters of this fatty acid from fish oil, namely urea occlusion and rapid cooling with liquid nitrogen, yielded 46 and 24 per cent C20:5 respectively.

The preventative effect on certain cardiovascular diseases is ascribed to the C20:5 concentration, which is high in South African pelagic fish oils. An encapsulated product with a C20:5 content of only 20 per cent is being sold in some countries.



**Scaling of Cape hake.** The Fishing Industry Research Institute made a survey of the machines used for scaling Cape hake. A pilot-scale machine with a variable rotation speed and mesh as well as other adjustments was designed. The South African fishing industry has felt the lack of such a scaling machine for years.

**A marketable fish extract.** At the request of the fishing industry, the Fishing Industry Research Institute developed a method of making fish extract out of concentrated fish protein.

Stickwater from a fish meal factory was digested, boiled and concentrated to the consistency of treacle. After the removal of an undesirable fishy flavour and a bitter aftertaste, a clear extract with a pleasant flavour was obtained.

It was decided, however, that cannery draining liquor would be a more suitable raw material than stickwater, since fish meal plants do not meet the standards required for food processing. The draining liquor is also purer than the stickwater and less energy would be consumed in the preparation of the extract.

2. *Tofu* is a versatile food which is popular in many Asian countries. It is similar to soft cheese in appearance and is produced by precipitating bean 'curds' from soymilk. There are many tasty ways of preparing tofu, for example the traditional sweet-and-sour dish shown in the photograph.

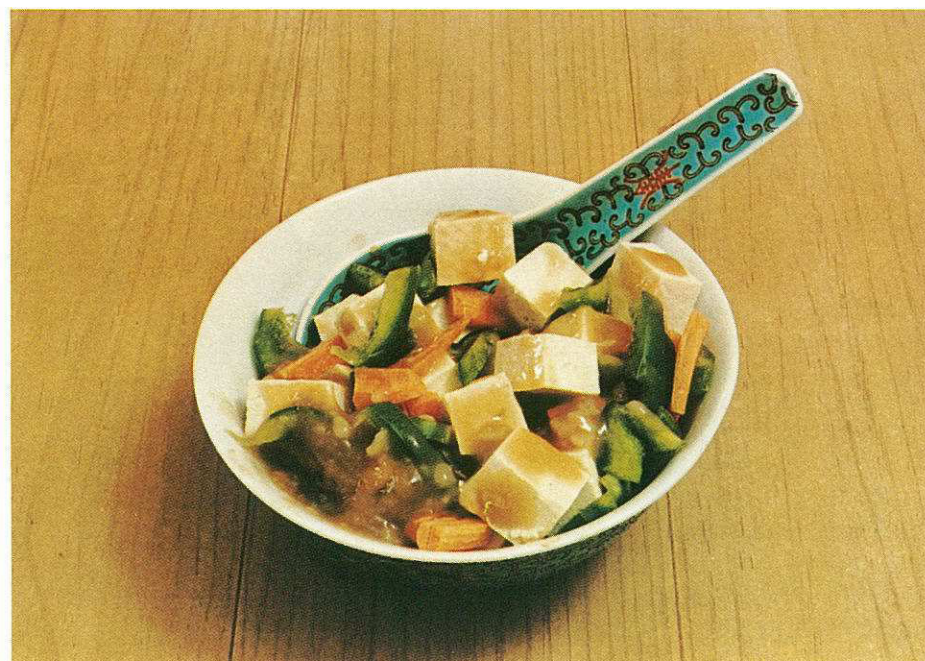
The soybean project at the National Food Research Institute reported on in 1982 is now nearing completion. Various dishes consisting of the two products, *tempeh* and *tofu*, appeared on the CSIR staff lunch menu as an acceptability test. The Institute will be able to present its findings to the food industry, and it is hoped that the products will be manufactured commercially.

Soybeans are highly nutritious and cost far less than other high-protein foods such as meat and dairy products. However, in the unprocessed

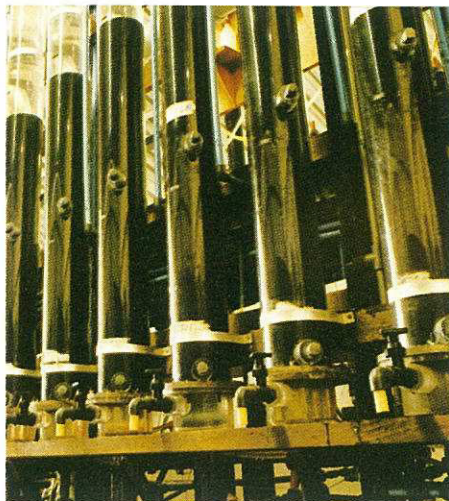
state their taste is not generally acceptable. The products developed by the Institute are aimed at presenting soybeans in a palatable form.

1. *Tempeh* is eaten mainly in Indonesia. It is prepared by inoculating soybeans with the fungus *Rhizopus oligosporus*, and the final product has the appearance of cakes of soybeans.

The most common method of preparation is deep-frying — the illustration shows a 'tempeh burger' which appears on the CSIR staff lunch menu.







The use of granular activated carbon as a final step in water purification is a highly efficient means of removing remnants of organic pollutants from water intended for drinking. The photograph shows a bank of columns used for this process in pilot plant studies done by the National Institute for Water Research.

**Tracing of water leakages.** In terms of an agreement with the Water Research Commission, the National Building Research Institute investigated procedures for tracing leakages in urban water mains systems. It was estimated that up to 15 per cent of all purified water is lost through such leakages. Recommended methods for tracing leaks have been published in the *S A Water Bulletin*.

**Chlorides and the corrosion of water pipes.** The National Chemical Research Laboratory used rotating disc electrodes and a mini-processing console to study the corrosive properties of chloride-containing neutral water.

It was found that in the case of reasonably pure water with a chloride content of no more than 40 parts per million, corrosion was activation controlled and the flow rate of the water had a very slight effect on the corrosion rate. Where the chloride content was higher, diffusion control took over and the corrosion rate became increasingly dependent on the flow rate until the two factors were

directly proportional at about 80 parts per million.

In times of drought, corrosion rate increases owing to the increase in salt content of the water, which causes a diffusion-controlled reaction. Under these circumstances steel pipes can be protected to a certain extent by corrosion inhibitors.

**Automatic system for water analysis.** The National Research Institute for Mathematical Sciences developed a computer system for the control and automatic analysis of the approximately 160 000 water samples sent to the National Institute for Water Research by a large number of organizations and researchers each year.

By means of this system the details of the analysis of every sample are recorded, a daily progress report is compiled, the analyses are checked, the results are filed and a final report on every sample is compiled.

**Monitoring of organic matter in drinking water.** The National Institute for Water Research, in collaboration with the National Electrical Engineering Research Institute and with the financial assistance of the Water Research Commission, has developed equipment for the continuous monitoring of organic matter in drinking water.

Total organic carbon and ultraviolet absorption are two of the parameters used to detect the presence of organic pollutants such as pesticides and herbicides in factory effluents. The new equipment can now be installed at water purification plants to ensure that drinking water will be pollutant free.

**Water purification.** Flotation techniques for the treatment of urban effluent, which were developed by the National Institute for Water Research, have been modified for the treatment of polluted surface water.

Increasing eutrophication (enrichment, especially by nitrates and

phosphates) of rivers and storage dams leads to excessive algal growth in the water. The organic matter produced by this growth cannot easily be removed by conventional processes such as sedimentation and filtration and therefore remains in the product water.

The flotation process was thoroughly tested and a full-scale purification plant based on the process is under construction at Lake Insezi near Richards Bay.

**Monitoring water quality.** The National Institute for Water Research developed a continuous automatic system for the monitoring of water quality, based on the detection of toxic enzyme-inhibiting substances. The living organisms used for such biological monitoring systems are adaptable and do not always react to toxic conditions that may be harmful in the long run. A non-living toxicity sensor may therefore have many advantages.

The crux of the system is a micro-calorimeter in which a particular enzyme is immobilized on glass beads. To automatize the cyclic injection of test solutions and collect data a minicomputer is used.

**Tannery wastewater management.** In collaboration with local authorities and the government departments concerned, the Leather Industries Research Institute is advising tanneries on wastewater management in accordance with the results of the research conducted over the past eight years under the sponsorship of the Water Research Commission, the CSIR and industry. Plant designs and layout and flow diagrams have been prepared for several tanneries.



### Rapid testing of concrete aggregates.

In the course of an extensive investigation the National Building Research Institute developed a rapid but efficient test to determine the alkali reactivity of concrete aggregates.

When certain reactive concrete aggregates are used with cement with a high alkali content, the presence of moisture causes a chemical reaction that results in cracking. To prevent serious damage to concrete structures, the alkali reactivity of suspect aggregates should be determined before use.

Formerly these tests took about a year but with the new test, results can be obtained within 10 days.

### Strategy for do-it-yourself housing.

The Department of Cooperation and Development requested the National Building Research Institute to assist the Western Cape Administration Board in the formulation of a development strategy based on the system of high-density self-help housing to be applied at Khayelitsha, the Black township near Cape Town.

The Institute also helped the Administration Board to draw up a framework for the strategy. Tenure for homeowners in Khayelitsha was not approved until late 1984 after many of the houses in the first phase had been completed.

Since successful self-build projects depend on tenure, many of the Institute's contributions could not be implemented.

### Failure of ceramic tile cladding.

Adhesion failures in ceramic tile cladding on the exteriors of buildings have reached alarming proportions in the past few years. Measures to prevent such failures have been dealt with in an information sheet put out by the National Building Research Institute and, apart from incorrect detailing and fixing, excessive irreversible moisture expansion of some tiles has been identified as contributing to such failures.



A major tile manufacturer was assisted to identify production and quality control procedures which could be implemented to reduce the moisture expansion of their product. If the recommended procedures and appropriate materials are used, millions of rands could be saved.

**Housing for the aged.** A prototype residential unit for the aged that has been designed by the National Building Research Institute is considerably smaller than the current norm. Nevertheless, it can be occupied by one or two old people who are still able to look after themselves, those requiring limited nursing care and also by the physically handicapped or even persons in wheel chairs. It will obviate the need for aged persons to be moved as their circumstances and state of health change.

One of these units is being evaluated by the Institute in the laboratory, after which experimental units will be erected at existing institutions. Design guidelines will be made available in the near future.



Evaluation of the fire properties of a curtain wall construction undertaken on a full-scale installation by the Fire and Concrete Engineering Division of the National Building Research Institute.

1. The values are monitored by recording instruments to the left of the fire tower. The material begins to deform as the heat from the fire behind it increases.
2. The fire finally breaks through the curtain wall construction.



**Alcohol from bagasse as fuel supplement.** An investigation by the CSIR's Research Group for Microbiology and the Department of Microbiology of the University of the Orange Free State has revealed that other yeasts besides *Pachysolen tannophilus* can be used for the manufacture of alcohol from bagasse. As a result of its higher rate of fermentation a strain of *Candida shehatae* has a higher maximum alcohol yield than *P tannophilus*, which has been used in many experiments abroad.

**More efficient boilers.** The National Timber Research Institute completed an investigation into the efficiency of boilers for the pulp and paper industry.

It was found that incomplete combustion and the loss of energy involved in the release of exhaust gases were the main causes of inefficiency. A report on the findings, which included proposals for efficient boiler operation, was submitted to the paper industry.

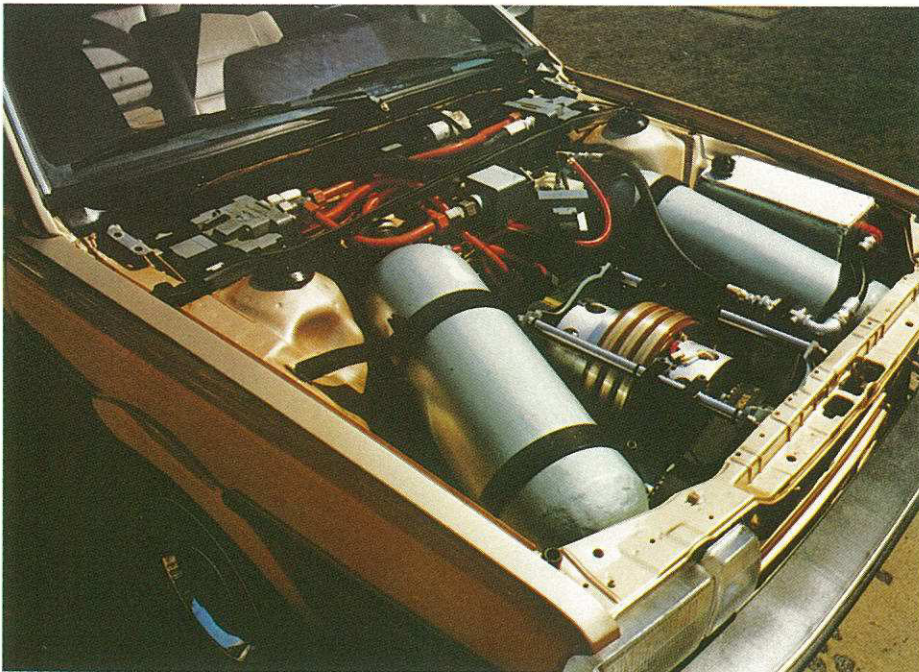
**Fluidized-bed combustion and gasification of coal.** In the National Programme for Energy Research particular importance is attached to the development of facilities for the fluidized-bed combustion and gasification of coal. These techniques can be used for the processing of coal with a high ash content, which is plentiful in South Africa, and also for the utilization of fines fractions.

A national fluidized-bed com-

bustion facility has been erected at the pilot plant site of the National Institute for Coal Research. A pilot plant for fluidized-bed gasification was designed and built at the University of Natal. Negotiations with the university, the South African Inventions Development Corporation and a commercial partner concerning the possibility of marketing the gasification process are under way.

**South African Energy Information System.** A South African Energy Information System (SAEIS) was established in 1984 through the cooperative efforts of the National Institute for Informatics of the CSIR, the Department of Mineral and Energy Affairs and the CSIR Foundation for Research Development.

The aim of the SAEIS is to coordinate energy information activities in South Africa and to make information available. Information on all aspects of energy is available on a large number of overseas bibliographic data bases, while information on energy management, energy saving in industry and solar energy is available on a number of local bibliographic data bases.



The Design and Development Division of the National Mechanical Engineering Research Institute studied the application of regenerative partial hydrostatic transmissions to electric vehicles. The latest system uses two fixed-displacement hydraulic units functioning either as pumps or motors in conjunction with a specially designed AC electric motor, whose stator and rotor both transmit torque to the system. The transmission was designed for high regenerative energy efficiency and is controlled by a microprocessor. When the motion of the vehicle is retarded the available kinetic energy is

stored as pressure energy in hydraulic accumulators which can subsequently be used to accelerate the vehicle from rest.

The photo shows a vehicle fitted with fixed-speed electric motor and partial hydrostatic transmission.



**Toxins in South African plants.** In collaboration with the Veterinary Research Institute at Onderstepoort, the National Chemical Research Laboratory determined the nature and structure of a number of plant toxins.

An investigation was conducted into the toxic substances in *Tylecodon wallichii* and *Kalanchoe lanceolata*, plants belonging to the Crassulaceae family that give rise to stock losses from cotyledonosis. The molecular structure of the bufadienolide toxins was determined mainly by means of nuclear magnetic resonance spectroscopy.

Scientists can use this knowledge to determine whether these dangerous toxins occur in specific plant material and to study their metabolism and biochemical actions in order to develop a suitable antidote.

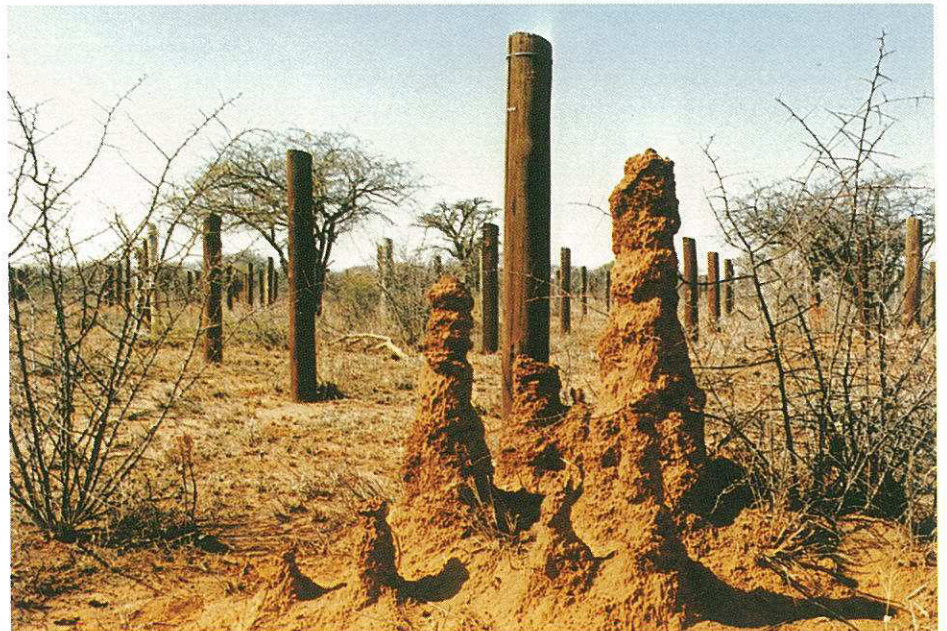
**Controlling the fly nuisance.** The first part of an investigation into the fly nuisance, undertaken by the National Institute for Water Research at the request of the Department of Health and Welfare, was completed in the year under review.

The research was mainly aimed at the activities about which the Department received the most complaints, namely stock and poultry farming. It was found that control and prevention of the fly nuisance were based mainly on proper land-use planning and waste processing.

The results of the investigation were included in a reference work which can be used to compile publications for particular groups.

**The detection of intestinal viruses in water.** Research at the National Institute for Water Research (NIWR) showed that the PLC/PRF/5 cell line developed from a primary human liver-cell carcinoma at the National Institute for Virology is much more effective in the detection of intestinal viruses than the cell cultures used at present.

The NIWR is fortunate in still



having cultures of primary vervet monkey kidney cells (PVK cells) at its disposal. PVK cells are much more sensitive than the cell culture systems used in other parts of the world, but the supply of vervet monkeys is limited and the growth of the primary cell cultures may be poor. Researchers are therefore constantly looking for more suitable cell culture systems.

As PLC/PRF/5 is available as an established cell line, it can be used in any laboratory in the world. It is, moreover, one of the few cell culture systems suitable for the propagation of the hepatitis A virus.

**Air pollution on the Eastern Transvaal Highveld.** An extensive research programme on air pollution in the Eastern Transvaal Highveld has been undertaken in terms of the National Programme for Weather, Climate and Atmosphere Research. The CSIR, universities, government departments, industries, organizations such as Nucor, and private air pollution consultants are participating in the programme.

The results of the research will be used to determine the effect of industrial pollution on the environment and climate, to establish the



Termites occur everywhere in South Africa and cause a great deal of damage to untreated wood. Wood will last 10 to 20 times longer if it is treated with preservatives.

Research by the National Timber Research Institute: Field exposure of treated and untreated timber on a termite 'farm' in the Northern Transvaal.

amount of control of pollutant emission by industries that is required in the area and to help plan future developments with proper regard for the environment and the population.



**Reducing noise in buses.** The National Physical Research Laboratory was asked to investigate ways of reducing the noise level in a bus developed by the Economic Development Corporation in collaboration with a South African manufacturer for the daily transportation of workers. There was concern especially about the effect of excessive noise on the bus driver.

The Laboratory found that most of the noise came from the engine which is situated right next to the driver, and recommended that better sound insulation should be installed between the engine and the interior of the bus. It appeared that the insulation eliminated noise to such an extent that the driver could drive a whole day without loss of concentration, whereas previously he became severely fatigued after only an hour.

**Objective speech intelligibility test.** The National Physical Research Laboratory now has sophisticated computerized apparatus for the objective evaluation of the modulation transfer function of speech communication systems. Extensive research in other countries has shown that there is a good correlation between this function and speech intelligibility.

Good results were obtained where the apparatus was used to test a radio communication system. In principle the test can be applied to any speech channel, from a telephone to an auditorium.

**Acoustic system for the House of Assembly.** At the request of the Speaker and the Secretary of Parliament, the National Physical Research Laboratory redesigned the sound system for the House of Assembly and drew up specifications for the electroacoustic components required. A contractor installed the equipment according to the specifications. The Laboratory has been involved with the building's acoustic system since 1954.

It is now easier to follow what is being said in the House and the speech sounds more natural. The quality of sound recordings for the Hansard reporters has also improved considerably. The selection of microphones for speakers and the elimination of loudspeakers near them are now computer controlled.

**Disintegration of lime-stabilized road bases.** An investigation of the disintegration of lime-stabilized road bases by the National Institute for Transport and Road Research revealed that the condition was not simply the result of soluble salt, excessive compaction or insufficient lime. This condition may also be attributed to the carbonation of lime in the top layer of the base and the resulting exposure of the base to the atmosphere.

The investigation showed that the usual method of spraying stabilized bases with water twice daily may cause an increase in carbonation and is therefore undesirable in most cases. Disintegration can usually be prevented by covering the stabilized layer with the next layer or by sealing it as soon as possible.

**Pedestrian crossings between intersections.** The National Institute for Transport and Road Research investigated the provision, design and location of pedestrian crossings between intersections and reported its findings to the road authorities concerned.

The suggested criteria for the justification of uncontrolled as well as signal-controlled crossings between intersections have been accepted by the Committee of State Road Authorities. These criteria will be incorporated in the *South African Road Traffic Sign Manual*.

In the Institute's report on the design and location of pedestrian crossings various methods of making uncontrolled crossings more conspicuous are suggested, such as new road signs and zig-zag marking on

streets leading to crossings. Urban road authorities have been invited to participate in the evaluation of these crossings.

**Transport in developing areas.** The National Institute for Transport and Road Research investigated the need for and attitude towards transport encountered amongst less-developed population groups.

Several international organizations are also studying transport planning for developing areas. They have found, amongst other things, that little is known about the impact of new roads on the social and economic development of populations in remote areas.

The Institute's research in this field was mainly concerned with the ways in which consumers' surpluses - a prerequisite for capital accumulation and consequently for economic growth - could be raised by improving transport facilities.

The Institute intends to publish a number of reports on the transport requirements of populations in developing areas and on procedures regarding the siting and financing of roads and the determination of road standards for such areas.

**Overloaded vehicles.** The National Institute for Transport and Road Research developed a device, the Overload Sensor, for the identification of overloaded vehicles. The equipment has been successfully tested on the N3 main road between Pietermaritzburg and Durban.

Overloaded heavy vehicles damage road structures and are unsafe. For the transport operator overloading causes higher fuel consumption and maintenance costs.

According to traffic axle load measurements taken in Natal in 1981 and 1982, an average of 11 per cent of the axles of all heavy vehicles were loaded beyond the legal limit. It is hoped that, on the basis of investigations with the Overload Sensor, effective law enforcement will





Tests by the National Institute for Transport and Road Research on the capsize stability of buses.

limit overloading on Natal roads for the benefit of the road authorities, road users in general and the transport operators themselves.

**Bus safety standards.** In the course of research on bus accidents, which occur more frequently than other traffic accidents and are more serious, the National Institute for Transport and Road Research found that the most effective way of improving bus safety is to set proper standards of bus design and construction.

