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CSIR

annual report 

1976



1976

**council  
for scientific and  
industrial research**

thirty-second  
annual report

CSIR

Council for Scientific and Industrial Research



Office of the President

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Our ref.

Your ref.

1 May 1977

Dr the Hon. S W van der Merwe  
Minister of Planning and the  
Environment  
Private Bag X9068  
CAPE TOWN  
8000

Sir

I have pleasure in presenting to you the thirty-second Annual Report of the Council for Scientific and Industrial Research. This report covers the period 1st January 1976 to 31st December 1976.

Balance sheets and statements of income and expenditure for the financial year ended 31st March 1976, certified by the Controller and Auditor-General, are included.

Yours faithfully

C vd M Brink  
P R E S I D E N T

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*The activities of the year under review are dealt with under headings reflecting the broad aims of the CSIR. The superior numbers in the text, e.g. 15, refer to the relevant Institutes, the functions of which are outlined on pages 54 to 60.*

# Members of the Council for Scientific and Industrial Research

**Dr C vd M Brink** — Chairman  
*President of the CSIR*

**Prof A J Brink**  
*President*  
*South African Medical*  
*Research Council*

**Mr M T de Waal**  
*Joint General Manager*  
*Industrial Development*  
*Corporation of South Africa Ltd*

**Mr G C V Graham**  
*Managing Director*  
*Veldspun (Pty) Ltd*

**Dr J N van Niekerk**  
*Head*  
*Basic Research Division*  
*Research Department, ISCOR*

**Dr A J A Roux**  
*President*  
*Atomic Energy Board*

**Mr J W Shilling**  
*Former Director*  
*Anglo-American Corporation*  
*of South Africa Ltd*

**Prof E T Woodburn**  
*Head*  
*Department of Chemical Engineering*  
*University of Natal*

**Dr P S Rautenbach**  
*(until 22 June 1976)*  
*Chairman*  
*Public Service Commission*

**Dr L B Knoll**  
*Managing Director*  
*Massey-Ferguson South Africa Ltd*

**Prof H P van der Schijff**  
*Dean*  
*Faculty of Science*  
*University of Pretoria*

**Mr D P de Villiers**  
*(from 27 January 1976)*  
*General Manager*  
*South African Coal, Oil and*  
*Gas Corporation Ltd*

**Mr L F Rive**  
*(from 27 September 1976)*  
*Postmaster-General*

## Executive of the CSIR

*President*

**Dr C vd M Brink**

*Deputy President*

**Dr F J Hewitt**

*Vice-Presidents*

**Dr P J Rigden**

**Dr A P Burger**

**Dr J F Kemp**

Research as an investment

*The CSIR, like many other organizations in South Africa and elsewhere, is faced with the problem of rising costs without a corresponding increase in income. This has curbed normal expansion and in certain cases has also meant curtailment of activities. While priority has been given to those projects related to the most urgent national needs, some other less pressing though equally important activities have had to be neglected.*

*It should be stressed in this connection that while the CSIR devotes a major part of its resources to applied research aimed at the solution of immediate problems, it also has an important obligation concerning basic research. Basic research provides a foundation of knowledge for the solution of future problems and often enables our scientists to make significant contributions to the world's fund of scientific knowledge*

the  
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— thus enhancing our international scientific standing. The CSIR therefore endeavours to maintain a sound balance between basic and applied research. Expenditure on research, whether basic or applied, should be seen as an investment in the national interest.

#### New knowledge and techniques

*A standard base line is now available within South Africa for the calibration of distance measuring equipment. The setting-up of this base line provides a good example of co-operation at the national and international level in that the work was undertaken by the CSIR in collaboration with the Director-General of Surveys while the final measurements were done by scientists of the Finnish Geodetic Institute in Helsinki which has evolved the most accurate measuring technique for this purpose and has undertaken similar work for base lines in other countries.*

*Another milestone was reached with the successful completion of a research project to develop an absolute radiometer as a new light standard. This new development in the maintenance of national standards of measurement (one of the CSIR's statutory functions) is of particular significance for the calibration of standard lamps used by the South African Bureau of Standards and by industry for the precise measurement of light intensity in the manufacture and calibration of photographic and television equipment, light meters, light bulbs, and other artificial light sources. It also means that South Africa has now become independent of overseas light intensity standards.*

*An important new facility for research into the behaviour of materials under high pressure and at high temperatures was commissioned during the year. The fact that this equipment, a highly sophisticated hydraulic press, was designed by the CSIR and manufactured by a firm in Johannesburg, has meant considerable savings in foreign exchange. Imported equipment of comparable performance would have cost approximately five times as much.*

*Because of its geographical situation South Africa offers unique opportunities for studying the Indian, Atlantic and Southern Oceans. An important experiment started during the year under review involved the use of free-drifting buoys to collect data on the Southern Ocean. Buoys were dropped in the Southern Ocean by the relief ship RSA on its way from Antarctica to the Cape to transmit meteorological and oceanographic data to South Africa via an American communications satellite. This experiment forms part of the preparations for participation in the Global Atmospheric Research Programme, probably the biggest ever international co-operative scientific project. The CSIR, the South African Weather Bureau and the University of Cape Town are participating in this project which could provide valuable data, including information required for the protection of ocean and coastal engineering ventures in South Africa.*

#### Development of the infrastructure

*The CSIR was also involved in large-scale investigations into current circulation in Saldanha Bay. As in the case of investigations concerning various aspects of harbour development at Richards Bay, the CSIR is making an important contribution to the development of Saldanha Bay by advising on layout of the breakwater system, wave penetration in the harbour and related aspects.*

*Another major project related to the development of the infrastructure is a geomechanics investigation undertaken on behalf of the Electricity Supply Commission (ESCOM) for the proposed Elandsberg hydro-electric scheme at Tulbagh. This scheme involves major underground excavations and tunnelling in unfavourable rock conditions for which highly specialized tests and investigations are required. The CSIR investigations should provide the necessary design data for determining the safest and most economical excavations. With adequate knowledge of the rock conditions considerable savings could be effected as the contractors would not have to make provision for unforeseen problems.*

*The CSIR is also assisting ESCOM with certain aspects of the proposed nuclear power station at Koeberg in the Cape, mainly with specialized testing of soils and materials.*



*In February 1976 the National Road Research Institute of the CSIR was formally renamed National Institute for Transport and Road Research. This change of name follows expansion of the Institute's activities in the fields of transport and traffic research (referred to in the report for the previous year). CSIR activities in the field of road research started in 1951 with the establishment of the Bituminous Binder Research Unit. In 1955 that Unit became the nucleus of a national road research institute whose activities were financed largely by the Department of Transport and the provincial authorities and which in course of time has developed into one of the CSIR's largest institutes with a staff of 240 and activities embracing all aspects of road construction and use. In recent years the activities of the Institute have included the development of an impact roller for road construction, investigations into the effects of abnormal loads on roads, studies related to pedestrian bridges, recommendations for new vehicle registration plates, seatbelts and testing devices for blood alcohol, the development of traffic prediction models, research on urban transport undertakings and the economic evaluation of road engineering projects.*

*For many years the CSIR has made important contributions towards optimum utilization of South Africa's limited water resources. Another milestone in research on water reclamation was reached with the opening of the extended and modernized reclamation plant in Windhoek. The extensions and modifications to the original plant, which was commissioned in 1969 and which made Windhoek the first city in the world to reclaim sewage on a continuous basis for domestic use, are based on further research conducted by the CSIR with financial support of the Water Research Commission.*

## Industrial development

*The establishment of a facility for the manufacture of integrated circuits at the CSIR is of considerable economic and strategic significance to South Africa. At the official opening of the new facility in August, an occasion attended by distinguished guests from both the public sector and the electronics industry, the Minister of Defence pointed out that a production facility is a prerequisite in any country wishing to develop advanced electronic equipment of its own design. Special purpose circuits are becoming increasingly complex and the design of modern electronic equipment must be undertaken by or in close collaboration with the manufacturer. The CSIR has been manufacturing integrated circuits for experimental purposes since 1973 and has acquired considerable expertise in this field. It should be stressed that the CSIR facility will in no way duplicate existing facilities in industry but should rather be seen as an important complementary service. Although it represents a considerable capital investment without direct contribution from or risk to industry, this service will enable local industry to develop the design and manufacture of advanced and unique electronic equipment on an experimental basis. Industry itself will be responsible, however, for any large-scale production of integrated circuits for which there may be a need at a later stage.*

*Another project aimed at making South Africa less dependent on imported materials, is the development of catalysts for use in the petroleum and petrochemical industry. The production of such catalysts from locally available sources is being investigated by the CSIR in conjunction with industry and other research workers in South Africa. This could also mean a saving of several millions of rand in foreign exchange.*