Buses are most frequently involved in collisions with pedestrians and in so-called no-collision accidents in which the vehicle leaves the road or

overturns. Apart from active safety measures to prevent accidents, passive measures such as the elimination of potential causes of injury can also be effective. Tests are being done on emergency evacuation and capsize stability of buses, as well as on the flammability of material and the force required to eject the windows from emergency exists.

**Rural speed limit and accidents.** The National Institute for Transport and Road Research investigated the causes of road accidents from 1974 to 1981, a period in which the South African speed limit was changed four times. It was found that the rural speed limit was a significant factor in all seven accident categories identified, in other words it also affected the urban accident figure.

On the strength of this investigation a speed limit of 90 km/h was recommended for all rural roads.

**Model for rural road network.** A team in which the National Institute for Transport and Road Research and, amongst others, the Department of Transport and the University of Pretoria are represented, developed a model to determine future transport needs on the country's rural road network.

The model is based on predictions of socio-economic variables such as population, vehicle ownership and gross geographic product, and the effect of such variables on trip generation and trip distribution. This method provides more accurate information than the old method of determining traffic increases



individually on the basis of historical values.

**Microwave transmitters, and signal attenuation caused by rain.** At the request of the Department of Posts and Telecommunications the National Institute for Telecommunications Research determined the extent of attenuation of radio signals that will occur on the links of a planned national digital microwave radio-transmission system as a result of rain.

The previous annual report mentioned the Institute's research on the attenuation of radiowaves by rain when high microwave frequencies are used for communication, and the construction of a model with which the required rainfall statistics for Southern Africa can be obtained.

In planning the system the Department initially relied on foreign know-how. The Institute was able to point out mistakes in the rain attenuation predictions of the foreign study group and proposed new prediction values on the basis of which parts of the system were redesigned. In this way errors that could have resulted in a

considerable financial loss were eliminated.

**Satellite tracking.** The Satellite Remote Sensing Centre of the National Institute for Telecommunications Research at Hartebeesthoek installed a new 10-m parabolic antenna with dual-frequency feed for the continuous supply of Meteosat cloud images to the South African Weather Bureau. Before the installation of the new antenna this service to the Weather Bureau was often interrupted as a result of the increasing demands of the French space agency (CNES) and the Landsat programmes.

The Centre provided the CNES with real-time tracking data when the Ariane 9 rocket was launched in French Guiana in May.

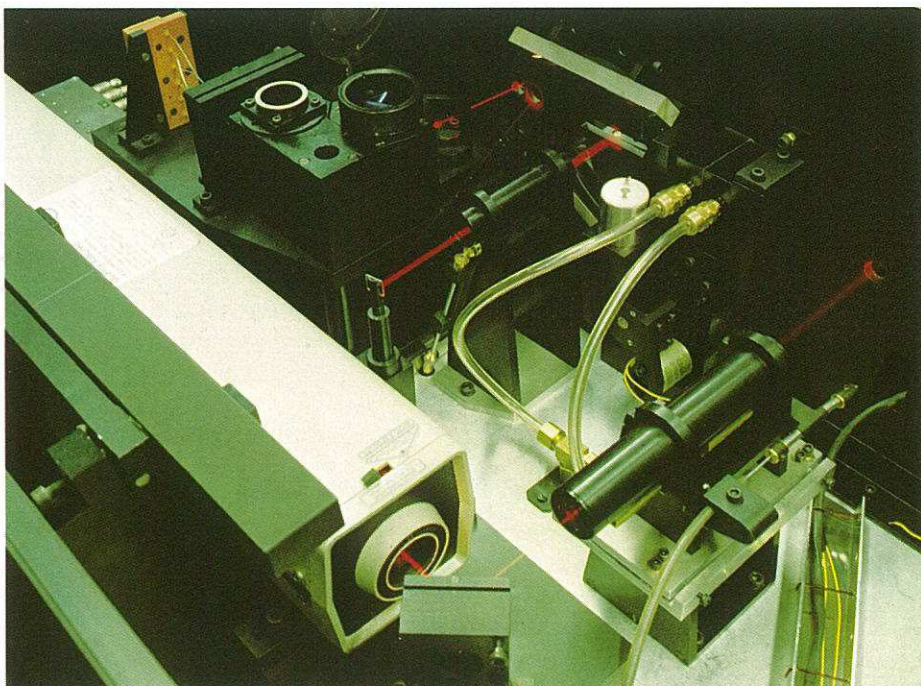
Soon after an important European telecommunications satellite, Telecom 1A, had been launched the Centre received the first signals from the satellite. It then maintained contact with the satellite for nine hours during the critical period when it was placed into geostationary orbit. During the next ten days the Centre

supported the operation for approximately 12,5 hours per day.

**Metallurgical slag as railway ballast.** Through technology transfer in terms of the National Materials Programme, it has been made possible for a private firm and the South African Transport Services to utilize large quantities of metallurgical slag produced in the metal industry as railway ballast.

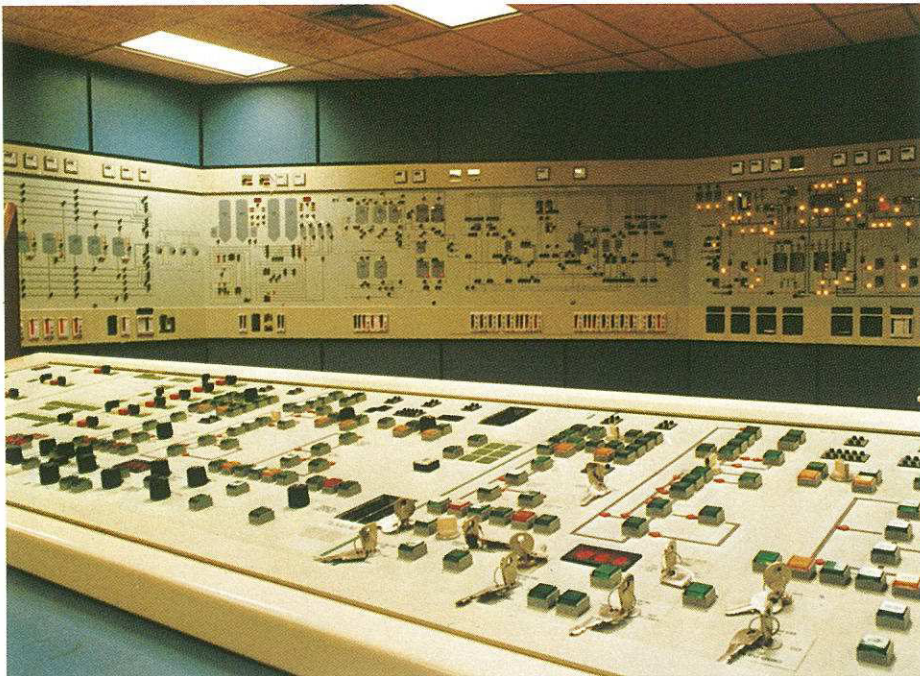
Slags are already being used as ballast material, fertilizer and filter medium in South Africa. These applications, although significant, are not enough to absorb the current production. In collaboration with the Department of Mineral and Energy Affairs, it was established that the slags have no commercial metal recovery potential and that there is no reason why they should not be used in dissipative applications.

The South African Transport Services need large quantities of ballast material and are evaluating the properties of slags. If the trials are successful, the dumping of waste slags will be considerably reduced, if not eliminated.



Optical replay system designed and constructed by the Optical Sciences Division of the National Physical Research Laboratory for the National Institute for Telecommunications Research. The photograph shows the laser on the left and the path that the beam follows through the system.

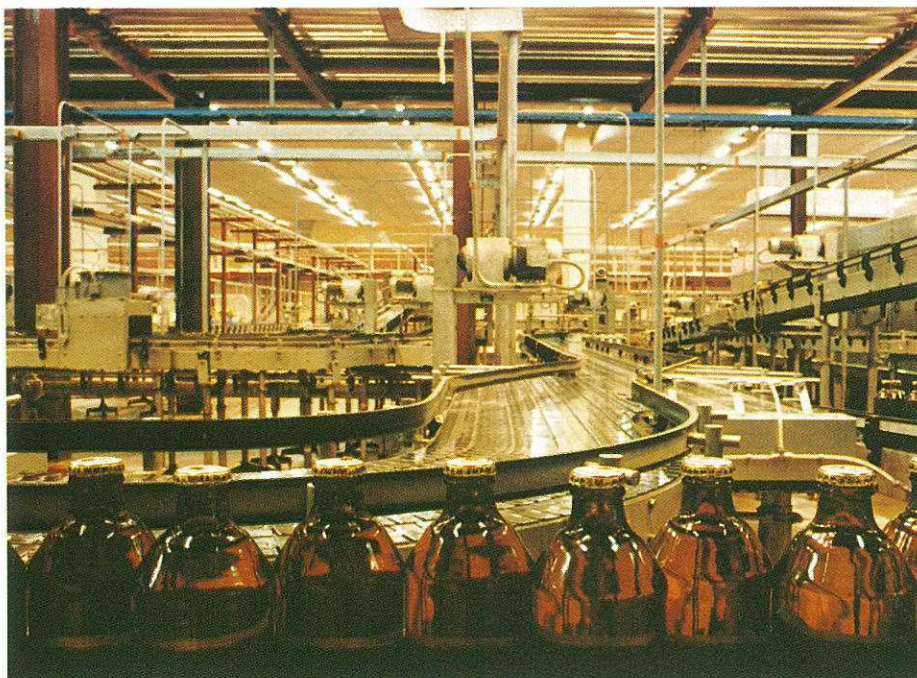
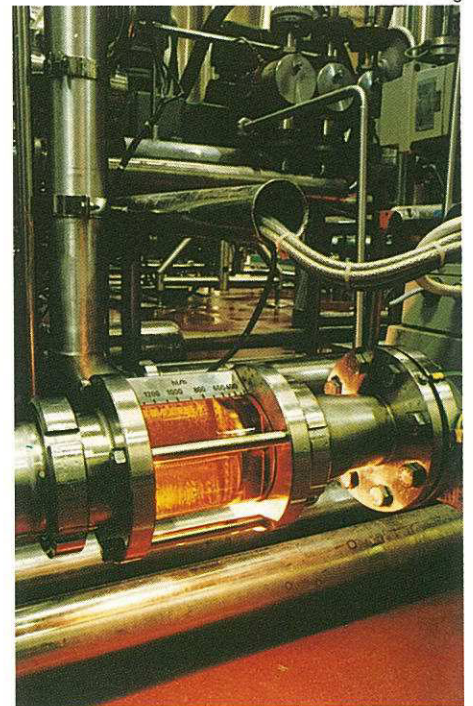




1 The software for an interactive computer system to aid production planning at breweries was developed by the Operations Research and Statistics Division of the National Research Institute for Mathematical Sciences (see page 27).

1. The central control room at a brewery. Controllers are able to keep a check on every stage of the production process.

2 & 3. The complex system for moving batches of the product through the various processing stages.



**Heat dissipation in underground cables.** In terms of a contract with a cable manufacturer, the National Research Institute for Mathematical Sciences calculated the equilibrium temperature for an underground three-phase cable that carries its full design power load. This particular type of cable is laid in trenches that are partly filled with a special material

and then covered with a layer of earth. This results in better dissipation of the heat generated in the cable so that the operating temperature of the cable is reduced.

The Institute's calculations enabled the manufacturer to evaluate the heat dissipation and to improve his design accordingly.

**Computer program for the design of wire ropes.** A manufacturer of wire ropes for the mining industry commissioned the National Research Institute for Mathematical Sciences to develop a computer program for calculating certain geometrical data for the design of wire ropes. The program is suitable for any round strand construction and develops the appropriate mathematical formulae, which are then solved automatically.

The development of the program is related to the work on winding ropes being done by the National Mechanical Engineering Research Institute.



**Decision support system for a brewery.** The National Research Institute for Mathematical Sciences developed an interactive computerized decision support system to aid the production planning and budgeting of a South African brewery. The company can use the package to evaluate various brewing, packaging and distribution plans for its products and combine them in the most advantageous way.

Since the system was introduced a year ago, the management has already been able to evaluate more alternatives than before in the decision-making process, thereby reducing the risk of making serious errors of judgement in their strategy.

**Variation in concrete strength.** At the request of the Portland cement industry the National Research Institute for Mathematical Sciences designed a random statistical sampling experiment by which estimates of the

relative scope of the factors contributing to variations in concrete strength can be obtained.

The experiment was conducted over six months and the estimates obtained were encapsulated in formulae that can be used to calculate average target strengths for concrete mixtures.

**Test specifications for mine hoist components.** The Mine Equipment Research Unit of the National Mechanical Engineering Research Institute, which has been responsible for the mechanical testing of all mine hoist components for many years, tackled a research project on non-destructive tests for hoist components.

Under the guidance of the Research Unit a management committee was formed to compile standard specifications for non-destructive testing of critical hoist components. The committee consists of representatives of mining concerns, steel manufacturers and component manufacturers. It is expected that the tests will now be rationalized and that most of the anomalies will be eliminated.

**Integrated logic arrays.** Since 1983, the National Electrical Engineering Research Institute, which has been

working on the development of committed integrated circuits for a decade, has been able to supply industry and also engineering faculties at a number of universities with prototypes of integrated logic arrays which are cheaper than the imported product. As premanufactured silicon chips with uncommitted logic arrays are used and the Institute has the required finishing facilities, it takes only a few weeks instead of months to complete the prototypes.

The Institute has supplemented its computer-aided design systems with a compact, cost-effective work station for the design of logic systems consisting of numerous elementary gates which can be combined in order to be realised in the form of semi-committed integrated circuits, as mentioned above. This work station, in conjunction with the rapid service for the manufacture of prototypes, will greatly encourage local manufacturers of electronic equipment to develop their own specific products.

**Improved design for rotor disc dc motor.** Research and development work done by the National Electrical Engineering Research Institute has led to a significant improvement in the efficiency of a disc-rotor type dc motor in which the magnetic field is created by electromagnets instead of permanent magnets.

It appears that the power of this type of motor can be increased by up to almost 30 per cent by giving the air gap between the poles of the magnet a certain shape rather than by using parallel pole surfaces. This improvement can be made to all kinds of disc rotor dc motors, and the added advantage for motors with permanent magnets is that magnet material can be saved.

The South African Inventions Development Corporation has applied for patent rights for the principle on which the improvement is based.

Work done by the Optical Sciences Division of the National Physical Research Laboratory.

The components of a thermal imaging optical system manufactured from the semiconductor materials silicon and germanium.





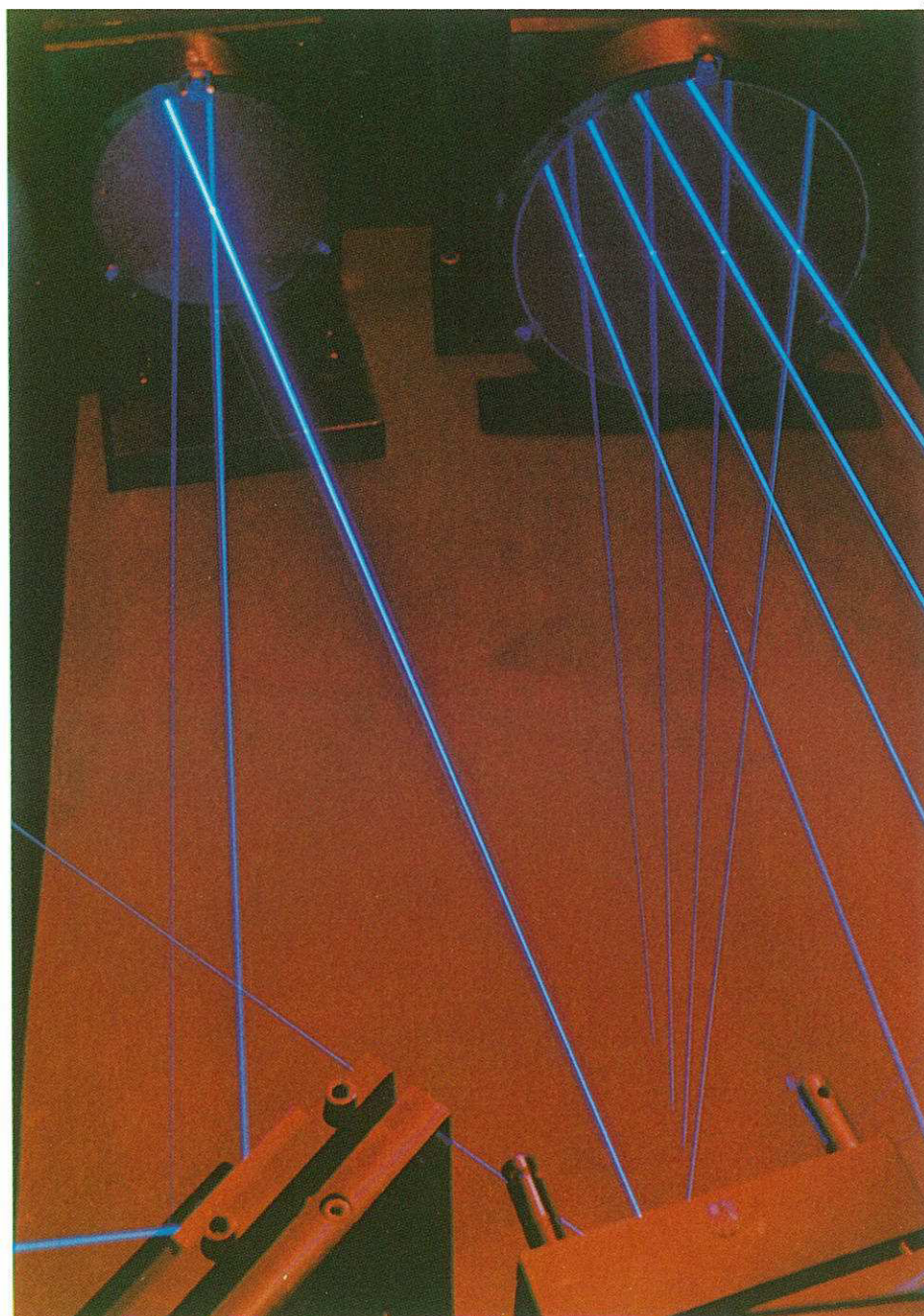
**Computer-integrated manufacturing and robotics.** After the necessary preliminary work by the National Electrical Engineering Research Institute, a Coordinating Committee for Research on Computer-integrated Manufacturing and Robotics was created in the year under review. There is a serious need for coordination in this field as it is expected that computer-integrated manufacturing (CIM) and robotics will play a very important role in South African industry in the future.

Local research in this field will focus on areas involving tasks which cannot be executed manually, or cases where these techniques can assist in upgrading the skills of unskilled workers. The Institute is undertaking projects aimed at developing expertise in the field of CIM and robotics by investigating applications considered to be of importance to South Africa. The aim is to investigate techniques by means of which the design, manufacture and testing of printed circuit boards can be integrated and automated where necessary. This project will include research into the best manipulator control techniques, vision inspection systems and pattern recognition techniques, and will be undertaken in close cooperation with other CSIR institutes.

A test bed consisting of a moving inspection table and manipulator or sensor control has been designed and assembled. Programmes which make use of a data base of the printed-circuit board design system are being developed.

The universities of Stellenbosch, Natal and the Witwatersrand have already tackled research in this field. More than 40 robots are already being used by South African industry.

**Processing performance of summer and winter mohair.** To elucidate the differences between winter and summer mohair the South African Wool and Textile Research Institute processed mohair from both a winter

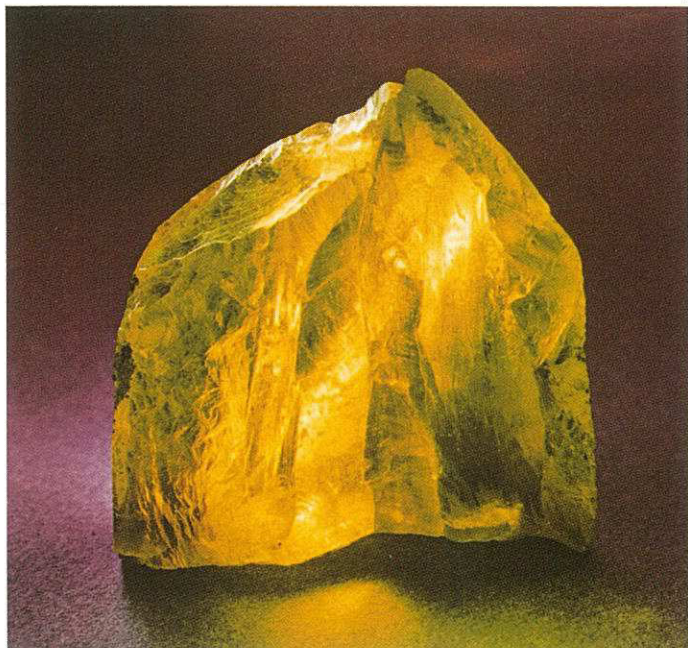


and a summer clip into tops, using the continental processing system. It was found that there was a direct relationship between differences in processing performance and differences in length and fibre diameter. There was no indication of other seasonal differences affecting the processing performance of mohair.

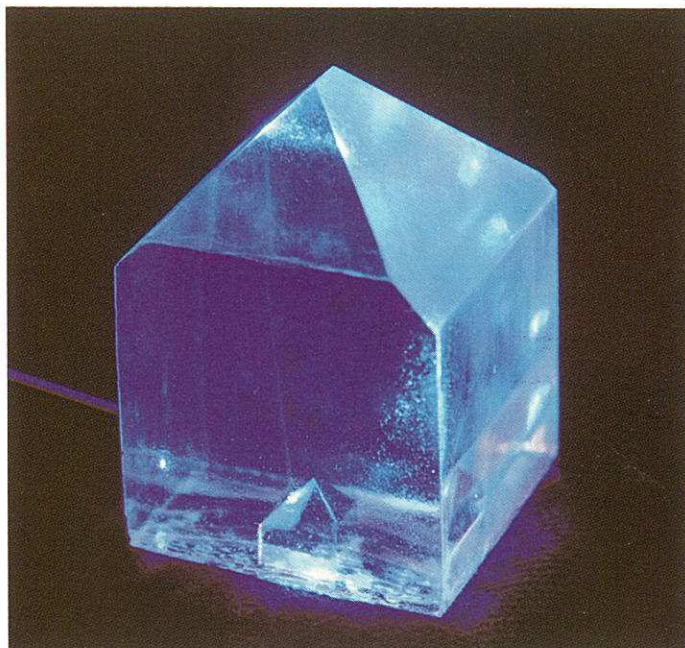
**Wrinkle meter for textiles.** An instrument which can determine the degree of wrinkling in fabrics has been manufactured by the South African Wool and Textile Research Institute. A microprocessor and video monitor are coupled to 'measure' the wrinkles in a piece of fabric, and the results are analysed by computer to give an idea of the wrinkle severity.



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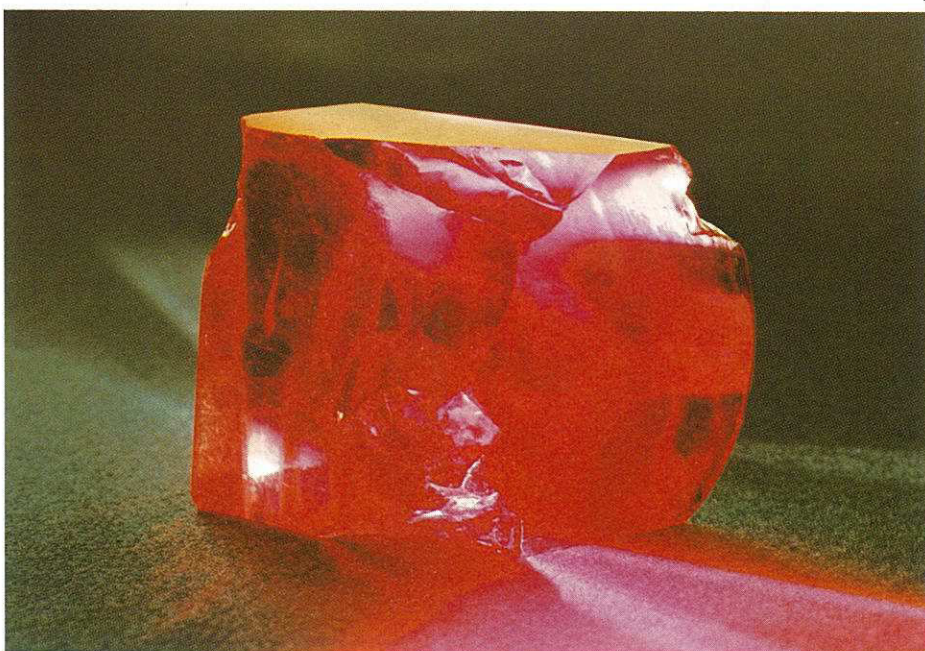
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## National Institute for Materials Research

1. Fluorescence induced by blue laser light is used for pressure calibration in miniature high pressure X-ray diffraction cells.
2. Doped cadmium fluoride crystal produced from the melt.
3. A ferroelectric crystal (8 cm side length) grown from water solution showing natural growth faces.
4. A crystal of doped manganese fluoride grown from the high temperature melt.

The instrument, known as the SAWTRI Wrinkle Meter, greatly simplifies and speeds up the process of wrinkle measurement and can therefore be very useful for research into methods of reducing fabric wrinkling.

**Dye fixing by radiofrequency energy.** The South African Wool and Textile Research Institute has found that when radiofrequency energy is used in textile dyeing the dipole moment of the dye has a considerable effect on the fixation of the dye. It was previously thought that the dye was fixed only by the heat of the



oscillating water molecules in the fibre.

The investigation also revealed that significantly higher temperatures could be obtained by using materials with high dipole moments, such as urea, instead of water as the dye carrier. At the higher temperatures dark shades can now be obtained by radiofrequency dyeing. The use of radiofrequency energy in the heating

process will result in significantly lower energy consumption.

**Textile machine on display.** An advanced automatic feeding mechanism for textile slivers developed by the South African Wool and Textile Research Institute was recently displayed at the International Textile Machinery Show in Milan. The National Electrical Engineering



Studies by the Chemical Engineering Research Group using Laser Doppler Velocimetry (LDV) in a T-junction. Two laser beams intersect inside a T-junction. Small particles in the fluid travelling through the intersection scatter light towards a photo-detector so that the speed of the particles can be measured. LDV is a non-intrusive technique to investigate fluid flow, and is used by the Chemical Engineering Research Group in manifold research.

Research Institute designed the electronic parts of the machine.

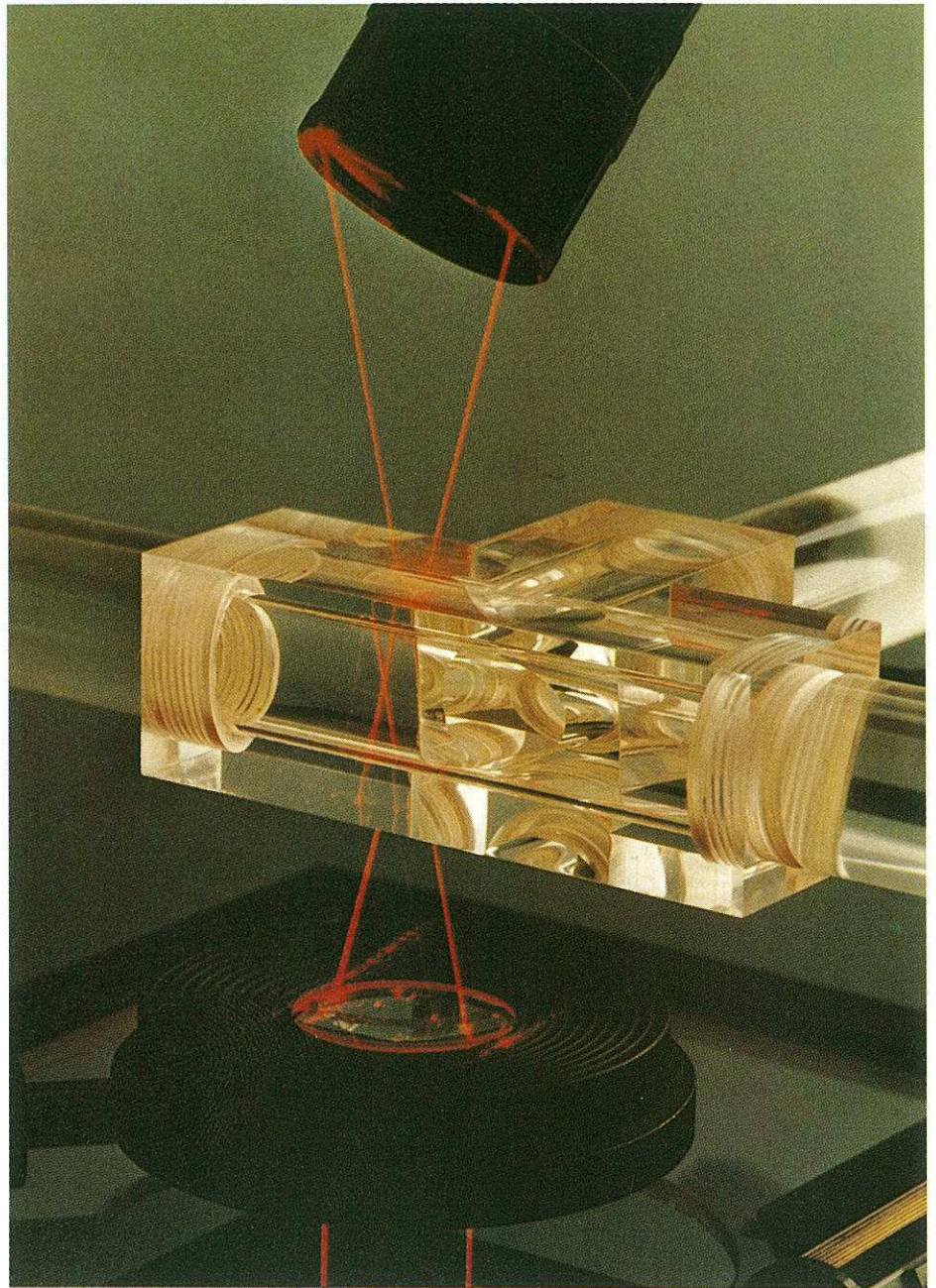
The South African Inventions Development Corporation awarded the manufacturing rights to an important foreign manufacturer of textile machinery who incorporated the mechanism into a fully automated gilling system.

**Cotton fibre and knit fabric performance.** Since many of the results of research on cotton fibre and cotton yarn do not apply to knit fabric, the South African Wool and Textile Research Institute decided to investigate the relationship between fibre properties, dye uptake and the properties of single jersey fabric.

A large variety of cotton lint samples from nine different cotton cultivation areas in South Africa was collected over eight growing seasons and converted into single jersey fabric.

It was found that the performance of the knit fabric and its dyeing properties depended on fibre properties rather than on cotton variety, except where the fibre properties concerned were affected by the variety. It was also found that the relationship between fibre properties and dyeing depended on the type of dyestuff. The bursting strength of the knit fabric depended mainly on fibre tenacity.

The findings of the investigation were announced in February at the International Cotton Testing Conference in Germany.



**Synthetic fibre properties.** The South African Wool and Textile Research Institute tested the physical properties of a series of synthetic fibres so as to be able to provide independent and specific information on their quality. The tensile strength, crimp and compression resistance of a large number of different batches of staple fibre, mainly polyester but also nylon and acrylic and a number of polypropylene fibres, were determined.

A table of average values for the various fibres was derived from the data obtained. This is a useful quality control and research reference.

**Ceramics for diamond synthesis.** A method for the evaluation of the shear strength of natural ceramic material used in diamond synthesis was developed by the National Institute for Materials Research. The ceramic must be able to withstand the



ultra-high pressure required during the synthesis. The method is already being used by the industry for quality control.

**Piezoelectric ceramics.** Piezoelectric ceramics produced by the National Institute for Materials Research are used in many types of underwater acoustic apparatus, such as telephones for divers to communicate with each other and with their ship.

A prototype ship's telephone with components of the ceramic material has been developed. It has excellent acoustic properties, and is much smaller than the older imported telephone.

**R & D programme for microelectronics.** Details of a national research and development strategy for microelectronics were submitted to the Scientific Advisory Council by the CSIR in 1983 to obtain financial support for the programme.

In the meanwhile, interested organizations have been invited to submit project proposals. Projects are evaluated for quality as well as relevance to strategy. Demonstration projects are being supported to make industry aware of local capabilities in the field of microelectronics. In one of these, for example, it was demonstrated how the components of a certain subsystem could be reduced from 99 to 25 by means of a special custom-made integrated circuit which would have definite advantages for the industry.

#### **New methods of hide preservation.**

One of the major achievements of the Leather Industries Research Institute

over the past years has been the development of hide preservation methods based on the use of biocides instead of large quantities of salt. These methods have been widely accepted by tanners and this has led to a considerable reduction in salt pollution.

The Institute is now investigating similar non-salt methods for the preservation of sheepskins. In view of the environmental constraints that industry may face in the future, the present research programme includes effluent recycling, chrome and lime recycling and the reduction or elimination of polluting chemicals.

**Training in the Leather Industry.** The Leather Industries Research Institute is expanding its training programme to meet the demand for qualified people who will be able to implement new technology in the leather industry. A new Footwear Training Centre was recently opened in Pietermaritzburg.

**Optimization of filter operation at sugar mills.** In a study of the continuous vacuum filtration processes used at sugar mills to recover sugar liquors from clarification sludges, the Sugar Milling Research Institute found that filtration efficiency was inversely proportional to specific cake resistance.

Improving the specific cake resistance therefore invariably leads to better filter operation. A number of other factors such as the quality of the filter aid and the type of flocculant used were also investigated.

The results of this study have already been applied and have

resulted in improvements in plant efficiency.

**Manufacturing technology information.** The National Institute for Informatics is responsible for the production of the weekly bulletin *Manufacturing Technology Reviews* (MTR). This information service alerts industry to the most important published articles of relevance to industry. The service is backed up by a bibliographic data base covering the technical journal literature from 1972 to date. The data base now contains 20 000 articles.

**Microprocessor-based process controller for sugar mills.** A two-loop version of the multiloop microprocessor-based process controller developed by the Sugar Milling Research Institute has been tested at the Mount Edgecombe sugar mill. As a result of the tests a number of changes were made, especially to the operator interface.

In addition a batch control version was installed on a vacuum pan at the Noodsberg sugar mill, additional data being displayed on the controller in the form of a mimic diagram.

**Refined sugar conditioning.** The Sugar Milling Research Institute introduced a method for conditioning refined sugar to prevent caking as a result of moisture migration when sugar is transported in bulk.

The sugar is dried in an insulated silo by warm dry air at 40 °C. After 72 hours it is loaded into insulated railway tankers and transported from Durban to specially designed storage silos at Germiston.



**Principal component analysis for satellite data processing.** Principal component analysis is used by the National Physical Research Laboratory for processing satellite data to be used in digital form for geological purposes. It is a specialized technique which was developed to enhance selected image characteristics. This method of data compression permits as much multi-channel information as possible to be displayed in a single image.

Data obtained from the Landsat satellite have been processed by this method, and used, amongst other things, for the compilation of a new geological map of the Barberton area and the search for water in South West Africa. With the increasing use of satellites with a larger number of channels, principal component analysis will be used to an even greater extent.

**Motor fuel from coal derivatives.** In an investigation into the conversion of coal derivatives such as methanol or dimethyl ether to motor fuel, the Chemical Engineering Research Group found that oligomerization plays the main role in the catalytic conversion of short olefinic hydrocarbon substances such as ethene and propene into higher olefins. Minor olefins can also be oligomerized if the hydrocarbons are prepared directly from synthesis gas (obtained from coal). In this way the preparation of methanol is eliminated.

**Satellite data for resources surveys.** The Satellite Remote Sensing Centre of the National Institute for Telecommunications Research is one of 15 centres for the direct reception of Landsat data used for studying natural resources. The information can be obtained from the Centre in the form of photographs or in digital form.

Meteosat data are also received and supplied to the Weather Bureau every half hour. Landsat data are used for

the identification and mapping of agricultural crops and natural vegetation systems, the monitoring of water quality, the estimation of flood damage and other purposes.

There will shortly be access to a new generation of resources satellites which will be able to provide data with a higher resolution, so that many of the present shortcomings will be eliminated. As the Centre will not be able to receive data direct from the new satellites owing to technical limitations, a number of satellite images of areas in South Africa will be obtained provisionally from NASA for evaluation purposes.

However, after a special survey the National Committee for Remote Sensing pointed out that in order to meet local requirements the facilities of the Centre will have to be upgraded so that the new information could be received direct.

**Mass spectrography for the determination of silicon purity.** A mass spectrographic technique for the determination of boron and phosphorus in solid silicon samples at minuscule trace element concentrations was developed by the National Institute for Materials Research.

These determinations are important as extremely pure silicon is required for the manufacture of electronic grade silicon for the electronics industry.

**Classification of coal.** The National Institute for Coal Research studied the connection between the reflectivity of vitrinite and the carbon content of the various coal macerals, namely vitrinite, exinite and inertinite, with the aim of determining the total carbon content of all ranks and types of South African coal.

Petrographic methods, such as the determination of the maceral composition and reflectivity of vitrinite, are being used increasingly in the classification of coal in order to determine the optimum utilization

potential of coal by, for instance, coking and liquefaction. The investigation showed that petrographic analysis could be used to great advantage in the classification of South African coals.

**Dry beneficiation of coal.** The National Institute for Coal Research built and tested a small plant for the continuous dry destoning of coal. The plant consists of an oscillating table with a deck through which a controlled air current is blown.

One of the advantages of this method of beneficiation is that good separations are achieved at high relative densities without the use of water. The acceptance of this technique by industry will be assessed in due course by a larger unit.

**Characterization and classification of coal.** The Department of Geology of the University of Pretoria and the National Institute for Coal Research carried out an investigation into the characterization and classification of South African coal. The investigation fell under the National Programme for Energy Research.

A published report on the study lists the chemical and physical properties of South African coal and proposes a fundamental classification system. The proposal will be presented at an international conference in 1985.

**Studies in marine geoscience yield valuable results.** Research projects undertaken by the National Research Institute for Oceanology in the field of marine geoscience are not only yielding scientific insights but are also proving to be of immediate practical value.

Two main programmes, Sediment Current Interaction and Agulhas Bank Geoscience, deal with the continental shelf off South Africa's east and south coasts respectively. Geophysical and sedimentological surveys have revealed sediment dispersal patterns that are very



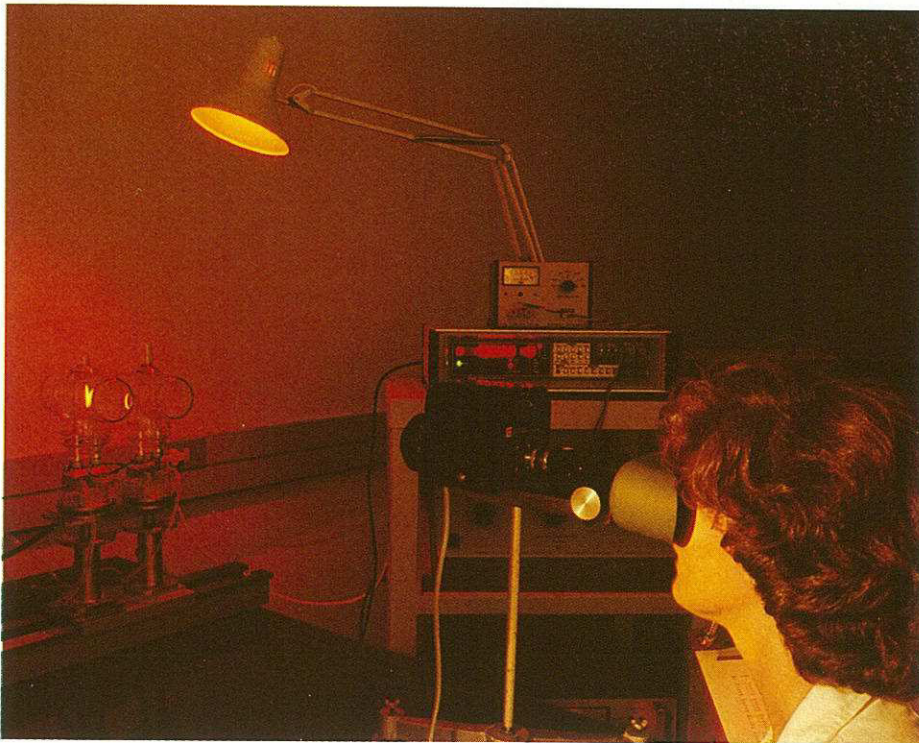
different from those off the Atlantic coast of North America or in the North Sea.

Off our east coast, the Agulhas Current vigorously transports shelf sediments and generates enormous submarine dunes up to 17 m high. Such features had previously only been found in areas of strong tidal currents. Off our south coast, sediment transported by the dominant south-westerly swells form huge submarine spit-bars beyond headlands such as Robberg Peninsula. The

unusual South African situation provides alternative facies models for sedimentary formations that evolved in the past.

The Institute's offshore surveys have also proved valuable to the local exploration industry. Soekor is studying the feasibility of piping gas ashore from the Agulhas Bank hydrocarbon reserves. Seismic reflection and sidescan sonar surveys are being used to map potential hazards to pipelines such as rocky ridges.

On the east coast, north of Richards Bay, heavy minerals such as titanium, which have accumulated in coastal sand dunes, are being exploited. Surveys by the Institute reveal the thickness of sediment which has accumulated in the adjacent continental shelf so that it is possible to gauge the volume of potentially titaniferous reserves offshore, and provide information on how these reserves may be worked without damaging the marine environment.



Calibration of optical pyrometers using high stability tungsten strip lamps in the National Measuring Standards and Metrology Division of the National Physical Research Laboratory.





**Nocturnal temperature inversion and pollution.** A method of extrapolating the temperature profile up to the inversion peak on the basis of measurements taken only at 1,2 and 9 m above ground level was developed by the National Physical Research Laboratory. Knowledge of the characteristics of temperature inversions is important since both the confinement of industrial pollution close to ground level and the reduced efficiency of dry cooling systems at power stations are caused by this phenomenon.

The usual methods of temperature profiling are costly when instrumented towers of up to 300 m high are used, and very labour intensive when instruments are sent up by balloon. With the new method the required data can be collected continuously and comparatively cheaply.

**Air pollution at Witbank.** In an ongoing cooperative programme studying 'acid deposition' in South Africa the Atmospheric Sciences Division of the National Physical Research Laboratory measures anions

such as sulphate and nitrate in airborne dust at 18 sites in the Transvaal and Orange Free State. High concentrations of sulphate were sometimes found at Ferrobank near Witbank and a more detailed short-term study was carried out at Ferrobank and four other points in Witbank at the end of 1983.

The concentrations of nitrates, phosphates and chlorides were low at all five points. The sulphate concentrations elsewhere in Witbank were no higher than elsewhere in the Eastern Transvaal Highveld, but at Ferrobank the daily sulphate concentration sometimes approached or exceeded the Californian 24-hour limit of  $25 \mu\text{g}/\text{m}^3$ . In addition at Ferrobank unusually high concentrations of vanadium were also observed during 1984. The Department of Health and Welfare was informed of these results and steps have been taken to reduce the pollution

**Desulphurization of flue gas.** A method of desulphurizing flue gas to reduce sulphur dioxide emission at power stations was recently tested by

1. The *RV Meiring Naudé*, research vessel of the CSIR's National Institute for Oceanology, which was commissioned in 1968. It is equipped for multidisciplinary oceanographic work with wet laboratory, electronics laboratory and biological/chemical laboratory.

2. Scale model tests being carried out to determine the vertical and horizontal motions due to irregular wave action of a model of a 150 000 dwt ore carrier used for coal export from Richards Bay Harbour. The test basin in the 40 x 45 m model hall at the National Research Institute for Oceanology is equipped with programmable irregular wave generators by means of which actual wave spectra recorded at Richards Bay can be simulated.

3. Part of the 80 x 140 m model hall at the National Research Institute for Oceanology — the photograph shows a large hydraulic model with mobile bottom material constructed for a study of beach improvement schemes along the False Bay coast.

the Chemical Engineering Research Group, first in the laboratory and then at the pilot plant of a foreign supplier of desulphurizing equipment. In contrast to other desulphurizing systems, this method, which involves the use of spray driers, does not require much water.

According to the test results 26 to 40 per cent of the sulphur dioxide can be removed from a typical flue gas by using fly-ash as the alkali source. If lime is added to the fly-ash, desulphurization of up to 88 per cent can be achieved.

The use of this method at power stations is now being investigated. Other methods for the elimination of sulphurous gases are, however, also being considered.

**Invaders in the fynbos biome.** After a workshop on exotic invaders in the fynbos biome organized in terms of the National Programme for Environmental Sciences, a report was published containing information on the extent, causes and ecological importance of the invasion as well as solutions to the problem.

A list of thirty plant invaders in





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order of severity of the threat was compiled - with the potential danger of every species indicated separately.

### **Man and environmental conservation.**

A new potential field of research, conservation behaviour, was described by the Nature Conservation Research Section under the National Programme for Environmental Sciences.

The socio-economic factors that may be the main causes of the deterioration of South Africa's natural environment, are complicated by ignorance and lack of understanding of man's dependence on his environment. Possibilities for research in this wide field are described in a publication that appeared early in the year. The subject will be discussed in more detail during a workshop scheduled for 1985.