*Following considerable expansion of CSIR research into better utilization of timber, the Timber Research Unit acquired full institute status in February and is now known as the National Timber Research Institute. The original Timber Unit which was established in 1960 under the aegis of the National Building Research Institute, became an independent unit in 1966. Since then it has served the fast-growing timber industry and its staff has grown from 4 to 75. The Institute's current activities include investigations into new pulping methods for better utilization of local raw materials (including the manufacture of paper and rayon pulp from bagasse), engineering uses of timber (for roof trusses etc.), production of stocklam of acceptable quality (which also involves the development of new adhesives based on locally available raw materials), development of equipment for the saw-milling industry (such as a device for measuring sawmill output) as well as techno-economic studies for the timber industry.*

*In the field of textile technology the CSIR has made an important contribution in developing a process for simultaneous flame-proofing and shrinkproofing of woollen fabrics. It was found that a chemical used in the textile industry for flameproofing of cotton, also imparts shrink-resistant properties to woollen fabrics without the adverse effects on the handling and feel of the fabric associated with the normal shrinkproofing resin. The Institute responsible for this development is the South African Wool and Textile Research Institute which will be celebrating its 25th anniversary in 1977. Originally established in Grahamstown by the South African Wool Board, the Mohair Board and a number of textile manufacturers, the Institute was moved to Port Elizabeth in 1967. On becoming a national institute of the CSIR in 1971, the scope of its research was extended to cover the natural fibres (both vegetable and animal) as well as synthetic fibres.*

*A project of considerable significance to South African manufacturing industry in general was highlighted during the year when the Minister of Labour officially commissioned a mobile climate laboratory at the CSIR. This project, which is being undertaken by the National Building Research Institute and sponsored by the Department of Labour, is concerned with measuring the effect of indoor climate factors such as temperature, humidity and ventilation, and certain other factors such as noise and lighting, on the productivity of factory workers. The information gained from these studies will also be used in bringing the South African Factories Act up to date. The mobile climate laboratory, which was designed and constructed at the CSIR with the assistance of a research consultant from Sweden, will be visiting factories throughout the country to study the reactions of factory workers in their own working environments. These studies could well lead to better working conditions for factory workers, not only in South Africa, but throughout Africa and even in other countries with comparable climates.*

#### International liaison

*During the year an agreement was entered into for extended scientific and technological co-operation with Israel. While South Africa and Israel have been exchanging information and expertise in fields of common interest for many years, this agreement between the CSIR and Israel's National Council for Research and Development (NCRD), and a similar agreement between the agricultural departments of the two countries, is seen as the beginning of a new phase of co-operation particularly in the exchange of scientists. The foundation for the agreement was laid in April 1975 when the President of the CSIR and the Secretary of Agricultural Technical Services visited Israel as guests of the NCRD. One of the objects of the visit was to investigate ways and means for extending scientific co-operation between the two countries. During a visit to South Africa by the Director and Deputy-Director of the NCRD and an executive of Israel's agricultural research organization, details of the proposed programme for further co-operation were agreed upon and some months later a joint statement was issued. The agreement between the CSIR and the NCRD provides for the exchange of 12 man-months of research per year in various fields of science and*

*technology. Also envisaged as part of the programme of co-operation are annual joint symposia on topics of mutual interest, to be held alternately in South Africa and in Israel. The symposium on the recycling of waste water held in Israel during November 1975, was taken to be the first within this framework.*

*Another notable event concerning scientific co-operation with Israel was a three-day conference held in April 1976 at the University of the Witwatersrand to commemorate the birth one hundred years ago of the late Dr Chaim Weizmann, the famed biochemist who became the first President of the State of Israel. The conference was organized by the South African Committee of the Weizmann Institute of Science in collaboration with the CSIR.*

*These developments also brought a number of distinguished visitors from Israel to the CSIR during the year, including Prof. M A Brull, Dean of the Faculty of Engineering at the University of Tel Aviv, Dr E Tal, Director of the NCRD, Mr Y Zaphir, Deputy Director of the NCRD, Prof. S Lavee of the Volcani Institute and Prof. G Goldrich of the Weizmann Institute.*