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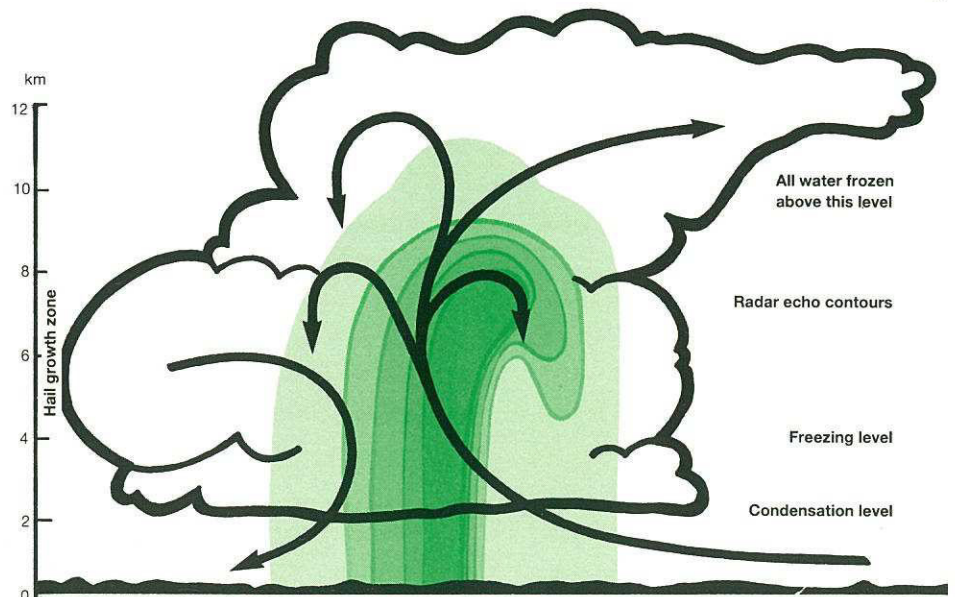
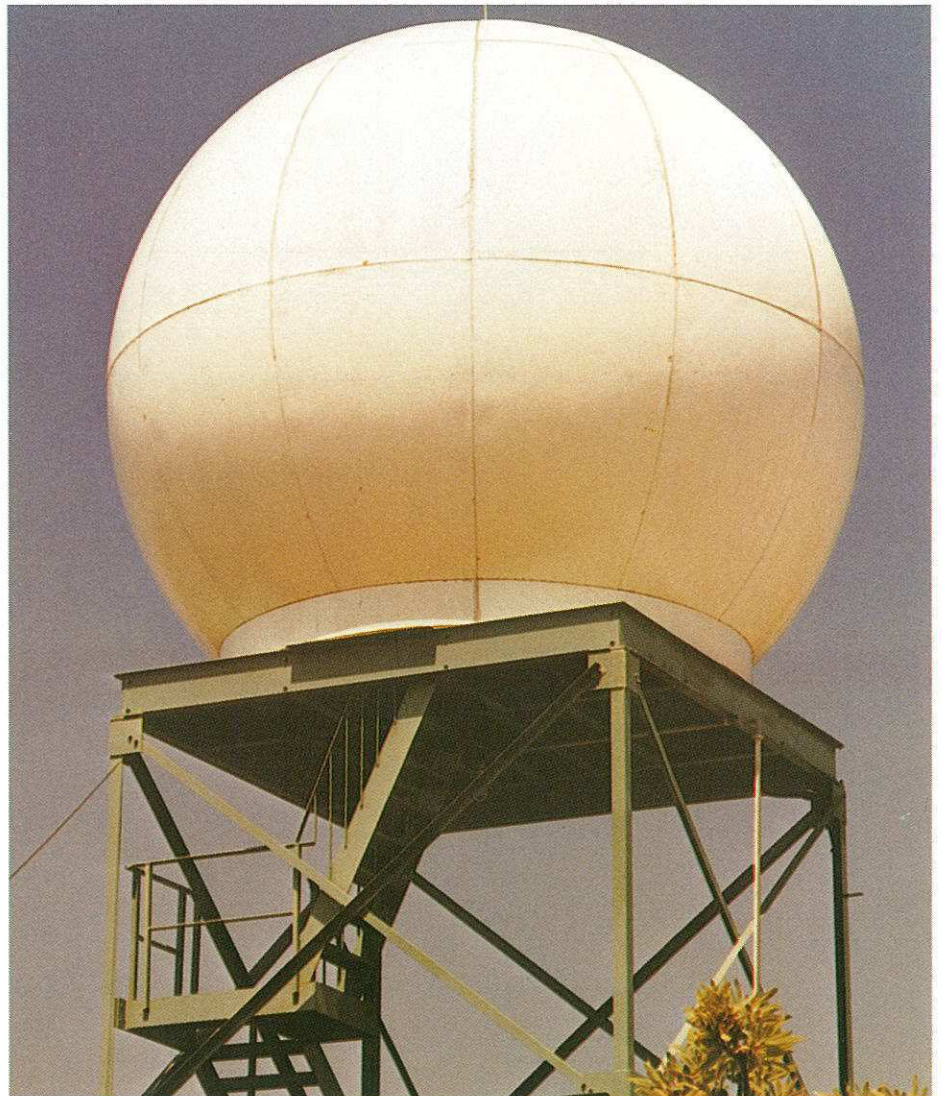
**Hydrodynamic and water quality estuary models.** For some years a one-dimensional hydrodynamic model has been used by the National Research Institute for Oceanology in studies of the hydrodynamics of estuaries. The Institute continues to give assistance in local applications of this model, particularly when it has to be adapted to meet special requirements.

The Institute also developed a one-dimensional transport dispersion model for use with the hydrodynamic model. Excellent results were obtained with this model in a study of the salinity distributions in the Knysna estuary where the extraction of fresh water for municipal uses is under consideration. Data on salinities in the estuary were used to calibrate the model and subsequently various fresh water inflow conditions were simulated. The model simulations were used with great success to predict the effect of the extraction of fresh water on the salinities in the estuary.

The program for the model is written in such a general way that a new application to another estuary merely requires the preparation of a new dataset to suit the new topography.

**Information on Cape estuaries.** The Estuarine and Coastal Research Unit (ECRU) of the National Research Institute for Oceanology has so far produced 23 reports on 28 estuaries, and a further 14 reports covering 25 estuaries are in preparation. This work is done under contract to the Department of the Environment.

ECRU was established in 1979 to contribute information relevant to the development of an effective management policy for the entire South African coastline; to compile syntheses of all available knowledge on the estuaries of the Cape between the Kei and Orange Rivers; to identify gaps in information, and to fill these gaps by research; to stimulate interest in this work at universities and other institutions; and





1. The new radar antenna on the CSIR's Pretoria site which, in conjunction with two other antennae, will help scientists from the National Physical Research Laboratory's Atmospheric Sciences Division to track storms.

2. A schematic representation of a thundercloud showing the varying degrees of precipitation detected by radar. From the central area, the hail growth zone, precipitation gradually gets lighter. Air flow, of basic importance in the formation of rain, hail and lightning, is indicated by the arrows within the cloud.

3. Diagram showing the location of the three radar antennae which will make up the new network to help scientists in their study of storms. The circles show the overlap at a 50 km range that occurs in the area covered by the three stations which feed data to the CSIR.

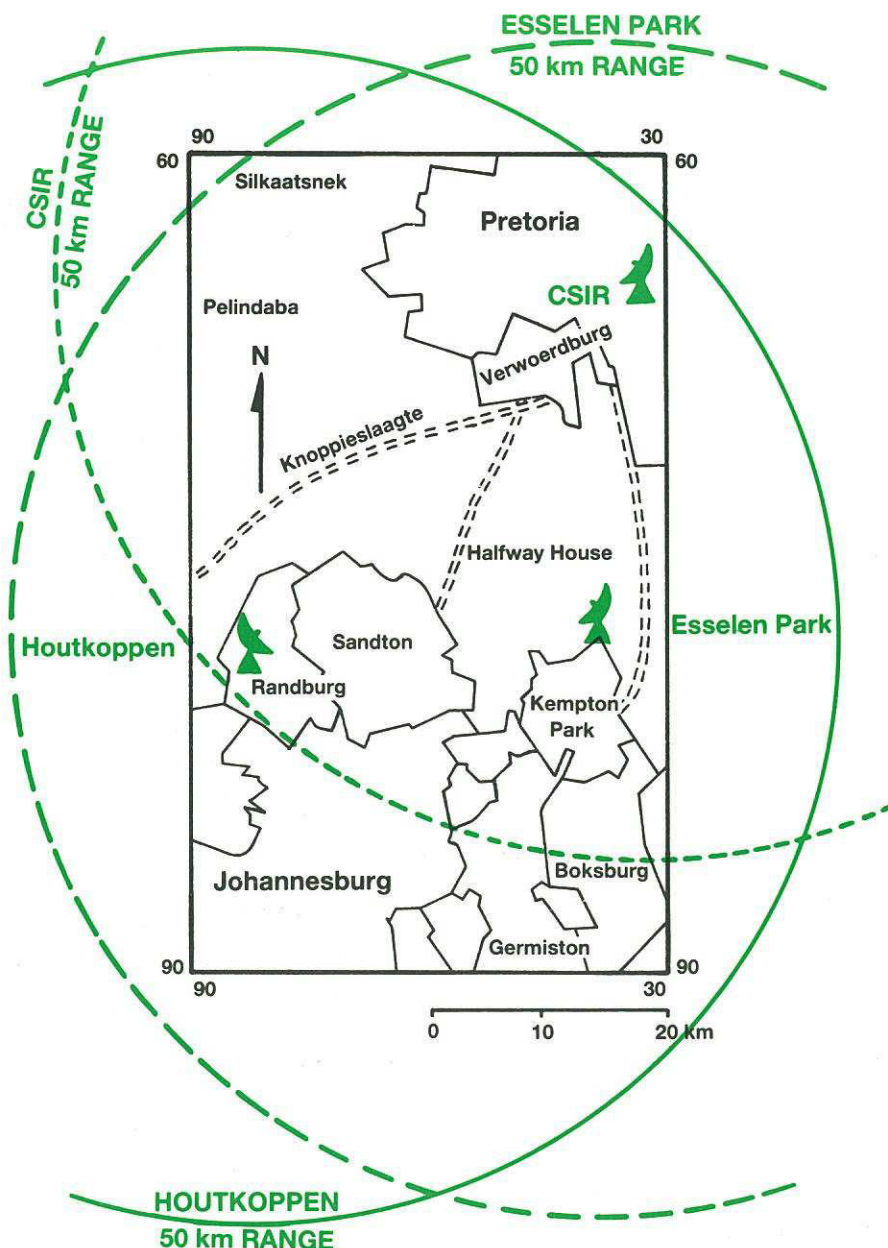
to contribute to ad hoc investigations on the impact of proposed developments in the coastal environment, especially in estuaries.

During the year under review the number of requests for ad hoc investigations increased considerably. A special working group was established to coordinate these investigations which often involve contributions from the coastal engineers of the Institute as well as the ECRU biologists.

**Study of Natal estuaries.** A hydrological/hydraulic study, aimed at acquiring an understanding of the long-term functioning of the estuaries of Natal, is being done by the National Research Institute for Oceanology for the Natal Town and Regional Planning Commission.

In the work schedule for 1979-1988 there are three phases: evaluation of available data; classification of the estuaries; and examination of specific problems in particular estuaries. The first phase has been completed and the second phase is under way.

To date twenty-one estuaries have been classified according to hydrological/hydraulic factors. Aerial photographs dating back to 1937 were used as the main data source.





**Activation of carbon-hydrogen bonds.**

Factors governing the activation of carbon-hydrogen bonds by certain iridium complexes have been studied at the National Chemical Research Laboratory. A new mechanism for the selective cleavage and formation of carbon-hydrogen bonds has been found in which the electrophilic character of the iridium atom played a dominant role.

**NMR service to researchers.** The nuclear magnetic resonance spectroscopy service, which the National Chemical Research Laboratory has been providing for the past 20 years in the fields of organic and inorganic chemistry to universities and other research organizations, was considerably expanded by the installation of a new 11,7 tesla Bruker NMR spectrometer.

Nuclear magnetic resonance spectroscopy is regarded as the most important physical technique for investigating chemical molecules. Owing to new developments such as superconductive magnet systems and Fourier transform and pulsing techniques, NMR spectroscopy can now also be used for studying macromolecules (such as proteins, nucleotides and polymers), solid state chemical compounds (such as coal and catalysts) and the chemical interaction in cells and tissues (for example in medicinal developments).

**Molecular structure of lolitrem B.** The molecular structure of lolitrem B, a tremorgenic mycotoxin which causes a nervous disorder known as ryegrass staggers in sheep, cattle and horses, was determined by nuclear magnetic resonance techniques at the National Chemical Research Laboratory. The investigation was undertaken in terms of an agreement with the New Zealand Ministry of Agriculture and Fisheries.

The lolitrems are produced by a fungus which infects ryegrass seed, and animals grazing in pastures

consisting mainly of ryegrass (*Lolium perenne*) are affected.

On the basis of the knowledge of lolitrem B gained at the CSIR, it may be possible to elucidate biochemical reactions in animals with ryegrass staggers and to find a suitable antidote to the mycotoxin.

**Structure of phomopsin A.** The National Chemical Research Laboratory, in collaboration with the Animal Health Division of the Australian research organization, the CSIRO, investigated the structure of phomopsin A, the most important toxin of the fungus *Phomopsis leptostromiformis* which infects lupins.

If sheep and other animals eat lupins infected with the fungus, they may contract a serious liver disease known as lupinosis. The disease is causing serious losses, particularly in Australia, and has already occurred in South Africa.

Phomopsin A is a previously undiscovered cyclic peptide which contains six unusual amino acids. The amino acid sequence was determined by nuclear magnetic resonance spectroscopy.

Knowledge of the toxin is essential for the development of an antidote for lupinosis, as well as techniques for investigating contaminated feedstuffs.

**Toxin from the sesbania plant.** In an investigation of the seed of the sesbania plant, the National Chemical Research Laboratory isolated the main toxin of the plant, sesbanimide, and determined its structure. The shrub *Sesbania punicea* is widespread in South Africa and because of its toxicity has been declared a noxious weed.

Although the investigation of the biological properties of sesbanimide is still in progress, this is one of the most dangerous plant toxins yet to have been isolated.

**X-ray crystallography for the determination of chemical structures.**

The National Chemical Research Laboratory recently acquired a modern single-crystal diffractometer with which accurate information on crystal structures can be obtained.

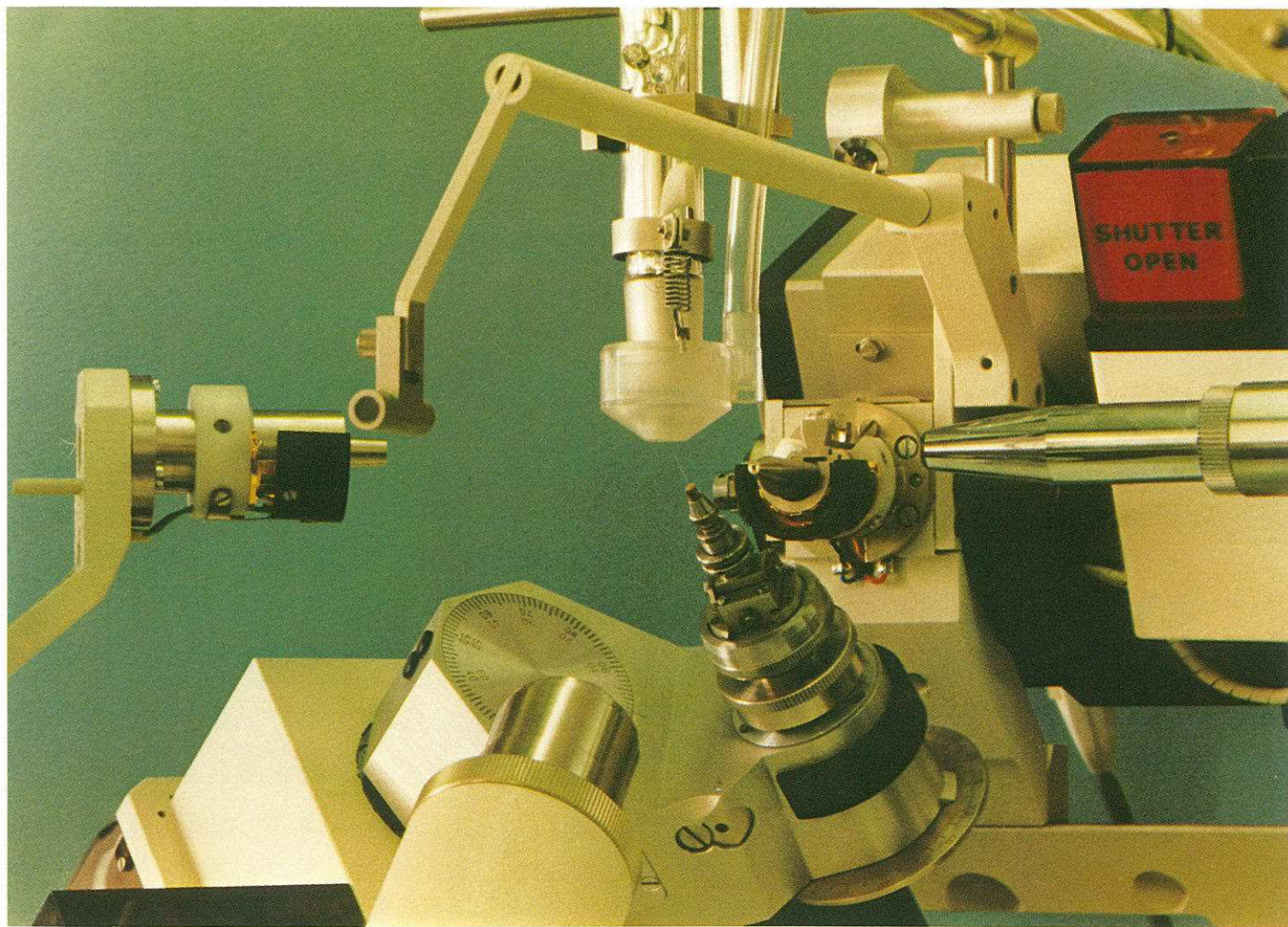
The Laboratory plays an important part in the field of structural chemistry, and has already determined the structure of several previously unknown compounds, such as fungal toxins, steroids and organometallic complexes. Information on the spatial structure of molecules is used, amongst other things, to develop better catalysts.

**New particle accelerator.** During the year under review, the National Accelerator Centre commissioned the first of two accelerators which will provide beams of accelerated charged particles for radiotherapy, for the manufacture of radioactive isotopes and for physical research. In the accelerator, known as an injector cyclotron, beams of charged particles are first accelerated to a speed of 39 000 km/s and then transferred to the other accelerator, a separated sector cyclotron, where they can be accelerated to a speed of 168 000 km/s.

The components for the two cyclotrons and the beam transport system were designed by staff of the Accelerator Centre and mostly manufactured in South Africa. The building complex with its power supply, switchgear, cable ducts and advanced water cooling system was designed in collaboration with South African consulting engineers, building consultants and architects.

**Astronomical observations.** To upgrade its facilities for infrared photometry, the South African Astronomical Observatory installed a special oscillating secondary mirror in its big reflecting telescope. New photometers for measuring the brightness of stars and for scanning





the sky at various wavelengths were also acquired.

A study of the infrared radiation from the nucleus of a number of unique galaxies undertaken by astronomers at the Observatory, in collaboration with researchers of the European Southern Observatory in Chile, seems to point to stellar eruptions every  $10^8$  years rather than to continuous star formation.

The possibility of massive black holes in the nuclei of Seyfert galaxies is also being investigated.

A British team working at Sutherland has begun to study a large hydrogen cloud with the aid of the two-dimensional digital detector installed in 1983. It was established that the optical radiation - if any - has a much lower surface luminosity than that of any other known galaxy.

Important information on dust clouds around and between stars was obtained through research at the Observatory. It was found that the star R Fornacis has become fainter since 1983 in the visible as well as the infrared spectrum owing to its light being absorbed by the dust surrounding it. This was one of the rare cases where the size of the dust particles around a star could be determined.

The Observatory also established that the same law governing the distribution of dust particles applied to our own galactic system and the Small Magellanic Cloud.

**Observation of geomagnetic pulsations.** In a collaborative project between the Magnetic Observatory and the Department of Physics at Rhodes University, measurements of

The new four circle X-ray diffractometer installed at the National Chemical Research Laboratory to be used for the National Data Collection Service. The instrument collects diffraction data from single crystals so that the three-dimensional structure of the molecules can be determined.

various ionospheric parameters were made using a digital chirp ionosonde during periods of occurrence of geomagnetic pulsations. It was found that when geomagnetic pulsations in the period range 15-25 seconds are observed at ground level, the phase path of a fixed frequency radio wave reflected from the ionosphere oscillates at the same period. These oscillations can be ascribed partly to the oscillating electric field in the ionosphere and can be used to compute its east-west component.



This technique has not been used before and is significantly more sensitive than the incoherent scatter radar technique previously used.

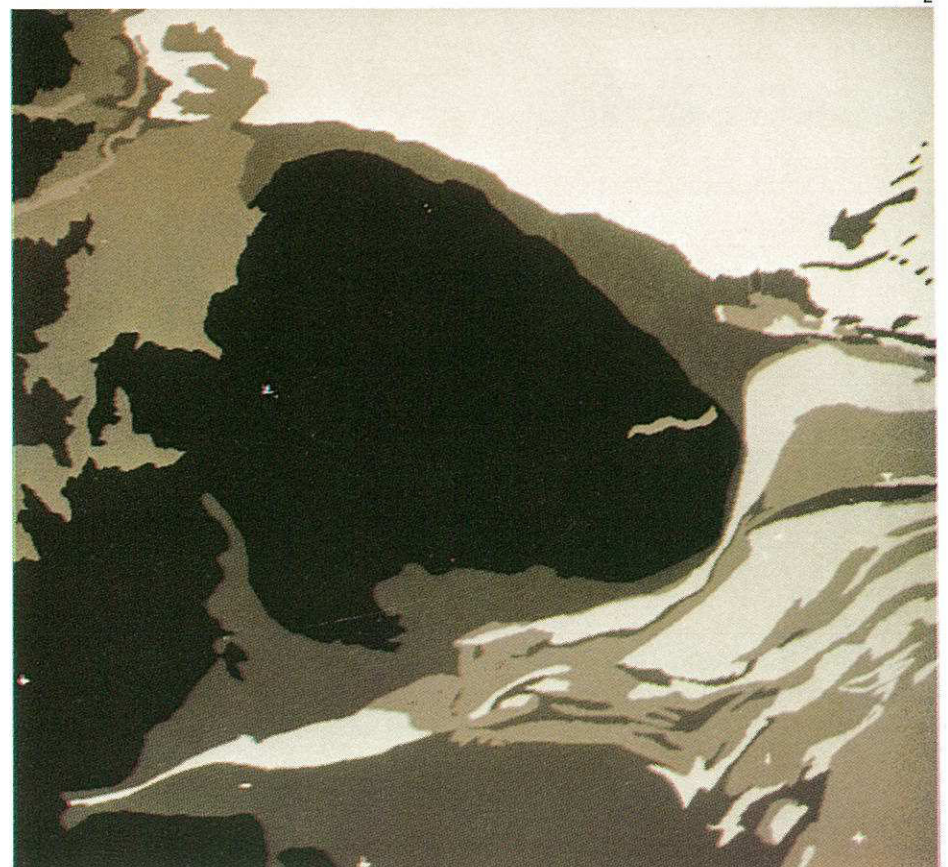
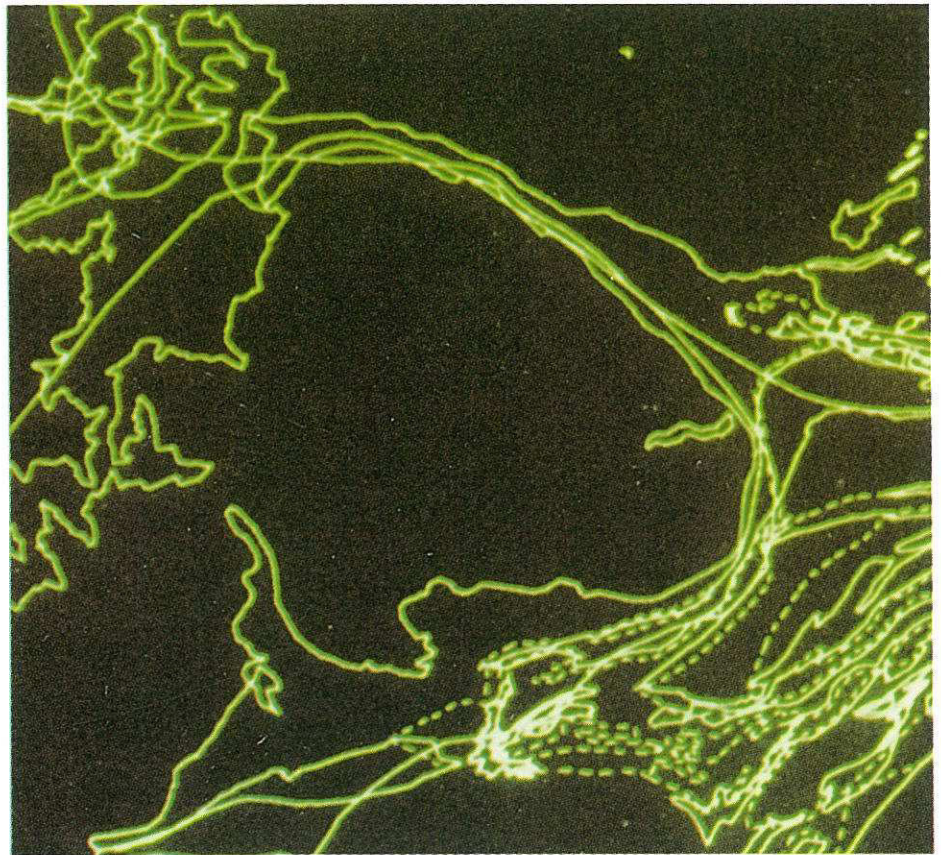
Certain types of geomagnetic pulsations can be regarded as resonant oscillations of geomagnetic field lines. The frequency of oscillation depends on the field line length and the plasma density along the field line. Most pulsations observed to date have been interpreted as half- or full-wave oscillations, but theory predicts that quarter-wave resonances are possible.

During July 1983, the Magnetic Observatory at Gough Island, Sutherland and Graaff-Reinet recorded pulsations lying along an east-west line at a geomagnetic latitude of  $-40^\circ$ . At Sutherland and Graaff-Reinet the dominant frequency of the pulsations decreased gradually through the day from 60 to 45 mHz as would be expected for half-wave resonance at  $40^\circ$  latitude. At Gough Island the frequency increased from 35 to 65 mHz with a significant jump at approximately 10h30 UT. Investigations are aimed at determining whether the jump in frequency was due to a change from quarter- to half-wave resonance or to a sudden decrease in plasma density along the field line.

**Cooperation in radio astronomy.** The Radio Astronomy Observatory of the National Institute for Telecommunications Research participated in various international observation projects where exceptionally high image resolution was achieved by means of simultaneous coherent observations at widely spaced observatories.

As a result of the Observatory's experience of the VLBL (very long base line) technique it is often asked to participate in such international observation projects.

**The study of pulsars.** The Radio Astronomy Observatory of the National Institute for Telecommunications Research developed special





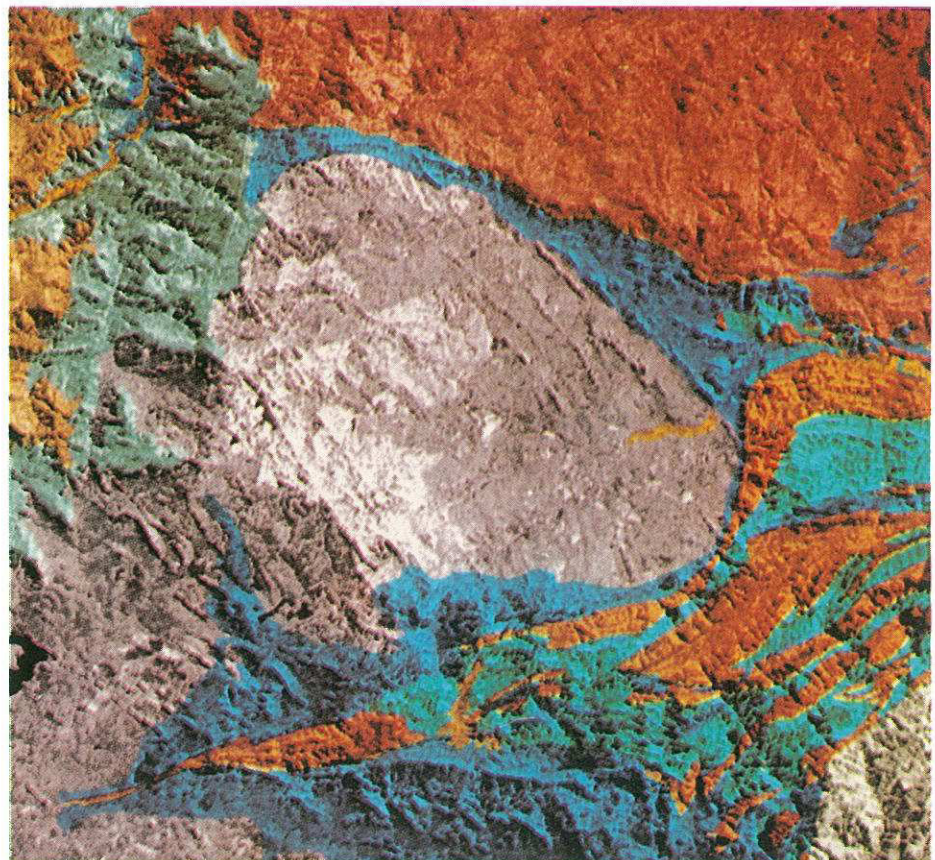
## Digital integration of a geological map with a satellite image

A project was undertaken by the Optical Sciences Division of the National Physical Research Laboratory to investigate computerized techniques of combining geology maps with suitably processed satellite imagery to display the relationship between bedrock geology and surface topography. The computerized cartography system being developed at the Computer Science Division of the National Research Institute for Mathematical Sciences was used to computerize and rasterize the geological map data, and the image processing was done at the National Physical Research Laboratory.

1. Vector format map of geological stratigraphic boundaries, hand-digitized from a simplified version of the 2530 Barberton 1:250 000 Geological Series map sheet.
2. The geological map rendered suitable for image processing by rasterizing the vector data according to fixed priorities. Each outcrop area is represented by an arbitrary number displayed as distinguishable grey levels.
3. A Landsat MSS edge-enhanced First Principle Component image of the same area, consisting of a weighted average of all spectral bands to emphasize topography through solar shadowing.
4. The integrated map image. The satellite image was registered to the map by means of ground control points transferred from a topographical map, and the colour was synthesized by a colour transformation.



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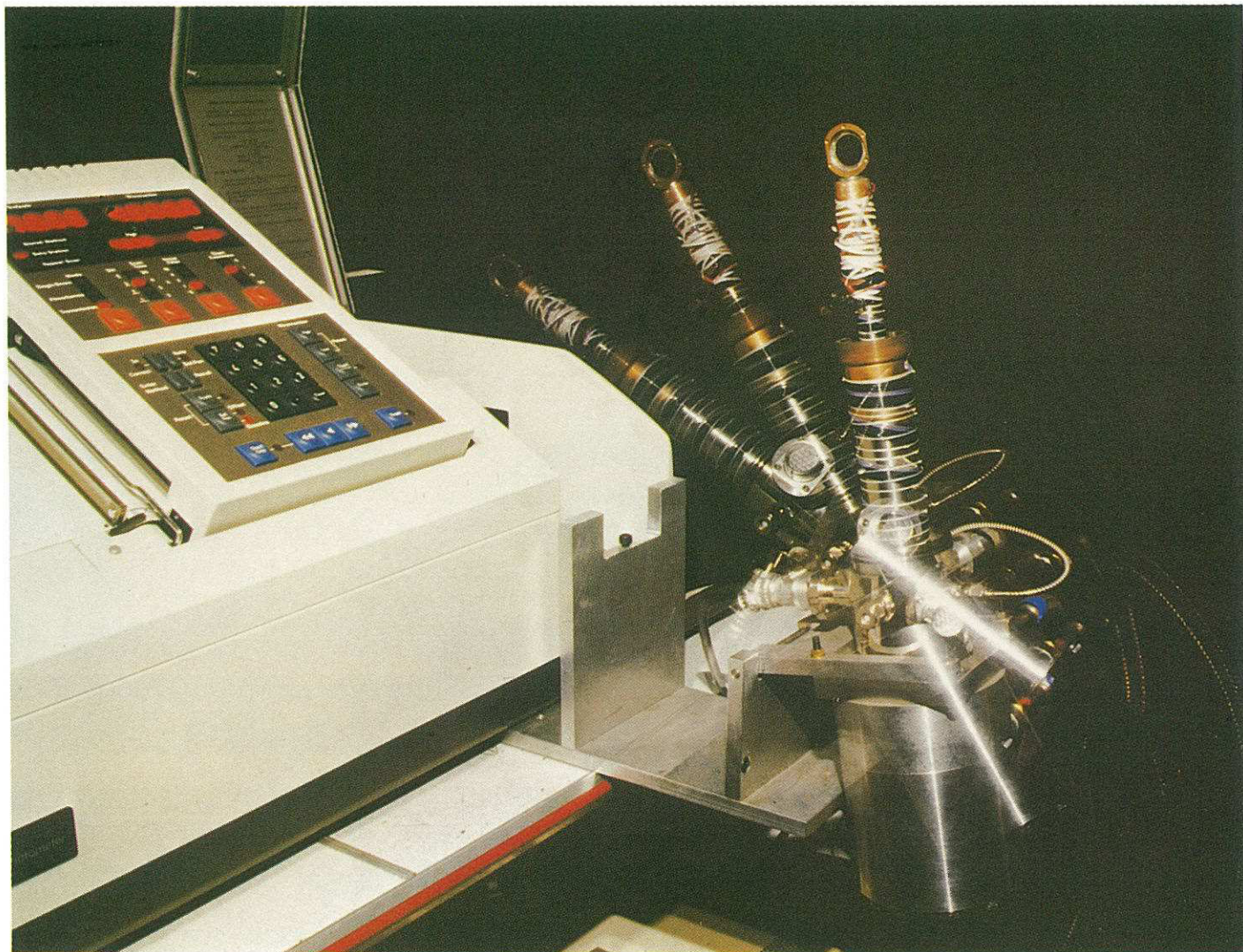


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equipment for determining the arrival times of the radio emissions of pulsars. Astronomers can use this apparatus to study changes and discontinuous deviations in pulsar periods.

The work is of international importance, *inter alia* as far as testing theories on matter at very high nuclear densities is concerned.





**Accurate determination of long base lines.** The Radio Astronomy Observatory of the National Institute for Telecommunications Research collaborated with the University of Bonn to determine the distance between the radiotelescopes at Hartebeesthoek and at Madrid, Spain. The distance was measured to an accuracy of one metre by a specialized interferometric technique.

The results of this work are applicable to geodynamics and the dynamics of the earth's crust which require measurements of long distances to an accuracy of 10 cm. With the improvements to equipment at present being carried out at Hartebeesthoek, this degree of accuracy should be reached within a few years.

**Ferritic nitrocarburising.** A simple method for the structural analysis of the surface layer of iron-carbon nitride formed during ferritic nitrocarburising of steel was developed by the National Institute for Materials Research. The method consists of evaluation by optical microscope and the results are confirmed by X-ray diffractometer data.

Ferritic nitrocarburising is a heat-treatment process that has long been used in industry to reduce adhesive wear in steel and to improve seizure resistance. Until now, however, there was no simple reliable method of characterizing the structure of the surface layer.

The infrared spectrophotometer used in the Electronic Materials Division of the National Institute for Materials Research. The instrument is fitted with a closed-cycle cryostat which permits low temperature spectrometry of thin semiconductor wafers. The arm of the instrument was photographed in three different positions to show how it is operated.

**Conductivity of material under high pressure.** The National Institute for Materials Research has developed a method for measuring the thermal conductivity of materials under high pressure. The technique can be applied to obtain useful data for the synthetic diamond industry and also to study fundamental aspects of solid state physics.

The Institute is collaborating with international groups on the standard-



ization and comparison of experimental methods.

**American/South African research cruises.** The most comprehensive and intensive research of the southern reaches of the Agulhas Current was done during cruises in November and December 1983.

This region, where the Agulhas Current penetrates the Southern Ocean south of Africa, is characterized by dynamic processes which cause dramatic changes in the locations of ocean currents and ocean fronts over short periods. It has been established by satellite remote sensing that the dynamic variations in this region are some of the highest in the oceans of the world.

The project for intensive observations in the region was supported by research groups from five American institutions and seven South African organizations, amongst others the National Research Institute for Oceanology.

A research cruise aboard the *R V Knorr*, the largest vessel in the United States research fleet, was the main part of the study. During this multidisciplinary study many readings were taken (some to a depth of 5 km), and included measurements of salinity, temperature, oxygen, nutrients, helium and tritium. Certain biological aspects were also studied, such as the distribution of bird species, chlorophyll and zooplankton.

Real-time satellite coverage of the ocean was provided to the ship by the

CSIR, which is the first time this was done in the Southern Hemisphere. In addition, information on the movements of a large number of drifting weather buoys, placed in strategic positions in the circulation patterns before and during the cruise, were provided to the ship via satellite during the cruise in support of the day-to-day planning. Supplementary readings in the same region were taken before and during the main cruise by three South African vessels, the *R V Meiring Naudé*, the *S A Agulhas* and *Africana*.

The new data collected are being processed and the first symposium was held in Stellenbosch by the South African contingent. There has been increasing interest in the United States and a further cruise on the *R V Thomas Washington* is being planned for February/March 1985.

**Agulhas Bank plankton.** As part of its Agulhas Bank Studies Programme the National Research Institute for Oceanology is investigating plankton dynamics in relation to water column structure, especially thermocline development. The diversity of the measurements necessitates a multidisciplinary approach to the investigation.

Attention was focused on the western section of the Agulhas Bank because this is an important spawning area for the commercially significant anchovy, *Engraulis capensis*. As anchovy are serial spawners they require a large food supplement to

maintain spawning activity. The spawning fish are planktivorous and thus need an abundance of plankton in terms of biomass or a sufficiently high rate of plankton production.

There were three research cruises aboard the CSIR research ship the *Meiring Naudé* in the year under review. The main aim was to study phytoplankton and zooplankton biomass distributions, but some primary production measurements and required nitrogen flux estimates were also made. The cruises confirmed hypotheses on the vertical distribution of plankton which were based on previous physical oceanographic investigations in the area.

**Study of the sedimentation processes.** The National Research Institute for Oceanology is involved in a field exercise for the collection of data on sedimentation processes in coastal waters and estuaries. The objective is to acquire a better understanding of these processes and to broaden the data base.

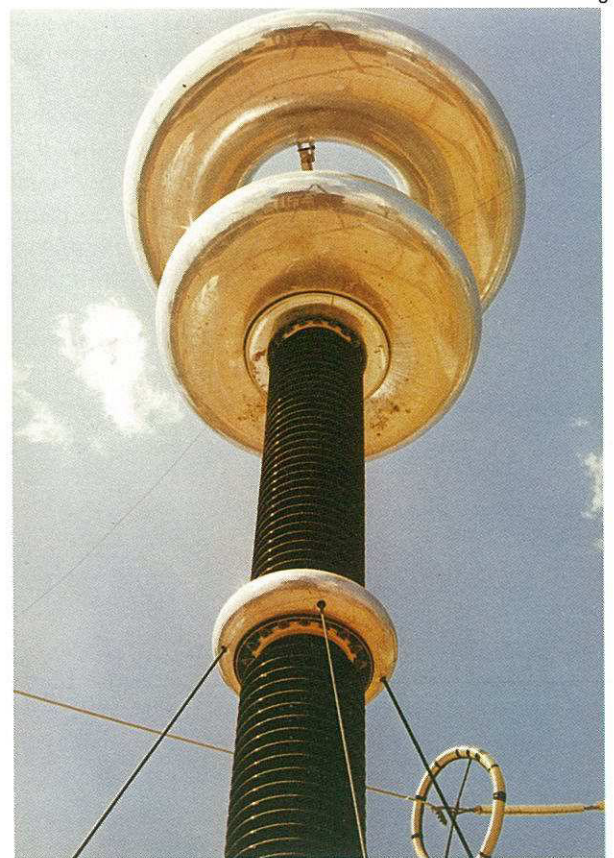
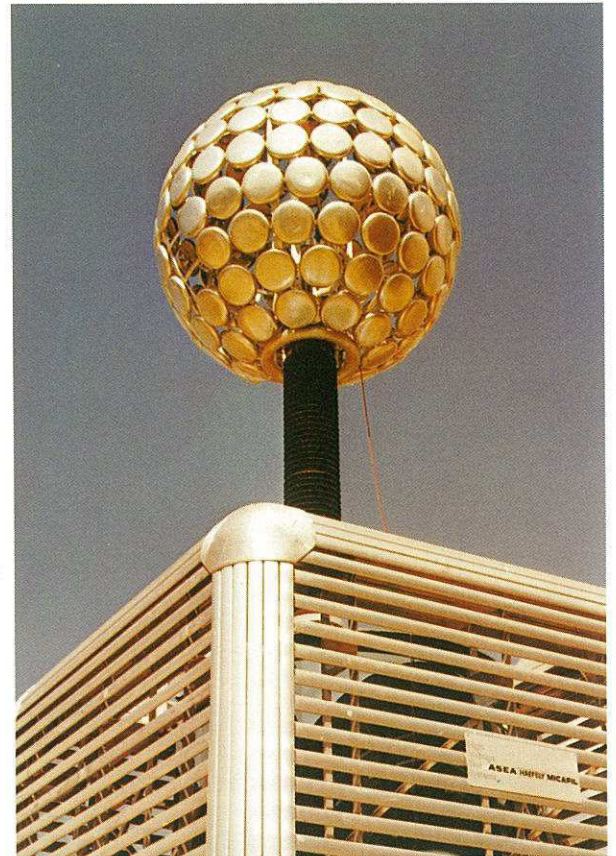
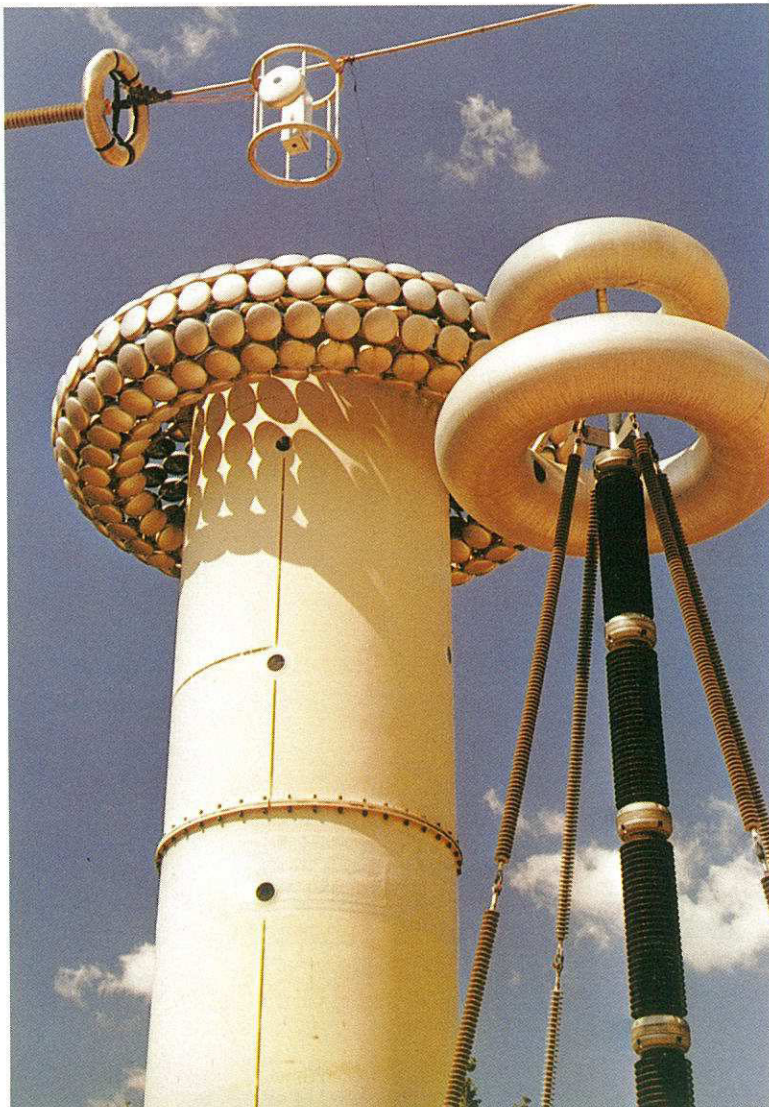
This work was initiated in collaboration with the University of Port Elizabeth as a follow-up of earlier beach ecology studies undertaken by the University with funding from the South African National Committee for Oceanographic Research.



**The high voltage research facilities in the outdoor test area of the National Electrical Engineering Research Institute.**

Laboratory operations comprise fundamental research into the withstand characteristics of long air-gaps, with particular emphasis on the joint influence of atmospheric and geometric correction factors. The primary objective will be to develop improved background knowledge of the engineering parameters appropriate to the efficient design of high-voltage systems for use at the high altitudes in many parts of the country.

1. A 316 MV impulse generator and voltage divider in the foreground, and top left, an experimental conductor for crossed conductor breakdown tests with a fibre-optic transducer for charge measurements.
2. Upper stage with 1 MV AC electrode of 2 x 500 kV cascaded test transformer set capable of supplying 1 A continuously.
3. Voltage divider for 1 MV AC test transformer cascade.





**Lightning research: assistance to Brazil.** A contract to the value of more than R400 000 was signed by the National Electrical Engineering Research Institute for the design, supply and installation of equipment for a research project on lightning parameters which is to be carried out for a Brazilian electricity supply company.

This project, which has been financed by the World Bank, includes the construction of a sophisticated installation for the measurement of lightning current on a specially designed microwave tower, the supply of magnetic links and instruments for the measurement of lightning current peaks, and the supply of closed-circuit television systems and special camera systems for the observation and measurement of lightning striking distances.

The Institute also advised the company concerned on the choice of the most suitable site for the erection of the research station, and the basic design of the station.

Cooperation with Brazil in the realization of this project not only ensures recognition of South Africa's expertise, but also offers access to information which could prove valuable for local research programmes.

**High-voltage research.** As reported last year, the National Electrical Engineering Research Institute concluded an agreement with a subcontractor of the Electrical Power Research Institute (EPRI) in the USA with a view to participating in an international research programme for flash-over testing of air gaps under various environmental conditions.

The purpose of this programme is to develop improved techniques for the electrical and structural design of medium-voltage transmission lines.

Cooperation in this field is continuing.

**National measuring standard for electricity.** The national measuring

standard for the transfer of alternating and direct current voltage was put into operation at the National Measuring Standards and Metrology Division of the National Physical Research Laboratory with the assistance of an expert from the National Laboratory in West Germany.

**Analysis of water from the Dead Sea.** Water from the Dead Sea in Israel is being investigated by the National Physical Research Laboratory in collaboration with the Weizmann Institute. The aim of the study is to determine the interaction between atmospheric carbon dioxide and carbon in the water as well as the circulation pattern of the water.