*A distinguished visitor from Britain was Sir Ieuan Maddock, Chief Scientist of the United Kingdom Department of Industries. Sir Ieuan, who visited South Africa as a guest of the CSIR, also visited various other research institutions in South Africa and gave the keynote address at a one-day seminar on industrial research and development organized by the CSIR in Johannesburg.*

*The CSIR was also privileged in having as its guests Prof. R Lüst and Dr F Schneider, President and Secretary-General respectively of the Max-Planck-Gesellschaft in Germany. The places visited by them included the CSIR Radio Astronomy Observatory at Hartebeesthoek and the observing station of the South African Astronomical Observatory at Sutherland.*

*The numerous scientific meetings in South Africa with which the CSIR was associated during the past year included two major international symposia. One dealt with the role of analytical chemistry in the exploration, mining and processing of materials and was held under the auspices of the International Union of Pure and Applied Chemistry (IUPAC). The other covered a topic of equal importance to South Africa, viz automation in mining, mineral and metal processing and was organized by the CSIR on behalf of the South African Council for Automation and Computation (SACAC) under the auspices of the International Federation of Automatic Control (IFAC). At both symposia papers were presented by overseas and South African specialists.*

*Participation by South African scientists in scientific meetings abroad is also considered to be of great value as in many cases these meetings offer the opportunity for exchanging of ideas on research results and developments in advance of publication in the scientific literature. In addition to contact maintained by scientists at the specialist level, the CSIR continues to play an important part in representing South African scientific interests in general through membership of the International Council of Scientific Unions (ICSU). The universality of science, which is a guiding principle of this non-governmental body, was emphasized by one of the recommendations at the 16th General Assembly of ICSU held in Washington DC during 1976. South Africa was represented at this meeting by the President of the CSIR and the Head of the CSIR International Relations Division.*

*The President of the CSIR also visited the Netherlands during the year as guest of the research organization TNO. During the previous year the President of the TNO had visited South Africa as a guest of the CSIR.*

#### National liaison

*During the year under review the CSIR was honoured to receive a visit from members of the Parliamentary Planning Group, including the Minister of Health, Planning and the Environment and the Deputy Minister of Planning. This was the second visit to the CSIR by Dr the Hon. S W van der Merwe since he assumed the portfolio of Planning and the Environment. The Council greatly appreciates the interest shown by Dr Van der Merwe and is looking forward to a period of fruitful co-operation with him.*

*Earlier in the year formal leave was taken of the previous Minister of Planning and the Environment, Mr J J Loots, with whom the CSIR had a very pleasant association over a period of almost six years. The Council would also like to take this opportunity of wishing him every success in his new office as Speaker of the House of Assembly.*

*For some years it has been the practice to hold one of the three Council meetings each year away from Pretoria in a centre where the CSIR is represented. On the eve of the Council meeting held in Bloemfontein during October, an audio-visual programme on the activities of the CSIR was presented to a number of distinguished guests from academic, professional and industrial circles in that city. The programme consisted of a slide series on CSIR activities of particular importance to the Orange Free State and a new CSIR film dealing with research in road safety. During the same week, three of the local libraries — the Bloemfontein Public Library, the library of the Bloemfontein Teachers' Training College and the Library of the University of the Orange Free State — arranged special exhibitions of CSIR photographs and publications together with their own collections of scientific material. The interest shown by these bodies and by the local newspapers and broadcasting service is greatly appreciated.*

*Another notable regional event was an open day held in Stellenbosch on 30 September by the National Research Institute for Oceanology to coincide with the 5th Western Cape Regional Conference of the South African Institution of Civil Engineers. The exhibits in the Institute's large model shed, which included hydraulic models of the Umgeni and Illovo rivers, the harbour developments at Richards Bay, Swakopmund, Knysna and Gansbaai, as well as the Koeberg scheme, evoked considerable interest.*

#### New appointments

*The appointment of two new Council members was announced during the year. Mr D P de Villiers, Chairman of the South African Coal, Oil and Gas Corporation Ltd (SASOL) was appointed to replace Dr B Gaigher, Member of the Board of Trade and Industries, who had been a Council member for almost 19 years. Mr L F Rive, Postmaster-General, was appointed in the place of Dr P S Rautenbach, formerly Secretary for Planning and at present Chairman of the Public Service Commission.*