In this connection, a staff member of the Laboratory visited the Weizmann Institute for two months in terms of the exchange agreement between the CSIR and the Israel National Council for Research and Development.

**Van de Graaff accelerator reaches 100 000 hours.** The Van de Graaff accelerator, which was installed at Faure in 1963/64, recently reached a total operating time of 100 000 hours.

The accelerator, which was originally the nuclear research facility of the Southern Universities, is now a national facility and is part of the National Accelerator Centre. It serves approximately 70 scientists and 25 institutions, some of them in the USA and Germany.

**Integrated circuit design.** A seminar on integrated circuit design in South Africa was held in October 1984 under the auspices of the National R&D Programme for Micro-electronics.

The development of the expertise required to design integrated circuits is one of the priorities emphasized in the National R&D Strategy for Microelectronics. Several projects have been undertaken towards this end and steps are being taken to

transfer knowledge to industry, in view of the positive effect that capability in this field could have on the competitiveness of our final products.

Almost 70 per cent of those who attended the seminar represented industrial interests so that it was possible to analyse case studies and to review the latest technological developments.

**Information on urban engineering services.** Guidelines for the provision of urban engineering services drawn up by a steering committee of the National Building Research Institute were published by the Department of Community Development and are at present being tested by local authorities and other organizations.

In March the Institute presented a series of seminars in the country's most important centres to explain the guidelines to the organizations involved.

**NBRI regional office in Bloemfontein.**

An annual Treasury grant and financial support from the local building community enabled the National Building Research Institute to open a regional office for the Central Region (Orange Free State, Northern Cape and South Western Transvaal) in Bloemfontein on 1 August. The office will be housed provisionally at the Department of Architecture of the University of the Orange Free State.

**Treatment of polluted seabirds.** With the support of the South African National Committee for Oceanographic Research a member of the Sea Fisheries Research Institute visited the Oiled Bird Rehabilitation Centre in Somerset, England, to study the methods of this experienced institution.

Information on the care of polluted seabirds and the organization of the centre are now being studied at the University of Port Elizabeth with a



view to improving the methods used in South Africa.

**Water supply and sanitation.** A seminar on the introduction of appropriate technology for water supply and sanitation was held at Thohoyandou in Venda from 26 to 29 March 1984 under the auspices of the National Institute for Water Research. This seminar, which was organized by the Symposium Secretariat of the CSIR, was part of South Africa's contribution to the United Nations' International Water Supply and Sanitation Decade. It was attended by 70 delegates from national and independent Black states and 100 consulting engineers and representatives of government departments and interested organizations from the Republic of South Africa.

The practical experience gained by South Africa during the last decade in providing neighbouring states with water supply and sanitation technology was conveyed to the representatives of developing areas. The most important conclusion was that there was an urgent need for training and education.

**Theory and applications of state estimation.** A seminar on the theory and applications of state estimation was presented from 1 to 3 February 1984 by the National Research Institute for Mathematical Sciences. The purpose of the seminar was to present and explain the theory and techniques developed during the last decade in nonlinear filtering to researchers and practitioners in this field.

It was the fifth in a series of such summer seminars, and was attended by 74 scientists and engineers from industry, universities, technikons and other CSIR institutes.

**Lightning warning system.** Members of the National Electrical Engineering Research Institute, together with the firm Spescom Ltd, received one of the

1984 Shell Design Awards for the production of a unique lightning warning system. This system was originally designed for use in collieries, where premature ignition of electronic detonators could give rise to considerable problems.

The lightning warning system has been patented, and commercial production is being undertaken by Spescom Ltd. The use of this system, which provides a reliable and objective indication of storm conditions, can cause the suspension of activities owing to an approaching storm to be considerably reduced. The system may also be extremely valuable at fuel depots, electrical installations, civil engineering sites, and any other areas where explosives are used.

**Limnology in the Southern Hemisphere.** An international conference on limnology in the Southern Hemisphere was held at the Wilderness in July under the auspices of the International Society for Theoretic and Applied Limnology and the Programme for Inland Water Ecosystems.

The matters discussed included the existing knowledge of inland waters in the Southern Hemisphere and the application in the Southern Hemisphere of limnological principles developed in the Northern Hemisphere.

**International oceanographic study project.** A group of 21 deep-sea oceanographers of the South African National Antarctic Programme took part in SIBEX 1 on board the *S A Agulhas*. It was the first phase of an extensive international study of the biology and oceanography of the Southern Ocean. Research was done on a variety of oceanographic subjects in the Indian Ocean sector of the Southern Ocean. SIBEX 2, the second phase of the investigation, will be completed early in 1985.

SIBEX (Second International Biomass Experiment) will concentrate

on three target areas in the Atlantic, Indian and Pacific Ocean sectors of the Southern Ocean. South Africa, with Japan, France and Australia, is involved in research in the Indian Ocean sector.

The BIOMASS Programme (Biological Investigation of Marine Antarctic Systems and Stocks) is supported by member countries of the Scientific Committee for Antarctic Research on which South Africa is represented by the CSIR.

**Liaison offices abroad.** The CSIR's liaison offices in Washington and Los Angeles, in collaboration with the organization People-to-People, arranged a visit by a delegation of South African research administrators to several research organizations in the United States. The delegation consisted of members of the CSIR Executive, heads of statutory organizations and government departments, rectors of universities and directors of technikons.

During the year under review the offices in London, Paris, Bonn, Washington and Los Angeles organized about 950 overseas visits for South African scientists, dealt with more than 12 000 requests for document delivery and handled about 700 job applications by scientists and technicians on behalf of the CSIR and its sister organizations.

**Semiconductor research and development.** The National Institute for Materials Research organized a workshop to determine areas of cooperation between the Republic of China and South Africa in the field of semiconductor research and development. The workshop was held at the CSIR Conference Centre in Pretoria from 7 to 11 May 1984.

A delegation of four specialists, under the leadership of Dr Choh H Li, Director, National Science Council of Taiwan, met not only South African scientists and engineers active in the field of semiconductors, but also representatives



from industry, universities and statutory organizations.

The workshop was the result of a wider agreement between South Africa and the Republic of China to promote scientific and technological research.

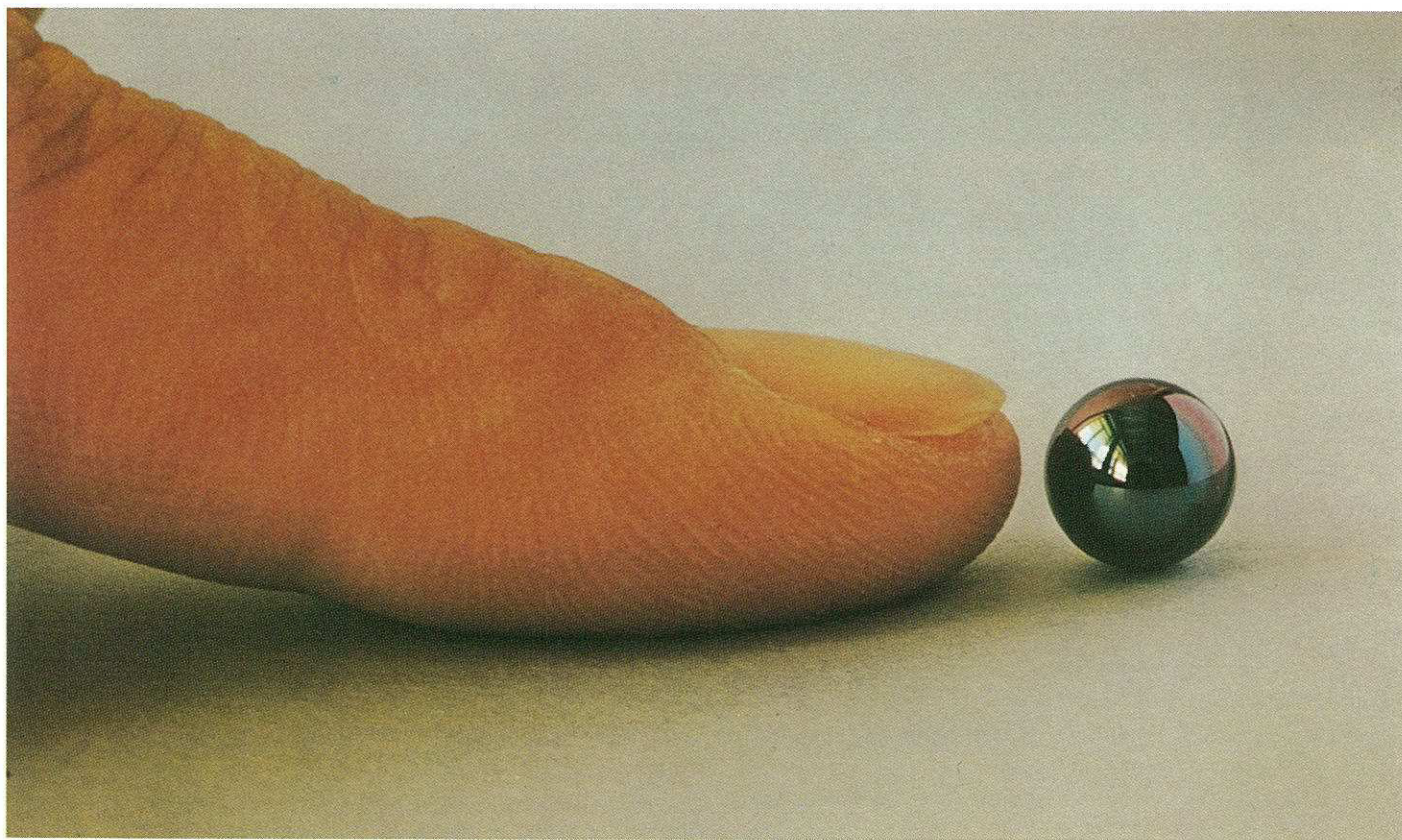
**New experimental tannery.** In October the Deputy Minister of Agricultural Economics and Water Affairs, the Honourable G J Kotzé, officially opened the Shuttleworth Experimental Tannery at the Leather

Industries Research Institute (LIRI) in Grahamstown.

The new tannery, which was named after LIRI's former Director, now enables the Institute to process more hides in tanning experiments. It also assisted with the development of the new mimosa/aluminium tanning process in which considerable interest is being shown abroad.

The expansion was made possible by special donations from all sectors of the leather industry, the Meat Board and the CSIR.

**Chemical Information Service.** The National Institute for Informatics introduced a specialized chemical information service which enables scientists to search for chemical substances sharing structural characteristics. A search can thus be done on the basis of a structural characteristic without knowing the name of the substance. With the aid of a computer graphics terminal, chemical substructures can be built on-line, adding or replacing atoms and specifying bonds.



Silicon ball lens anti-reflection coated by a novel oxidation process by the Optical Sciences Division of the National Physical Research Laboratory.



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## Visitors

**Dr H-C Fang**, President of the Research Institute for Industrial Technology in Taiwan, two of his senior colleagues and His Excellency the Ambassador of the Republic of China, **Mr H K Yang**, visited the CSIR during the MINTEK 50 Conference in March to discuss the possibility of closer scientific and technological cooperation. The visitors were especially interested in the work done by the National Electrical Engineering Research Institute concerning the design and manufacture of integrated circuits and also in the field of industrial robotics, and invited the Institute to send experts to two international symposia in the Republic of China.

Two eminent Chilean scientists visited South Africa as guests of the CSIR. **Prof. Igor Saavedra**, Professor of physics at the University of Santiago and Chairman of the Chilean Science Academy, arrived in February and **Mr C Arguëlles**, President of the Commission for Science and Technology in Chile, arrived two months later. Both of them visited several CSIR institutes.

**Dr Bodo Bartocha**, Director of the International Programmes Division of the American National Science Foundation, visited South Africa at the invitation of the President of the CSIR. He had discussions on scientific collaboration at several CSIR institutes.

A group of Brazilian members of parliament, headed by **Dr B da Silveira**, visited the CSIR for discussions on low-cost housing and the heat mechanics of houses.

A group of 14 members of parliament from Paraguay visited the CSIR and showed a special interest in the work of the National Institute for Transport and Road Research.



**Dr the Hon. D J de Villiers**, Minister of Industries and Commerce, and the **Hon. K D S Durr**, Deputy Minister, visited the CSIR in December. They had discussions with the CSIR Executive and also visited various institutes.

**Prof. R R Colwell**, Executive Member of the International Union of Microbiological Societies, attended the biennial congress of the South African Microbiological Society and visited several CSIR institutes.

**Professor Hubert Curien**, President of the French Space Agency (CNES), accompanied by senior members of his staff, visited the National Institute for Telecommunications Research in order to inspect the new satellite tracking facilities of the Satellite Remote Sensing Centre at Hartbeesthoek.

The Centre was involved in the launching of the Ariane satellite in August of the year under review.

**Dr Aaron Klug**, who was awarded the Nobel Prize for Chemistry in 1982, recently visited the National Chemical Research Laboratory, the National Food Research Institute and the

The new main entrance and visitors' office of the CSIR at Scientia, Pretoria.

National Institute for Materials Research. He also had discussions with the CSIR Executive.

**Prof. J L Massey**, a well-known expert on coding theory and Professor of Digital Techniques at the Eidgenössische Technische Hochschule in Zürich, Switzerland, visited the National Electrical Engineering Research Institute on invitation from 1 to 12 October 1984. The main objective of his visit was to discuss certain of the Institute's research programmes and to offer advice where required. In addition, he presented three seminars at the Institute and also gave lectures at a number of local universities.

**Dr John McElroy** and **Mr Kenneth Hodgkins** of the National Oceanic and Atmospheric Administration (NOAA) in Washington paid a visit to the CSIR to discuss links between the CSIR and NOAA with members of the Executive. In terms of an agreement between the two organizations Landsat image data are being received and processed by the



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Satellite Remote Sensing Centre at Hartbeesthoek.

**Prof. C C Mjojo**, Vice-Principal of the University of Malawi, visited various CSIR institutes during December.

**Dr the Hon. L A P A Munnik**, Minister of Public Works and Land Affairs, visited the National Building Research Institute to acquaint himself with various aspects of the Institute's work in the field of housing.

**Prof. T M Parnell** of the University of Queensland, Australia, who is an international authority on high-voltage engineering, visited the National Electrical Engineering Research Institute for four weeks during November and December 1984. He participated in the Institute's high-voltage research programme, and also made recommendations regarding future work.

**Professor Giuseppe Ruffino** of the University of Rome, was invited by the National Measuring Standards and Metrology Division of the National Physical Research Laboratory to advise and assist them in developing and constructing a photo-

electric pyrometer. Prof. Ruffino, who is an international authority in the field of temperature measurement, spent three months at the CSIR and thanks to his efforts, the Laboratory now boasts a highly successful primary pyrometer.

**The Hon. D W Steyn**, Minister of Mineral and Energy Affairs, visited the CSIR on 15 October to attend a demonstration of electrically powered vehicles being developed by the CSIR.

A delegation consisting of the Minister of Local Government, Housing and Works, the **Hon. A A Venter**, and senior officials of his Department visited various CSIR institutes during December.

**Mr R J L Williams**, member of the West Australian Legislative Council, visited the National Building Research Institute. He was particularly interested in the Institute's work on the provision of low-cost housing.

## Staff

At the beginning of the year **Dr L R P Butler** became Chief Director of Information and Research Services after three and a half years in Bonn as the CSIR's Counsellor (Science and Technology). Dr Butler was formerly Head of the Applied Spectroscopy Division of the National Physical Research Laboratory and for six months he was Manager of the Energy Research Programme. Dr Butler succeeded Mr D G Kingwill who retired at the end of 1983.

**Dr A E Carte**, **Dr M W McDowell** and **Dr R Turner**, divisional heads in the National Physical Research Laboratory, were promoted to the rank of Deputy Director with effect from 1 April 1984.

At the end of April **Dr G G Cillié** retired as Chief Director of the National Institute for Water Research (NIWR). Dr Cillié joined the CSIR in 1947 after starting his career as a process engineer in industry. His career at the CSIR was interrupted from 1955 to 1962 when he was Chief



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Chemist of the Paarl Municipality. He concentrated on water and waste water treatment. In 1963 he was appointed Head of the NIWR's regional laboratory in Bellville. He was promoted to Director of the Institute in 1972 and in 1983 became Chief Director.

**Dr A J Eriksson**, formerly of the Electrical Power Department of the National Electrical Engineering Research Institute and subsequently also an Assistant Director of this Institute, was appointed Director of the Institute on 1 March after an absence of about 18 months. Earlier this year Dr Eriksson was invited by the University of Toronto to spend three months in Canada, where he took part in a lightning research programme.

In the course of the year **Mr N C Hauffe**, formerly Counsellor (Science and Technology) in Los Angeles, was transferred to London in the same capacity to replace Dr J Morris who was appointed Chief Director of the National Building Research Institute.

**Dr T Hodgson** was appointed Head of the Production Engineering Advisory Service on its transfer to the National Mechanical Engineering Research Institute on 1 October.

**Mr P Lasserre** was appointed Head of the Technical Services Department with effect from 20 December as successor to Dr T Hodgson.

**Dr J Morris**, formerly the CSIR's Counsellor (Science and Technology) in London, was appointed Chief Director of the National Building Research Institute as from 1 October. He succeeded Mr J F van Straaten who retired at the end of June. Dr Morris, who joined the Institute in 1966, was Head of the Organic Materials Division until he became Scientific Counsellor in 1978.

**Dr A Pizzi** succeeded Dr D L Bosman as Chief Director of the National Timber Research Institute in June 1984. Dr Pizzi was formerly Assistant Director of the Institute and Head of the Wood Chemistry and Adhesives Division.

As from September 1984, **Mr V A Shaw**, formerly Chief Director of the Centre for Computing Services, was appointed Chief Director of the National Institute for Informatics (NII), which was formed by the merging of the Centre for Scientific and Technical Information and the Centre for Computing Services.

**Mr A G Brunt**, formerly Assistant Director of the Centre for Scientific and Technical Information, was appointed Director: Information Services at the new institute. Mr Brunt is responsible, amongst other things, for the development of advanced information services for scientists both in and outside the CSIR, the provision of computerized information and enquiry services to industry and the introduction of a national energy information service.

**Miss N M Lodder**, formerly Assistant Director of the Centre for Scientific and Technical Information, was appointed Director: Library Services at the NII. She is responsible for developing and coordinating library services within the CSIR and promoting the CSIR's national commitments to library services.

**Mr A P K Dabrowski**, formerly Head of the Amdahl-IBM Support Group, was appointed Deputy Director: Computing Facilities at the NII. He is responsible for the planning, procurement and operation of the Institute's computing facilities.

**Mr G Ladner** was appointed, with effect from 1 January 1985, Deputy Director: User Support Services at the NII. He will be responsible for three groups providing user support.

**Dr D F Toerien**, formerly Director of the Institute for Environmental Sciences at the University of the Orange Free State, was appointed Chief Director of the National Institute for Water Research (NIWR). He succeeded Dr G G Cillie who retired at the end of April. Dr Toerien was attached to the NIWR from 1966 to 1976 as a researcher and later as Head of the Limnology Division.

**Dr W J van Biljon**, formerly Professor of Geology at the Rand Afrikaans University, assumed his duties as Counsellor (Science and Technology) in Bonn on 1 January. He succeeds Dr L R P Butler who became Chief Director of Information and Research Services.

**Dr R van Houten**, who worked at the CSIR for 22 years and was Chief Director of the former Centre for Scientific and Technical Information (CSTI) since 1980, retired at the end of August. Under his leadership the Group for Scientific and Technical Information of the Information and Research Services grew until the CSTI was founded in 1975. He made an invaluable contribution to the development of scientific and technological information and library services on a national level.

At the end of August **Dr C G van Niekerk** retired from the National Institute for Aeronautics and Systems Technology where he was a Director and Head of the Aeronautics Laboratory. Dr Van Niekerk worked at the CSIR for more than 31 years. He started in the Aeronautics Division in the National Mechanical Engineering Research Institute in 1953 and later became Head of the Aeronautics Research Unit.

**Mr J F van Straaten**, formerly Chief Director of the National Building Research Institute for four years,



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retired at the end of June after 38 years at the CSIR. As researcher and later as Head of the Environmental Engineering Division he enjoyed worldwide recognition for his research on indoor environment.

## Merits

**Dr R B Anderson**, former head of the lightning research team at the National Electrical Engineering Research Institute (NEERI), delivered the opening address at the International Conference on Lightning and Power Systems presented in June by the Institute of Electrical Engineers in London. Researchers at NEERI were the authors or co-authors of five of the eight South African papers read at the conference. For the past fourteen years Dr Anderson was the convener of a working group on lightning of the International Conference on Large High Voltage Systems (known as CIGRE).

**Mr T J Botha** of the National Institute for Transport and Road Research was selected by Jaycees as one of their four Outstanding Young People of the Year. Mr Botha is General Manager of the Transport Information Bureau administered by the Institute on behalf of the Department of Transport. He received the award in recognition of his contribution in the field of traffic administration and road safety in South Africa.

**Dr J R Bull**, Chief Director of the National Chemical Research Laboratory, was presented with the Gold Medal of the South African Chemical Institute at a ceremony held at the CSIR Conference Centre in September. The medal is awarded annually for published results of outstanding work in the field of chemical research.

**Dr J B Clark**, Chief Director of the National Institute for Materials Research, was awarded the Meiring Naudé Medal by the Royal Society of South Africa. This medal, which was recently introduced, is awarded to persons under the age of 35 for outstanding contributions to science in South Africa. Dr Clark's research work was on phase transitions and phase diagrams of various materials, and he was responsible for initiating the research on advanced ceramics at the CSIR.

The recipients of the Council's Merit Prizes for 1984 were **Mr W J Botha**, Director, Space Programmes, of the National Institute for Telecommunications Research, **Mr P P Roets**, a Director of the National Research Institute for Mathematical Sciences, and **Dr J T Fourie**, an Assistant Director of the National Institute for Materials Research. Mr Botha received the award for his contribution to the development of the Satellite Remote Sensing Centre at Hartebeesthoek over many years. Mr Roets was awarded his prize for his part in the creation, development and application of a high-level computer programming language, SCRAP (Systems Construction and Applications Programming). Dr Fourie's prize was awarded for his electron microscopy work in the field of plastic deformation of metals, which is recognized as outstanding and original both in South Africa and abroad.

Merit prizes were first awarded in 1983. They then went to Dr J Coetzer of the National Institute for Materials

Research, Dr F Hengstberger of the National Physical Research Laboratory and Dr V P Joynt of the Applied Chemistry Unit.

**Dr A J Eriksson**, Director of the National Electrical Engineering Research Institute, succeeded Dr R B Anderson as Convener of the Working Group on Lightning of the Conférence Internationale des Grandes Réseaux Electriques (CIGRE), which coordinates the lightning engineering research activities of member countries. He was also appointed Honorary Professor of High-voltage Engineering in the Department of Electrical Engineering of the University of the Witwatersrand.

**Dr L P Fatti** of the National Research Institute for Mathematical Sciences was unanimously elected Vice-President of the Habitat Council at a meeting of the Council's Executive in Cape Town. He is also President of the Operations Research Society of South Africa. Dr Fatti was also awarded the Goodeve Medal for 1984 by the British Operational Research Society for a paper entitled *Optimal smoothing of demand for industrial gas*, which appeared in the Society's journal.

**Dr M W Feast**, Chief Director of the South African Astronomical Observatory and Honorary Professor of Astronomy at the University of Cape Town, was awarded the Gill Medal by the Astronomical Society of Southern Africa. The medal, which is the Society's highest award, was presented to Dr Feast at its annual general meeting.

**Mr R Fieldwick**, Head of the Safety Engineering Group of the National Research Institute for Transport and Road Research, received the Annual Transportation Convention's Best Paper Award for his paper *Some factors influencing traffic accidents* in August 1984. This is the third



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consecutive year that the award has been won by a staff member of this Institute.

**Mr K A Finlayson** of the National Building Research Institute received the Claude Harris Leon Foundation Community Service Award in recognition of his work in the field of low-income housing research and the design and planning of human settlements as well as his contribution to alternative procedures in large-scale housing.

**Dr W H Gries** of the National Institute for Materials Research was elected Associate Member of the V-2 Commission of the International Union for Pure and Applied Chemistry (IUPAC). The Commission is concerned with microchemical techniques and trace analysis and the evaluation of new and existing methods.

Dr Gries was also made a member of a special subcommittee for surface analysis.

**Mr R F M Guedj** of the Satellite Remote Sensing Centre at Hartebeesthoek received the highest French award, the Order of the Knight of the Legion of Honour. The order was presented to him by the French Ambassador at the French National Day celebrations. Mr Guedj also received a medal for his contribution to the French/German satellite telecommunication project in 1979 and another in recognition of his contribution to projects of the CNES (Centre National d'Etudes Spatiales).

**Dr F Hengstberger** of the National Physical Research Laboratory received a senior research fellowship from New Zealand to work in that country's national laboratory and help establish the national light and radiometric standards there. He was also appointed associate director and coordinator of eight technical committees by the International Illumination Commission.

Two of the commercial radiometers designed by Dr Hengstberger were sold to New Zealand and Spain.

**Dr A I Kingon** of the National Institute for Materials Research received the SMM award for outstanding work in the field of solid-state physics and/or materials science done by a post-graduate student. The winning paper, which was published in the *Journal of the American Ceramics Society*, consists of a carefully designed programme of experimentation on the production of a particular class of electronic ceramics known as PZT ceramics.

**Mr D G Kingwill**, who retired as Director of Information and Research Services after nearly 40 years at the CSIR, received an honorary law degree from Rhodes University. Since the founding of the CSIR in 1945, Mr Kingwill worked for the development of the CSIR in the widest sense of the word, for the promotion of scientific research in South Africa and for the country's scientific and technological representation abroad.

**Dr R A Kruger**, Coordinator of the Ceramics and Related Materials Section of the CSIR Foundation for Research Development's National Materials Programme, was invited to become a member of the Permanent Scientific Committee of CERP (CEramics REsearch for PROduction). Dr Kruger is the first member of the Committee who is not from Western Europe or the USA.

**Dr S H Kühn**, Chief Director of the National Institute for Transport and Road Research, was invited to become a member of the Board of Patrons of the Institute for Futures Research of the University of Stellenbosch. Dr Kühn was responsible for the introduction of modern management techniques in research planning and for the development of a system of quality control in road construction.

**Professor Jennifer Thomson**, Head of the Laboratory for Molecular and Cell Biology, was one of the four Young People of the Year to receive the Jaycees award. Professor Thomson was the leader of a team of scientists who succeeded in cloning the gene for an industrial enzyme. She is the CSIR's first advisor on biotechnology and also Honorary Professor in Molecular Genetics at the University of the Witwatersrand.

**Miss Rachel Quick** of the National Research Institute for Mathematical Sciences received the De Beers Gold Medal which is awarded to the best honours student in physics at the University of the Witwatersrand. At present Miss Quick is involved in research on intermediate energy physics, particularly the role of quarks in nuclei and in computational physics.

**Dr G J Ritter**, a Director of the National Physical Research Laboratory, received an award from the South African Acoustics Institute in recognition of his outstanding contribution to the promotion of the study of acoustics in South Africa.

Three of the four awards annually presented by the Electron Microscopy Society of Southern Africa were received by members of the National Institute for Materials Research. The Microstructure Award for the best innovative technique went to a team of researchers for work relating to the thickness determination of thin specimen foils using convergent beam electron diffraction. The members of the team were **Dr M P Shaw**, **Miss N Barnett** and **Mr D E Jesson**. Mr Jesson also received an award for the best student paper in the Physical Sciences Section of the Annual Conference of the Electron Microscopy Society.

**Mr J T Thirlwall** received the Cameca Prize for the best paper in the Microprobe Section of the Conference.



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In August **Dr W J van Biljon**, the CSIR's Counsellor (Science and Technology) in Bonn, was awarded the Havenga Prize for Geology in recognition of his contribution to geological research in South Africa. The prize was presented to Dr Van Biljon by the Chairman of the Suid-Afrikaanse Akademie vir Wetenskap en Kuns, Dr C F Garbers, during a ceremony at the University of Pretoria.

**Mr J D N van Wyk**, Chief Director of the National Electrical Engineering Research Institute, was nominated as one of the five Deputy Chairmen of the Technical Council of the Inter-

national Federation of Automatic Control (IFAC), with responsibility for four Technical Committees, viz. those on Applications, Computers, Manufacturing Technology, and Terminology and Standards.

**Dr P J van Wyk**, a Director of the National Food Research Institute and Head of the Food Technology Division, was appointed for a second term of office as Honorary Professor in the Department of Food Science at the University of Pretoria.

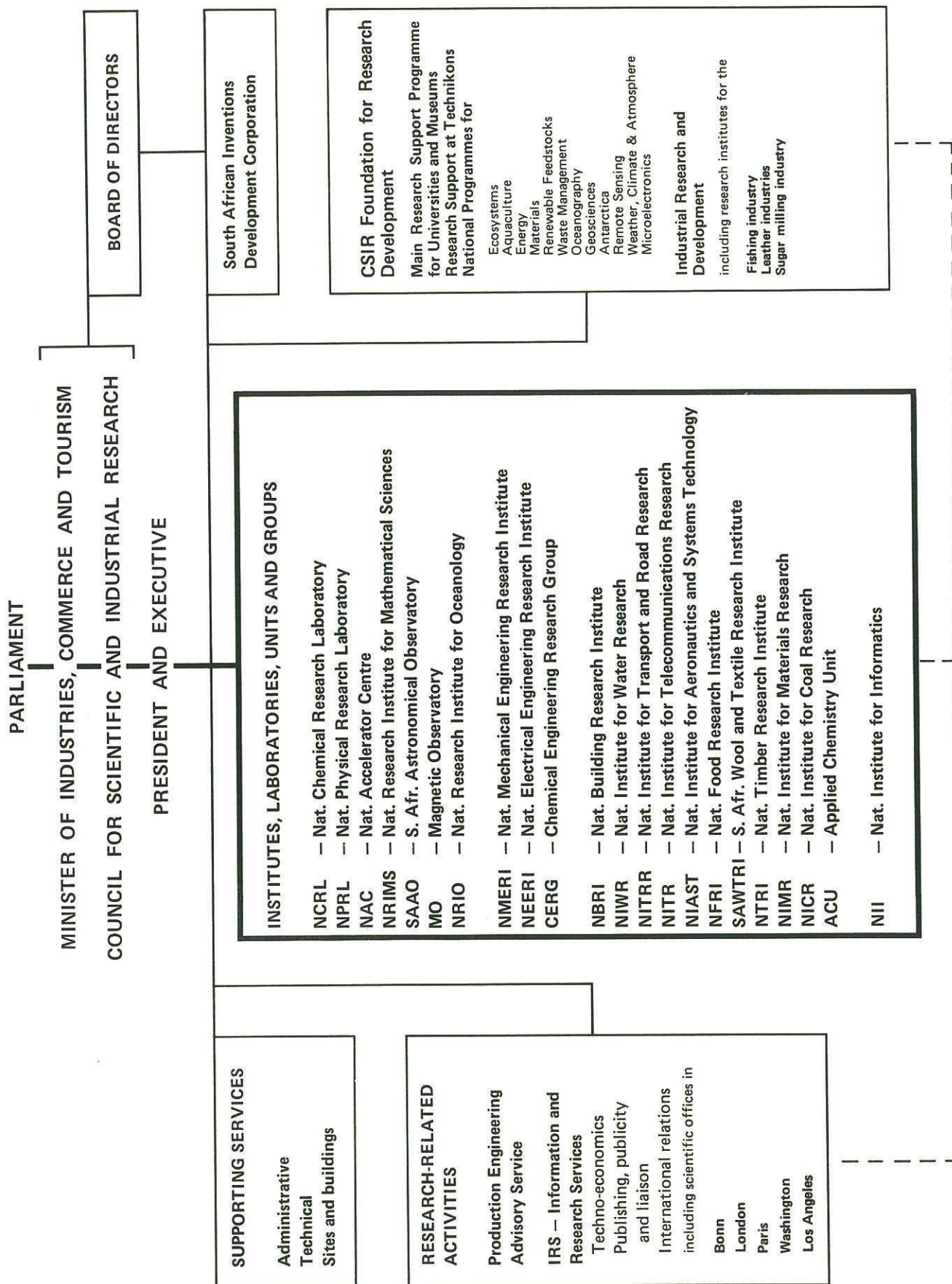
**Dr T C Verster**, a Director of the National Electrical Engineering Research Institute, was nominated as

a member of the non-statutory standing Committee for Electronics established by the Cabinet to enhance the local electronics industry.

**Mrs M N Vosloo** of the CSIR's regional office in Port Elizabeth, where she represents the Centre for Scientific and Technical Information (now the National Institute for Informatics), was awarded first prize in an international competition for the search strategy she used on behalf of a client to retrieve information on the oil pollution of seabirds from a computerized data base.



# Organization and functions of the CSIR





# Organization and functions of the CSIR

## NATIONAL CHEMICAL RESEARCH LABORATORY

**Chief Director:** Dr J R Bull

The National Chemical Research Laboratory (NCRL) is a centre at which the latest developments in chemical science are brought to bear on problems of national significance.

In accordance with its policy, namely of concentrating on research in fields where there is a need for more basic knowledge, many of the Laboratory's research projects are carried out in collaboration with research organizations that are more directly concerned with the application and exploitation of research findings. Well-motivated long-term projects are therefore approached from a fundamental point of view. The Laboratory is also responsible for providing advanced research services to chemists in South African universities and industrial laboratories.

The NCRL is organized into divisions for analytical chemistry, inorganic chemistry, molecular biochemistry, and organic chemistry.

## NATIONAL PHYSICAL RESEARCH LABORATORY

**Chief Director:** Dr J S V van Zijl

The activities of the National Physical Research Laboratory (NPRL) are determined by the industrial and national needs of the Republic of South Africa. Research and development is undertaken in the various fields of the natural sciences, including optics, solid state physics, geophysics, acoustics, geochronology, atmospheric physics and natural isotopes. The research is usually carried out in fields of application where a need for further knowledge exists or is anticipated, but it can also be of a more fundamental nature.

The NPRL is organized into two main research groups dealing with General Physics and Earth and Atmospheric Sciences, each of which

consists of a number of key divisions staffed by specialist researchers. Proficiency is required in highly advanced techniques, and personnel of the NPRL have to be especially conversant with those involving physical measurements and methods in order to make a meaningful contribution.

In addition, in terms of Act 76 of 1973, the NPRL has statutory responsibility for the maintenance of the national measuring standards of mass, length, time, temperature, electricity, light, ionizing radiation, force and pressure.

## NATIONAL ACCELERATOR CENTRE

**Chief Director:** Dr D Reitmann

In 1977 the CSIR accepted the responsibility of establishing the National Accelerator Centre (NAC) with the commission to provide a multidisciplinary accelerator facility for the use of all scientists in the country who are interested in research with and the application of accelerated beams of heavy particles.

The NAC consists of two groups, one near Faure whose main interest at present is the design and construction of a variable-energy separated-sector cyclotron with a maximum energy of 200 MeV per nucleon, and another in Pretoria using the existing CSIR cyclotron. In April 1983 the staff and facilities of the former Southern Universities Nuclear Institute, including the Van de Graaff accelerator, also became part of the National Accelerator Centre.

The objectives of the NAC in broad terms are:

- to provide a facility for basic and applied research using accelerated ion beams;
- to provide a service facility in South Africa for particle therapy and clinical trials in various treatment methods;

- to supply accelerator-produced radioactive isotopes to users in nuclear medicine, research and industry.

## NATIONAL RESEARCH INSTITUTE FOR MATHEMATICAL SCIENCES

**Chief Director:** Dr D H Martin

The National Research Institute for Mathematical Sciences (NRIMS) consists of divisions for numerical and applied mathematics, mathematics and dynamic meteorology, computer science, operations research and statistics, and theoretical physics.

Research activities cover the various mathematical sciences and their applications. Typical fields of study are theoretical nuclear physics, differential equations, control theory and optimization, statistical analysis techniques, methods of operations research, numerical analysis, interactive computer graphics and special programming languages.

## SOUTH AFRICAN ASTRONOMICAL OBSERVATORY

**Chief Director:** Prof. M W Feast

The South African Astronomical Observatory (SAAO) is operated jointly by the CSIR and the Science and Engineering Research Council of Great Britain. The Headquarters of the SAAO are situated in the grounds of the former Royal Observatory in Cape Town. A major observing facility equipped with modern instrumentation has been established at Sutherland in the Karoo. The large number of clear nights each year and the absence of smog and city lights makes this an excellent site for astronomical observations.

Besides being the National Observatory of South Africa, the SAAO provides observing facilities for astronomers from Great Britain



# Organization and functions of the CSIR

and the South African universities. Staff and visitors carry out research on a wide variety of astrophysical problems such as the chemical composition of stars, the nature of stellar pulsations, the size and structure of our Galaxy, the extragalactic distance scale, active galaxies and quasars. Investigations are also carried out in collaboration with space and radio astronomers.

## MAGNETIC OBSERVATORY

**Head:** Dr G J Kühn

The Magnetic Observatory at Hermanus is an important link in a worldwide network of organizations engaged in studies of the behaviour of the magnetic field of the earth. For this purpose the Observatory operates a chain of five magnetic recording stations extending from Tsumeb in the north to Sanae (Antarctica) in the south. As there is a direct interaction between variations of the magnetic field and the motion of charged atomic particles in the magnetosphere, particle related geophysical phenomena (such as the aurora) are also recorded and studied as part of the research programme of the Observatory.

In addition to its continuous monitoring programmes, the Observatory conducts regular countrywide surveys for the purpose of compiling magnetic charts for Southern Africa. Attention is also given to the use of satellite magnetic data for magnetic field modelling and for the mapping of crustal magnetic anomalies in Southern Africa.

The research programme of the Observatory embraces the study of disturbed conditions in the magnetosphere, including magnetic pulsations and magnetic substorm phenomena, as well as the study of the nature of regular quiet-time variations of the magnetic field. Variations of the magnetic field are also used by means of the so-called

magneto-telluric method to study the electrical properties of material in the crust of the earth.

## NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY

**Chief Director:** F P Anderson

The National Research Institute for Oceanology (NRIO), which has its headquarters at Stellenbosch, is a multidisciplinary organization in which all marine and coastal engineering sciences are represented. The research divisions are supported by a full range of services required to run a large institute remote from CSIR headquarters in Pretoria.

The coastal zone of South Africa is under severe pressure due to the growing population and its increasing affluence, and the Institute puts much effort into studying all aspects of this area in order to understand its natural functioning and predict man's impact on it. The dynamics of the Southern Ocean are also studied to determine the role of this ocean in Southern African weather and climate.

## NATIONAL MECHANICAL ENGINEERING RESEARCH INSTITUTE

**Chief Director:** Dr M S Hunt

The National Mechanical Engineering Research Institute (NMERI) deals mainly with the development of mechanical engineering processes and techniques, and the improvement of machinery, plant designs and materials used in industry. The Institute is also active in civil engineering hydraulics and geomechanics, which play an important role in mining and civil engineering.

The laboratories of the Institute at Scientia, Pretoria, accommodate divisions for design and development, tribology, strength mechanics, geomechanics, fluid mechanics, aeromechanics and heat mechanics

(including air-conditioning and refrigeration). The Mine Equipment Research Unit in Cottesloe, Johannesburg, which deals mainly with the safety of mine hoist ropes, is also part of the Institute.

The Production Engineering Advisory Service (PEAS) which used to be part of the Technical Services Department was transferred to the Institute on 1 October 1984. The unit is active in the fields of production engineering, machining technology and machine development.

## NATIONAL ELECTRICAL ENGINEERING RESEARCH INSTITUTE

**Chief Director:** J D N van Wyk

The National Electrical Engineering Research Institute (NEERI) undertakes research and development in widely differing fields of electrical engineering, with activities ranging from microelectronics through electronic instrumentation and computer technology to power electrical engineering.

The research and development activities of the Institute are grouped under four research departments, viz. Microelectronics, Cybernetics, Industrial Electronics and Electric Power. Each of these departments consists of a number of divisions responsible for specialist activities. In addition, the Institute maintains an information service on electronic instrumentation and undertakes the practical training of diploma technicians in electronic engineering for the CSIR. A small facility for the manufacture of integrated circuits was established in 1976.

## CHEMICAL ENGINEERING RESEARCH GROUP

**Head:** W G B Mandersloot

The field of chemical engineering deals with the processes and



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# Organization and functions of the CSIR

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operations by which the properties or composition of matter in bulk are changed. The activities of the Chemical Engineering Research Group (CERG) cover not only the needs of the chemical industry, but also many processing aspects of the petroleum, petrochemical, mineral, food, beverage, biochemical, pharmaceutical, ceramic, paper and textile industries and environmental technology (in which water, effluent and air are important). Owing to the interdisciplinary nature of chemical engineering, collaboration with other institutes and organizations is important.

The research and development items on the programme of the Group are selected according to the immediate and anticipated needs of industry. The main subjects are heat and mass transfer, properties of fluids, energy utilization in the process industry (particularly in drying), fluid dynamics, particle technology, reactor technology and catalysis, and prevention of air pollution. The Group provides the industrial sector with a wide range of consulting services which can, if necessary, be supported by applied or fundamental research.

## NATIONAL BUILDING RESEARCH INSTITUTE

**Chief Director:** Dr J Morris

The National Building Research Institute (NBRI) with a staff complement of some 240 people, has its headquarters in Pretoria and regional offices in Cape Town, Bloemfontein, Durban and Port Elizabeth. Its annual budget of some ten million rand is approximately one-tenth of one per cent of the amount spent on building and construction in South Africa every year. About one-third of its total budget is earned by services rendered to the building community.

The Institute's 12 divisions cover a wide range of research fields but areas

selected for special emphasis in the first half of this decade are:

- housing, particularly in the low income sector;
- school buildings, with special reference to the backlog in and special needs of Black education;
- promotion of human health, productivity and safety via design and planning of buildings and building services;
- conservation and development of material and energy resources.

The effective application of research results in the building industry is one of the Institute's high priority objectives.

## NATIONAL INSTITUTE FOR WATER RESEARCH

**Chief Director:** Dr D F Toerien

Water research is vital to a country like South Africa which has limited water resources. The National Institute for Water Research (NIWR) therefore has the task of developing expertise in the efficient use and conservation of available resources. Its activities include investigations into water purification, the treatment of effluent and the various types of pollution encountered in dams, rivers, estuaries and the sea.

The Institute has a total staff of 205 and is divided into a number of research groups and regional laboratories. The regional laboratories in Durban, Bellville and Bloemfontein concentrate largely on local water problems, and research groups in Pretoria undertake basic and applied research over a wide range of problems concerning the optimum utilization of water. Research groups have been established for investigating limnology, water quality, biological treatment processes, physico-chemical treatment processes and desalination. Another group deals with the practical application of technology developed by the Institute.

## NATIONAL INSTITUTE FOR TRANSPORT AND ROAD RESEARCH

**Chief Director:** Dr S H Kühn

Transport and road authorities encounter a wide range of problems in their endeavours to ensure the most economical use of transport facilities as a public amenity. The research programme of the National Institute for Transport and Road Research (NITRR) is directed at finding solutions to these problems through research into the planning, design, construction, maintenance and operation of roads and transport systems, road safety and the behaviour of road users, and the role of roads and transport in society. Another important function of the NITRR is to ensure the effective dissemination and application of research findings throughout the transport industry.

The NITRR works in close collaboration with national and provincial transport and road authorities, the South West Africa Administration, the South African Transport Services, the National Road Safety Council and the road industry, which together provide most of the funds for research.

## NATIONAL INSTITUTE FOR TELECOMMUNICATIONS RESEARCH

**Chief Director:** R W Vice

The National Institute for Telecommunications Research (NITR) carries out research and development in radio science and its applications. The work of the Institute falls under five research divisions.

The Radiocommunications Division is concerned with the prediction of the performance of communications systems under various environmental conditions.



# Organization and functions of the CSIR

The Systems and Circuits Division develops radio and radar systems for specialized applications, an example being the development of microwave distance measuring equipment.

The Radiometeorology Division carries out research into the use of radar in the measurement of rainfall and the observation of storm dynamics. It also conducts a programme of lightning research using radio techniques.

A programme of radio astronomy is carried out by the Radio Astronomy Division. The facilities include a 26 m radiotelescope and the associated radiometers.

The Satellite Remote Sensing Centre is responsible for the acquisition, processing and distribution of satellite data and imagery of the earth's surface and atmosphere. It is principally involved with data from the Landsat and Meteosat satellites and with the tracking of satellites on behalf of the French Centre National d'Etudes Spatiales.

## NATIONAL INSTITUTE FOR AERONAUTICS AND SYSTEMS TECHNOLOGY

**Chief Director:** Dr T J Hugo

The National Institute for Aeronautics and Systems Technology (NIAST) consists of laboratories for electronics, systems, aeronautics and electrical support. Its task is to develop technological expertise in these fields for the benefit of the relevant industries.

The Institute's main activities are concentrated on flight dynamics, aerodynamics, aircraft structures, propulsion, servo-mechanisms, and digital and microwave systems. Multidisciplinary projects, some involving extensive systems analyses, are also undertaken.

## NATIONAL FOOD RESEARCH INSTITUTE

**Chief Director:** Dr L Novellie

The main aim of the National Food Research Institute (NFRI) is to promote effective utilization of South Africa's food resources. The Institute consists of five research divisions: Food Chemistry, Food Technology, Biological Evaluation, Fermentation Technology, and Oils and Fats, and it also administers and is closely associated with the CSIR's Microbiology Research Group and Sorghum Beer Unit.

Typical fields in which fundamental and applied research are carried out are processing of subtropical crops, cereal technology and biochemistry, food processing and storage, lipid chemistry and technology, food microbiology, food analysis, fermentation processes and brewing technology. Biological studies of the utilization of nutrients in foods and diets are also undertaken.

## SOUTH AFRICAN WOOL AND TEXTILE RESEARCH INSTITUTE

**Chief Director:** Dr D W F Turpie

The South African Wool and Textile Research Institute (SAWTRI) in Port Elizabeth conducts research on those natural fibres - particularly wool, cotton and mohair - that are of major importance to the South African fibre producers and textile industry. Blends of these natural fibres with synthetic fibres are also studied.

In essence the Institute is a self-contained experimental textile factory with processing facilities enabling it to process almost any staple fibre from the raw state to the garment stage on full-scale machinery.