*At the end of 1976 the CSIR took leave of one of its Vice-Presidents, Dr A P Burger, who had been appointed Scientific Adviser to the Prime Minister with effect from 1 January 1977. Dr Burger, who had been with the CSIR since 1957, first as Head of the former Applied Mathematics Division in the National Physical Research Laboratory, became the first Director of the National Research Institute for Mathematical Sciences in 1961 and held that post until 1973 when he was appointed Vice-President. In the latter capacity his responsibilities included support of university research as well as CSIR activities in the fields of mathematical sciences, personnel research and oceanography. The Council wishes him every success in his new office.*

*Towards the end of the year it was announced that Dr D M Joubert, Director of the Transvaal Region of the Department of Agricultural Technical Services, had been appointed a Vice-President of the CSIR with effect from 1 February 1977. The Council takes this opportunity of welcoming him to the organization.*

*Mr F P Anderson was appointed Director of the National Research Institute for Oceanology (with headquarters in Stellenbosch) as from 12 February 1976. He succeeds Dr E S W Simpson who has taken the chair in oceanography at the University of Cape Town.*

*Sir Richard van der Riet Woolley, who has been Director of the South African Astronomical Observatory since its establishment in January 1972, retired at the end of 1976. He is succeeded by Dr M W Feast who has been attached to the Observatory since 1974.*

*Dr G K Nelson has been appointed Director of the National Institute for Personnel Research in succession to Mr D J M Vorster who retired at the end of December. Dr Nelson, who has been with the Institute since 1953, was previously Assistant Director.*

*A veteran physicist of the CSIR, Dr E C Halliday, retired in July 1976 and was succeeded as Head of the CSIR Air Pollution Research Group by Dr G P N Venter who has been with the CSIR since 1965.*



# knowledge - development and application

## Pharmacologically active substances

The reported antibiotic and fungicidal activity of an important class of peptide nucleosides, the polyoxins, has prompted the synthesis of a related analogue<sup>1</sup>. A sugar derivative with a protected amino acid moiety as a branched chain at C(3) was used as the starting material. Some unusual acetyl migrations occurred under acidic conditions during the preparation of the polyoxin.

An important objective in the continuing programme on the synthesis of steroidal analogues possessing unnatural configuration is the interpretation of the relationship between structural modifications and hormonal activity. Studies in the retrosteroid series have demonstrated the sensitivity of such activity towards changes in the conformation and substitution patterns. This phase of the work is nearing completion, and attention is now being turned to a series of dimensional analogues of testosterone with structural variations in a terminal ring.

## Metabolites of poisonous fungi

A mycotoxin from *Phoma sorghina* was implicated in the aetiology of onyalai, a haematologic disorder which occurs widely amongst the Black African population south of the Sahara. The extraction of cultures of this fungus has led to the characterization of magnesium and calcium tenuazonate as the apparent responsible mycotoxins<sup>1</sup>.

The structure of viridicatumtoxin, a metabolite of *Penicillium viridicatum*, was elucidated in collaboration with Japanese and American scientists. This substance represents a new type of mycotoxin and is structurally related to the tetracyclines.

## Structure-function relationships in proteins

As a sequel to the primary structural determinations of snake venom components, similarities have been found with the sequences of various secretory proteins from mammalian sources<sup>1</sup>. These similarities point to mammalian pancreatic enzymes such as phospholipase A and ribonuclease as the evolutionary precursors for the development of toxic secretions in snakes. On a molecular level, therefore, snake venom should be considered as a modified digestive secretion.

In the field of phosvitin biochemistry it has been found that primary structures of thirty-eight residue *N*-terminal peptides from hen, duck and turkey phosvitins all show a characteristic grouping of phosphoserine residues into blocks, interspaced with the remaining residues. This knowledge is an invaluable aid to a mechanistic interpretation of the phosphorylation-dephosphorylation process which, in phosvitins, is found to be different from other phosphoproteins.

## Ruminant digestion

The nature of the microbiological and biochemical changes in the rumen of sheep during gradual adaptation from a high roughage to a high grain diet has been investigated<sup>1</sup> in collaboration with members of the Veterinary Research Institute at Onderstepoort. It has been shown that two mechanisms for controlling the rumen fermentation are developed.

Initially there is a slow increase in the numbers of ruminal protozoa. These take up the greater part of the grain starch and prevent the bacteria from fermenting it. They also ingest the bacteria and prevent them from multiplying excessively. At high levels of grain intake the protozoa can no longer control the bacteria, and there is a sharp increase in the numbers of starch-fermenting bacteria which produce lactic acid, the major cause of acid indigestion in the animal. At this stage, however, the control of the fermentation is taken over by bacteria which can ferment lactic acid to less harmful end products. The numbers of these bacteria increase at the same or a faster rate than those of the starch digesters. In this way they prevent the accumulation of lactic acid and maintain healthy conditions in the rumen.

## Applications of X-ray photoelectron spectroscopy

The alteration in the physical properties of materials subjected to high fluxes of radiation or charged particles has important consequences for nuclear and space technology. Most effort has been concentrated on research into the production of defects and voids, but it is also important to investigate the more subtle chemical changes in irradiated solids. X-ray photoelectron spectroscopy has been used to follow the kinetics of the surface reduction of sodium perchlorate, where the generation of a grossly-defect sodium chloride phase was established<sup>1</sup>.

Niobium films supported on a stainless steel substrate can be used as very efficient superconductors for alternating current. It has been found that a layer exists between substrate and film, which improves adhesion at liquid helium temperatures. X-ray photoelectron spectroscopy has been used to show that this intermediate layer is composed chiefly of niobium carbide.

## Analytical chemistry

The systematic determination of ion exchange distribution coefficients continues<sup>1</sup>. The aim of this long-term project is to collect fundamental data which can be used to develop effective methods for the complete separation of complex mixtures of inorganic elements. The data collected are not only very valuable for the analytical chemist but have also found application in other fields, such as radiochemistry, throughout the world. At present the tartaric acid-tartrate system is being investigated.

A very selective method for the separation of beryllium from other elements by ion exchange chromatography has been developed. Trace amounts of beryllium in the six South African NIM-rock standards have been determined accurately by combining the ion exchange separation with a determination by spectrophotometry or by atomic absorption spectrometry with a graphite rod. A practical sensitivity of about 0,02 ppm beryllium in 1 g of rock could be obtained with both methods and the results showed excellent agreement. They were the first usable results published for those NIM-rock standards which contain very low beryllium traces.

## Platinum metal compounds

The platinum metal producers have renewed and increased a grant via the Chamber of Mines for another period of five years to support fundamental work on the platinum group metals.

Good progress was made during the past year on the mechanistic studies of iridium(I) complexes<sup>1</sup>, representing an area of platinum metal chemistry where fundamental knowledge is lacking. Firstly, the pattern of reactivity of the four-coordinate complexes shows marked changes from that established for rhodium(I). Secondly, a careful investigation of an oxidative-addition reaction has given detailed insight into the mechanism, and complemented the preparative programme that preceded it.

## Locally produced isotopes in Viking probe

The radioisotopes cadmium-109 and iron-55, manufactured at the CSIR<sup>2</sup>, are at present being used as X-ray sources for the analysis of soil samples scraped from the Martian surface. The cadmium-109 isotopes were produced from silver originating from South African gold mines and the iron-55 isotopes originated from locally mined manganese.

## Production of radioisotopes for medical purposes

Development of the radioisotope production programme is continuing at the CSIR cyclotron<sup>2</sup>.

A new radioisotope, krypton-81, has been made available for nuclear medicine since the beginning of the year. This isotope of krypton has a half-life of 13 seconds only, which rules out distribution as such. Its precursor, rubidium-81, however, has a more manageable half-life of 4,7 hours, so that it is possible to distribute a rubidium-krypton generator system which stays useful for a working day.

The radioactive krypton gas is most useful for lung function studies, and the hospital currently using it reports excellent results. This hospital would like to be supplied on a daily basis, but the full programme at the cyclotron allows only one or two deliveries a week.

## Labelled compounds

Bleomycin is an antibiotic with chemotherapeutic effects on certain types of cancer. To trace the movement and action of this preparation in the body, it is desirable to label it with a suitable radioisotope.

Labelling of bleomycin proved to be unsatisfactory in the past because of instability of the labelled compound. A successful method has been developed at the CSIR<sup>2</sup> for the labelling of bleomycin with carrier-free copper isotopes. Unfortunately the radiation characteristics of the available copper isotopes are not very satisfactory, but the labelled bleomycin nevertheless has already been supplied to three research hospitals for testing and evaluation.