Textile research is aimed at improving our knowledge and understanding of locally produced textile fibres, their behaviour during processing and their end use for the benefit of the fibre producer, the textile manufacturing

industry and the consumer. Greater efficiency in the processing, dyeing and finishing of textiles is an important goal, which sometimes necessitates further development of existing processing machinery as well as the designing of new machines and instruments. Another important aim of the research programme is to impart to the final product the aesthetic and technical qualities, particularly easy-care properties, that are now being demanded by the discerning customer.

Finally, the Institute provides an important service in assisting the textile industry with trouble shooting and problem solving.

## NATIONAL TIMBER RESEARCH INSTITUTE

**Chief Director:** Dr A Pizzi

The aim of research and development work at the National Timber Research Institute (NTRI) is to make available knowledge and expertise which will help the timber processing industry to make maximum use of South Africa's timber resources.

The research is conducted in close collaboration with the timber processing industry to ensure that the results are applied and products manufactured which are acceptable to the consumer in terms of sophistication, quality and price.

Approximately one third of the Institute's budget of R3,3 million is derived from the timber processing industry.

## NATIONAL INSTITUTE FOR MATERIALS RESEARCH

**Chief Director:** Dr J B Clark

The National Institute for Materials Research (NIMR) carries out advanced research into the relationship between the structure and properties of materials, the processing of materials in line with structure-



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# Organization and functions of the CSIR

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property relationships and the performance of materials in engineering systems. Technologies are developed to replace imported materials and to find new applications for local raw materials.

Research is aimed at the needs of industry. Expertise and facilities of the highest international standards are used to promote materials science and engineering in South Africa.

## NATIONAL INSTITUTE FOR COAL RESEARCH

**Chief Director:** Dr T C Erasmus

The National Institute for Coal Research (NICR), formerly the Fuel Research Institute of South Africa, was incorporated into the CSIR on 1 April 1983.

The Institute has three divisions, the Chemistry, Engineering and Survey Divisions, at the Lynnwood Road complex, extensive pilot plant facilities at Research Road, Pretoria West, and a station for the sampling of export coal at Durban.

The three divisions conduct basic and applied research, both in the national interest and under contract to the coal industry and government departments.

## APPLIED CHEMISTRY UNIT

**Head:** Dr V P Joynt

The Applied Chemistry Unit (ACU) is an independent CSIR unit largely financed on a contract basis by outside organizations to undertake studies on the application of chemistry to various production and engineering problems. These studies are frequently joint programmes in which the sponsors second staff to the Unit to contribute directly to the research and development effort.

## TECHNICAL SERVICES DEPARTMENT

**Head:** P Lasserre

The Technical Services Department (TSD) designs and manufactures research equipment and renders essential services such as graphic arts, transport and stores to the laboratories and institutes of the CSIR.

The Department also undertakes work on contract for other bodies and industry if the work cannot be done anywhere else in the Republic.

## INFORMATION AND RESEARCH SERVICES

**Chief Director:** Dr L R P Butler

The Information and Research Services (IRS) is the corporate liaison activity within the CSIR with the following objectives:

- to act as the central liaison and communication centre for the CSIR;
- to promote the corporate image of the organization;
- to provide a management information service, both financial and techno-economic, for scientific and technology decision makers and strategy planners within the CSIR and elsewhere;
- to liaise closely with industry to promote research and development, as well as to encourage interaction with research bodies;
- to provide direct and indirect techno-economic support for stimulating development in the local manufacturing sector;
- to communicate the major scientific and technological successes and achievements of the CSIR to the public, private and educational sectors;
- to promote international scientific relations and represent South Africa in the field of science and technology overseas.

## NATIONAL INSTITUTE FOR INFORMATICS

**Chief Director:** V A Shaw

The National Institute for Informatics was formed in September 1984 by the merging of the Centre for Scientific and Technical Information and the Centre for Computing Services.

This merger indicates recognition by the CSIR of the increasing importance and interdependence of the information and computing technologies.

While some rationalization in the organizational structure has taken place and closer collaboration between the information and computing technologies has been implemented, the two services will retain their identities as the Centre for Scientific and Technical Information and the Centre for Computing Services.

The Centre for Scientific and Technical Information (CSTI) has as its general objective the promotion of use of scientific and technical information, in terms of the Scientific Research Council Act, which states that it is one of the functions of the CSIR 'to establish and control facilities for the collection and dissemination of information in connection with scientific and technical matters'.

To achieve this objective, the CSTI's main functions are as follows:

- the provision of information and library services to CSIR staff and to users outside the CSIR;
- the promotion and/or provision of information and library services to scientific and technical organizations and to industry;
- the undertaking of applied research in the library and information field.

The Centre for Computing Services (CCS) provides for the computing requirements of all CSIR institutes and carries out research to develop and support this function.

The computing facilities consist of three large central processors at Scientia and a smaller one at Faure,



# Organization and functions of the CSIR

serving some 25 CSIR institutes, laboratories, units and groups situated in various parts of the country. Research workers have access to these facilities, directly or via some 400 terminals, or via minicomputers or remote job entry stations linked to the central computers through a data communications network.

A wide range of software for interactive working, data base management, file and data management and for various applications is available on these systems.

The Centre also provides the necessary supporting services such as program guides and other information, training courses and a consulting service for its users.

University research projects approved by the CSIR Foundation for Research Development are also granted time on the CSIR computers and in particular circumstances, and subject to certain conditions, facilities are made available to outside bodies.

## FOUNDATION FOR RESEARCH DEVELOPMENT

**Head:** Dr R R Arndt (Deputy President)

The Foundation for Research Development (FRD), which was formed in April 1984 to combine the functions of the former Cooperative Scientific Programmes (CSP) and the Research Grants Division (RGD), is responsible for the development of research in the natural and applied sciences in South Africa.

The funds provided by the State to support self-initiated research at universities, museums and technikons are administered in terms of the Main Research Support Programme which continues the work of the RGD. The CSIR was first entrusted with this legal responsibility in 1946. These funds are awarded to postgraduate students and established researchers on the basis of individual merit by the Main Research Support Programme's

Advisory Committee and its various specialist subcommittees.

The National Programmes (previously the CSP) are aimed at solving well-defined national problems through cooperative research. Here the objectives of the proposed research and the quality of the research team are the criteria for support. The National Programmes were introduced to coordinate research efforts and to mobilize the best available expertise for research into complex interdisciplinary and multi-institutional problems of national and international importance that are unlikely to be solved by separate organizations working in isolation. Earlier programmes, several of which are still in existence, developed out of our participation in global ventures of the International Council of Scientific Unions (ICSU). Later programmes, on the other hand, are mainly focused on national needs. The coordinators collaborate with scientists and managers of statutory organizations, government departments and the private sector in planning, harmonizing and developing these programmes. Stimulation Support Programmes will be introduced to promote research not catered for by the existing programmes.

At present there are national programmes for the following fields of research: oceanography (with programmes on the Benguela ecology, coastal processes, estuaries, marine pollution, marine linefish and marine sedimentology); Antarctic research; environmental sciences (with sections for inland water ecosystems, terrestrial ecosystems and nature conservation research); geosciences; materials science and engineering (sections for metals and alloys, ceramics, renewable feedstocks, and wastes management); energy (sections for energy in transportation, coal research, and alternative technology); remote sensing; weather, climate and

atmosphere research; microelectronics; aquaculture; and biotechnology.

## FISHING INDUSTRY RESEARCH INSTITUTE

**Director:** Dr J P H Wessels

The Fishing Industry Research Institute (FIRI), which is affiliated to the University of Cape Town, is situated on the university campus.

The Institute is financed by voluntary contributions from the fishing industry and a subsidy from the CSIR. Firms which are indirectly connected with the fishing industry are eligible for associate membership of the Institute.

The affairs of the Institute are managed by a Board of Control on which the fishing industry, the CSIR, the Minister of Environment Affairs, the Fisheries Development Corporation of South Africa Ltd, and the Universities of Cape Town and Stellenbosch are represented. The research programme is planned and executed in consultation with specially appointed committees, the members of which are prominent technical personnel of the inshore and white fish industries.

The principal role of the Institute is to undertake fundamental and applied research on behalf of the fishing industry. This involves a variety of different products and processes, such as refrigerated and frozen whole rock lobster and rock lobster tails, canned pilchards and mackerel, fish meal, fish oil and the like.

The Institute also acts as a technical adviser to the industry on the purification of effluent, the control of odour, the testing of packaging materials and the purification of water for use in factories. Cooperation with international organizations such as the International Association of Fish Meal Manufacturers and the International Institute of Refrigeration



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# Organization and functions of the CSIR

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ensures that the industry keeps pace with the progress taking place in every sphere of fish processing.

## LEATHER INDUSTRIES RESEARCH INSTITUTE

**Director:** Dr D R Cooper

The Leather Industries Research Institute (LIRI) in Grahamstown is regarded as the pioneer of industrial research for South Africa's secondary industry. From its early beginnings in 1935 in the Chemistry Department of Rhodes University, the Institute has maintained a steady growth.

A feature of LIRI's work is the balance maintained between basic research and the application of science to the everyday technical problems of the industries served. A high rate of technology transfer has been achieved thanks to the close personal contact between the many subscribers and the frequency of

factory floor contacts at all levels between research and production staff.

## SUGAR MILLING RESEARCH INSTITUTE

**Director:** Dr A B Ravnö

The Sugar Milling Research Institute (SMRI) is the central scientific organization involved in research into the manufacturing problems of the South African sugar industry. It was established in 1949 by the South African Sugar Millers' Association Limited (SASMAL), the CSIR and the University of Natal, on whose campus it is situated in Durban. The Institute is financed by SASMAL and the CSIR.

In addition to all South African sugar mills, a number of sugar factories in neighbouring countries are also affiliated members of the Institute.

The main functions of the SMRI are as follows:

- Research into various aspects of the production of sugar from sugarcane, involving both basic chemical problems and the engineering aspects of factory design.
- Control and microbiological analysis of the sugar, molasses and intermediate products of the factory.
- Advisory work on factory and industrial problems.
- Research into the utilization of by-products of the sugar industry.
- Dissemination of information on sugar manufacture and by-product utilization.
- Training courses in sugar technology in collaboration with the Natal, M L Sultan and Mangosuthu Technikons.

(The sugar industry maintains a research station at Mount Edgecombe, Natal, where the cultivation of sugarcane is studied.)



# Financial statements

## COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

## STATEMENT 1

### BALANCE SHEET AT 31 MARCH 1984

	General Fund R	Building Fund R	1984 R	1983 R
<i>Accumulated funds:</i>				
Balance brought forward .....	110 889 220,03	69 683 096,74	180 572 316,77 <sup>1</sup>	148 842 958
Refund of unspent advance in respect of improvement of conditions of service 1982/83 .....	867 700,00	—	867 700,00	—
	110 021 520,03	69 683 096,74	179 704 616,77	148 842 958
<i>Additions:</i>				
Appropriation from income statement .....	2 931 995,00	97 668,00	3 029 663,00	3 144 583
Capital income (Note 1) .....	22 136 425,37	12 838 372,53	34 974 797,90	29 373 781
Physical assets and funds received .....	3 763 037,39	705 172,32	4 468 209,71 <sup>2</sup>	132 013
Surplus of income over expenditure .....	4 190 792,98	—	4 190 792,98	423 487
	143 043 770,77	83 324 309,59	226 368 080,36	181 916 822
<i>Reductions:</i> .....	2 859 897,77	—	2 859 897,77	1 344 505
Physical assets relinquished .....	363 721,08	—	363 721,08	—
Physical assets written off .....	2 496 176,69	—	2 496 176,69	1 344 505
<b>Total</b> .....	<b>R140 183 873,00</b>	<b>83 324 309,59</b>	<b>223 508 182,59</b>	<b>180 572 317</b>
<i>Utilization of funds:</i>				
Fixed assets (Note 2) .....			201 764 275,54	167 495 059
Balance brought forward .....			167 495 059,49	136 444 712
Net additions .....			34 269 216,05	31 050 347
Long-term leasehold .....			101 111,63 <sup>3</sup>	108 112
Investments .....			973 880,00	970 000
Shares in SA Inventions Development Corporation .....			970 000,00	970 000
Escom Stock: 6,875% - 1992 .....			3 880,00	—
Net current assets .....			20 668 915,42	11 999 146
Current assets .....			35 492 991,02	22 504 092
Saleable stock .....			150 363,95	108 630
Debtors and debit balances .....			10 434 927,72	7 653 777
Advances and deposits:				
Research grants .....			4 944 178,47	2 480 287
Other .....			5 939 404,01	3 431 106
Cash:				
Corporation for Public Deposits <sup>4</sup> .....			12 751 715,31	6 333 378
SA Reserve Bank .....			1 104 094,45	2 356 694
Other banks .....			100 146,94	67 710
Petty Cash Imprests .....			68 160,17	72 510
Current liabilities .....			14 824 075,60	10 504 946
Advances for investigations and services .....			8 269 566,93 <sup>5</sup>	5 893 995
Creditors and credit balances .....			6 554 508,67	4 610 951
<b>Total</b> .....			<b>R223 508 182,59</b>	<b>180 572 317</b>

<sup>1</sup>At 31 March 1984 contractual obligations against the General and Building Funds were R18 377 985 and R11 534 092 respectively.

<sup>2</sup>Amount of R139 611,63 prepaid for 120 year leasehold on 20 Heathrise Flat, London. This amount amortized at R7 000,00 per annum as from October 1978.

<sup>3</sup>Includes Stabilization Funds in respect of Department of Transport (National Road Fund) R246 539,13 and National Road Safety Council R28 266,99.

<sup>4</sup>Up to 30 March 1984 known as Public Debt Commissioners. Includes calculated interest for 31 March 1984 for an amount of R5 849,13.

<sup>5</sup>Mainly due to incorporation of the Southern Universities Nuclear Institute and National Institute for Coal Research.

PRETORIA  
24 NOVEMBER 1984

(Sgd.) J D VAN ZYL  
Chief Director: Administrative Services

(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 14(1) of the Scientific Research Council Act, No. 32 of 1962, and in my opinion it has been drawn up so as to reflect a true and fair view of the financial affairs of the Council for Scientific and Industrial Research.

PRETORIA  
10 DECEMBER 1984

(Sgd.) A P ELLIS  
Auditor General



# Financial statements

## NOTE 1: CAPITAL INCOME

	General Fund	Building Fund	1984	1983
	R	R	R	R
Parliamentary grant .....	19 517 000,00	9 900 000,00	29 417 000,00	26 271 110
Donations .....	—	—	—	19 702
Contributions .....	135 702,86	—	135 702,86	94 342
Interest .....	—	2 938 372,53	2 938 372,53	989 073
Sale of assets written off .....	119 572,79	—	119 572,79	107 476
Investigations and services .....	2 364 149,72	—	2 364 149,72	1 892 077
	R22 136 425,37	12 838 372,53	34 974 797,90	29 373 781

## NOTE 2: FIXED ASSETS (AT COST)

	Land and Buildings	Books and Journals	Furniture and Equipment	Prefab. Structures	Laboratory Equipment	Vehicles	Stores Stock	Total
	R	R	R	R	R	R	R	R
Balance brought forward	68 007 577,97	5 234 513,70	5 834 919,77	47 030,82	83 972 404,53	3 009 214,15	1 389 398,55	167 495 059,49
<i>Purchases:</i>								
CSIR .....	12 435 697,18	932 603,76	1 498 957,30	2 736,42	18 726 622,89	833 863,75	—	34 430 481,30
Grants .....	—	1 076,09	22 439,53	—	—	—	—	23 515,62
<i>Adjustments previous year:</i>								
CSIR .....	—	—	—	—	1 218,27	—	—	1 218,27
Grants .....	—	—	—	—	—	—	—	—
<i>Received:</i>								
CSIR .....	705 172,32	123 673,25	19 682,00	—	1 949 992,07	40 645,65	—	2 839 165,29
Grants .....	—	—	—	—	—	—	—	—
	81 148 447,47	6 291 866,80	7 375 998,60	49 767,24	104 650 237,76	3 883 723,55	1 389 398,55	204 789 439,97
<i>Less: Reductions</i> .....	—	26,21	153 723,28	—	2 600 041,17	108 918,65	162 455,12	3 025 164,43
<i>Relinquished</i> .....	—	—	4 425,68	—	359 125,81	169,59	—	363 721,08
<i>Written off:</i>								
CSIR .....	—	26,21	146 687,50	—	2 240 915,36	108 749,06	—	2 496 378,13
Grants .....	—	—	—	—	—	—	—	—
<i>Adjustments previous year:</i>								
CSIR .....	—	—	2 610,10	—	—	—	—	2 610,10
Grants .....	—	—	—	—	—	—	—	—
<i>Stores Decrease</i> .....	—	—	—	—	—	—	162 455,12	162 455,12
<i>Balance</i> .....	R81 148 447,47	6 291 840,59	7 222 275,32	49 767,24	102 050 196,59	3 774 804,90	1 226 943,43	201 764 275,54



# Financial statements

## COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

## STATEMENT 2

### STATEMENT OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31 MARCH 1984

	Grants R	CSIR R	Total R	1982/83 R
<i>Income</i>				
Parliamentary grant .....	6 071 100,00	96 777 213,35	102 848 313,35	79 925 890
Contributions to CSIR projects .....	44 000,00	3 986 412,13	4 030 412,13	1 572 630
Investigations and services .....	—	45 205 125,28	45 205 125,28	39 335 252
Publications .....	343,26	735 439,94	735 783,20	504 529
Sundry .....	30 658,90	891 794,68	922 453,58	1 188 692
<i>Total</i> .....	R6 146 102,16	147 595 985,38	153 742 087,54	122 526 993
<i>Less: Expenditure</i> .....	6 291 854,69	140 229 776,87	146 521 631,56	118 958 923
Salaries, wages and allowances .....	277 383,01	99 826 497,91	100 103 880,92	80 364 003
Consumable stores and services .....	17 106,02	35 568 837,81	35 585 943,83	30 170 658
Subsistence and transport .....	65 892,89	4 628 825,59	4 694 718,48	4 273 842
General expenses .....	(9 263,00)	9 771 342,81	9 762 079,81	7 159 773
Extraordinary expenses .....	—	31 384,82	31 384,82	19 873
Grants .....	5 791 274,12	4 335 464,35	10 126 738,47	8 787 685
Subsidies: Research by industry .....	—	1 069 516,51	1 069 516,51	1 081 396
Levies and depreciation .....	151 549,92	16 024 735,75	16 176 285,67	11 822 927
	6 293 942,96	171 256 605,55	177 550 548,51	143 680 157
<i>Less: Income internal services</i> .....	2 088,27	31 026 828,68	31 028 916,95	24 721 234
<i>Subtotal</i> .....	R(145 752,53)	7 366 208,51	7 220 455,98	3 568 070
Transfer to other funds .....	—	3 029 663,00	3 029 663,00	3 144 583
Equipment Fund .....	—	2 931 995,00	2 931 995,00	3 053 583
Building Fund .....	—	97 668,00	97 668,00	91 000
<i>Excess income transferred to accumulated funds</i> .....	R(145 752,53)	4 336 545,51	4 190 792,98	423 487

PRETORIA

(Sgd.) J D VAN ZYL  
Chief Director: Administrative Services

(Sgd.) C F GARBERS  
President



# Financial statements

## COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

## STATEMENT 3

CSIR BUDGET 1984/85

### A. OPERATING EXPENDITURE

ACTIVITIES	EXPENDITURE						FUNDS	
	Salaries R	Direct running expenses R	Awards and subsidies R	Total R	Parliamentary grant R	Recoverable Expenditure		
						Internal R	External R	
CSIR laboratories and departments .....	109 098 412	68 534 845	—	177 633 257	105 794 879	20 326 016	51 512 362	
Grants and subsidies .....	2 507 565	3 317 754	20 774 390	26 599 709	18 546 121	1 148 048	6 905 540	
<i>Subtotal</i> .....	111 605 977	71 852 599	20 774 390	204 232 966	124 341 000	21 474 064	58 417 902	
<i>Less: Internal Revenue</i> .....	—	21 474 064	—	21 474 064	—	21 474 064	—	
<i>Total</i> .....	111 605 977	50 378 535	20 774 390	182 758 902	124 341 000	—	58 417 902	

### B. CAPITAL EXPENDITURE

ACTIVITIES	EXPENDITURE						FUNDS	
	Books/ Journals R	Technical equipment and vehicles R	Furniture/ office equipment R	Bicycles R	Buildings R	Total R	Parliamentary grant R	Recoverable expenditure R
CSIR laboratories and departments .....	1 415 035	21 790 181	544 290	1 475	11 376 000	35 126 981	32 609 081	2 517 900
Grants to universities, etc. ....	11 000	2 167 694	54 800	—	—	2 233 494	1 676 919	556 575
<i>Total</i> .....	1 426 035	23 957 875	599 090	1 475	11 376 000	37 360 475	34 286 000	3 074 475
<i>GRAND TOTALS A &amp; B</i>						220 119 377	158 627 000	61 492 377



## CSIR PERIODICAL PUBLICATIONS

### **Annual report of the CSIR**

Gratis.

### **Scientiae**

Quarterly. Feature articles and news items on scientific topics. Gratis.

### **TI – technical information for industry**

Irregular. Short articles on aspects of CSIR research with industrial application. Gratis.

### **CSIR publications**

Quarterly list of articles and reports published under the auspices of the CSIR, with keyword and author indexes. Also contains information on recent translations by the CSIR Foreign Language Service. Gratis.

### **The CSIR – organization and activities**

Regularly updated. A directory of the various divisions and services of the CSIR. Gratis.

### **Scientific research organizations in South Africa**

Every two years. A guide to government organizations, statutory bodies and industrial concerns which maintain research laboratories. Price varies.

### **Scientific and technical societies in South Africa**

Every two years. A guide to societies, giving particulars of their aims and objects, membership, publications, etc. Price varies.

### **NBRI information sheet**

Every two months. Brief articles on technical and practical problems related to building. Gratis.

### **Housing research review**

Irregular. Newsletter of the Housing Research Information Service, National Building Research Institute. Gratis.

### **Houtim**

Quarterly. Technical news for the timber industry, compiled by the National Timber Research Institute. Gratis.

### **VIA**

Abstracts bulletin published twice a year covering all unrestricted technical reports and other publications of the National Institute for Transport and Road Research issued during the preceding six months. Gratis.

### **SAWTRI bulletin**

Quarterly. Technical news for the textile industry compiled by the South African Wool and Textile Research Institute. Gratis.

### **Water report**

Six-monthly. National Institute for Water Research newsletter. Gratis.

### **NEERI news**

Quarterly. General newsletter of the National Electrical Engineering Research Institute. Gratis.

### **Transport and road digest**

Irregular. Summaries of research projects giving the background and main results. Issued by the National Institute for Transport and Road Research. Gratis.

### **GTES newsletter**

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### **NAC news**

Irregular. Short reports on the progress of the National Accelerator Centre. Gratis.

### **NRIMS current activities**

Quarterly. Newsletter containing abstracts of reports recently issued by the National Research Institute for Mathematical Sciences. Gratis.

### **Appropriate technology newsletter**

Irregular. Review articles and announcements regarding appropriate technology. Issued by the Industrial Extension Service, National Institute for Informatics. Gratis.

### **NCRL news**

Six-monthly. General information on the scientific programme and activities of the National Chemical Research Laboratory. Gratis.

### **ENQUIRIES:**

Publishing Division, CSIR, P O Box 395, Pretoria, 0001  
Telephone: (012) 86-9211 extension 2118 or 4062

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