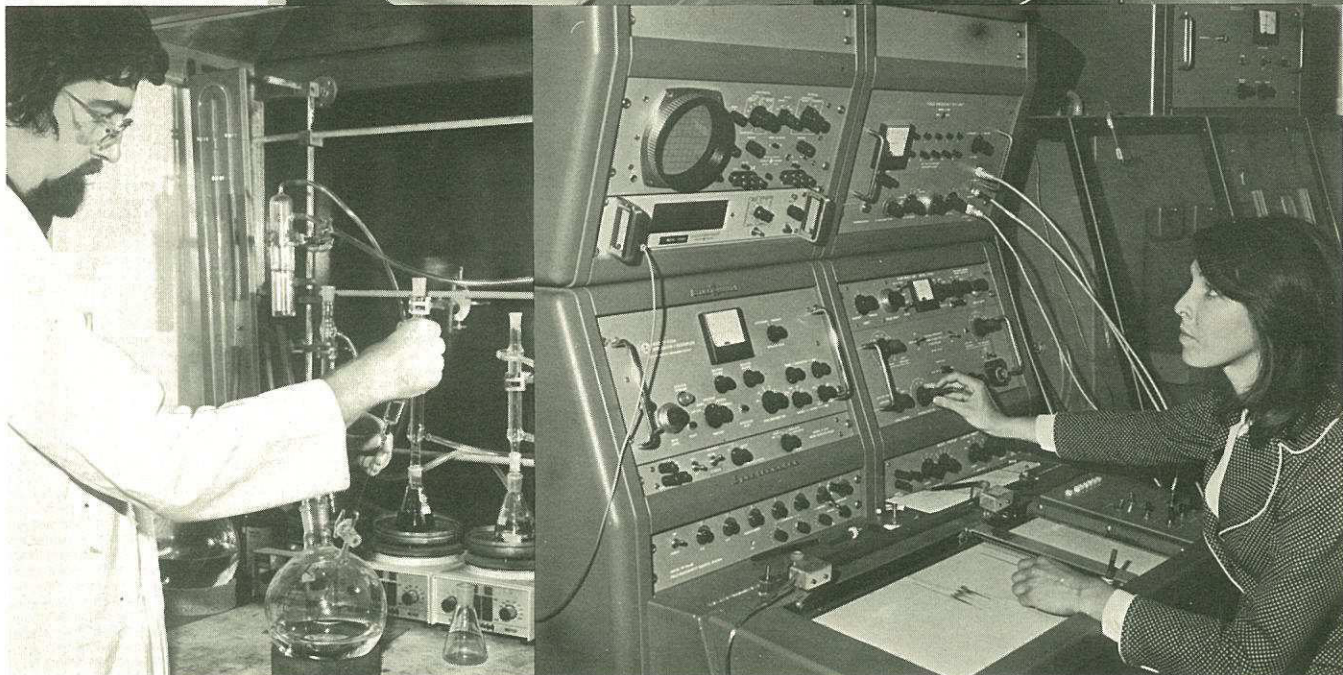
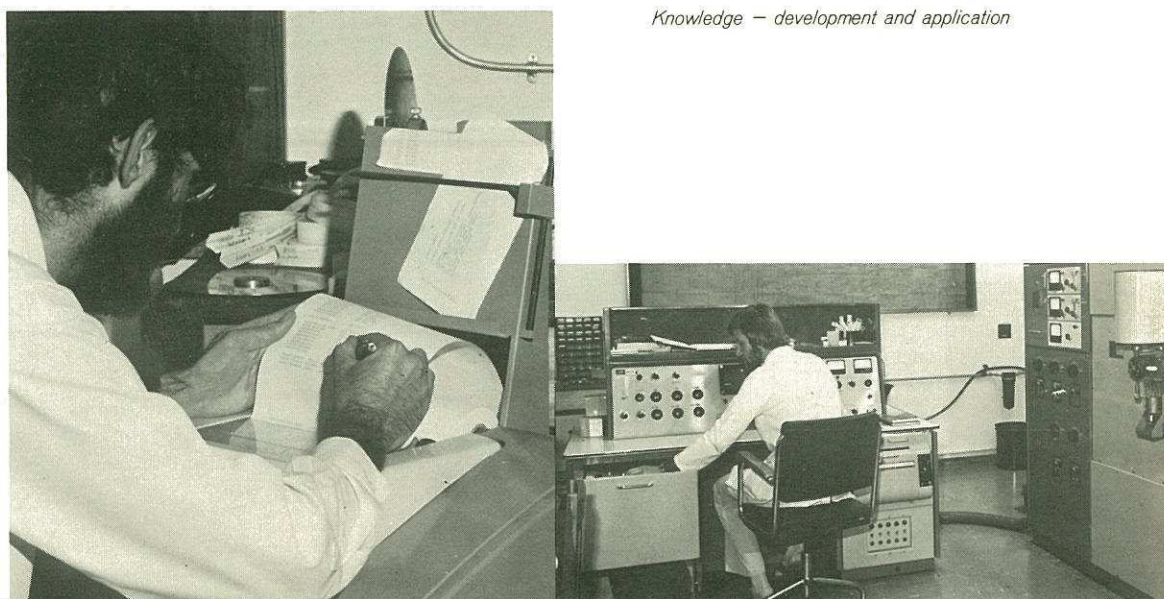
## Compact single-element analyser

This year saw the completion of the laboratory version of a very simple single-element analyser<sup>2</sup>. Aimed at providing a robust instrument for industrial application, the device combines the remarkable properties of the glow discharge source with resonance fluorescence from an atomic cloud. The unit is small and compact and is independent of temperature and unaffected by mechanical shocks or vibrations. The shapes of the emission and absorption spectral lines are essentially similar so that optimum conditions for the transfer of energy exist, resulting in a remarkably wide linear analytical range, e.g. in aluminium alloys copper may be determined from 0,0002 to 20 per cent.

A commercial prototype of this unit is now being developed.

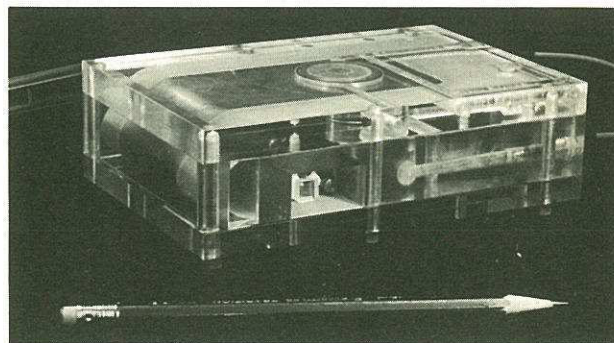
## Specimen degradation in electron microscopes

When a sample is introduced into an electron microscope, contamination occurs which degrades the ultimate resolution of the image. This phenomenon has been a problem since the beginning of electron microscopy in 1934 and still exists even in the most sophisticated electron microscopes.



The composite photograph above portrays typical activities in the laboratory, i.e. high-resolution mass spectrometry; preparation of organo-metallic compounds with potential catalytic activity; nuclear magnetic resonance spectroscopy.

**High-pressure pulsed gas lasers (p. 16):** This miniature model of a nitrogen laser (right) was developed from the experimental model (left).



As a result of research work done at the CSIR<sup>2</sup>, a physical model has been formulated which can explain all contamination phenomena and which, moreover, suggests various possibilities for preventing the contamination problem. Furthermore, the investigation has led to an unexpected result, namely a novel field of application for the electron microscope, where the adsorption energy and surface diffusivity of hydrocarbon molecules (including lubrication oils) can be investigated on any type of surface at different temperatures.

## Materials made from South African raw materials

Studies concerning the internal structural hardening of steel have indicated the importance of quality control at all stages of manufacture<sup>2</sup>. With knowledge gained in making 17-7 stainless steel contact was established with a local manufacturer. This led to the use of the ion microprobe mass analyser, a highly sophisticated instrument, to solve an important technological problem that was experienced in the manufacture of ferritic stainless steels.

Reports from overseas indicate that the demand for weldable structural steels of ever higher strength has led to the development of new types of steel and that they already represent a significant part of the product range of large steel mills in the industrial countries. This fact further underlines the necessity that our efforts as regards the study and development of materials made from South African raw materials should be increased.

## High-pressure pulsed gas lasers

The glow-mode technique for stabilising a pulsed gas discharge first developed by the CSIR<sup>2</sup> was further refined. It was combined with the travelling-wave principle and extensively applied to atmospheric and above-atmospheric pressure ultraviolet nitrogen lasers. In the large-volume versions output pulses of 3 MW and 1 nanosecond length were obtained.

A miniature version of the nitrogen laser is at present under development. Output powers of 200 kW with pulse lengths of 500 picoseconds have already been obtained from this compact and fairly robust ultraviolet emitting device. From all available information even this prototype completely outclasses all other available small nitrogen lasers. These powerful ultraviolet sources are well suited to applications, amongst others, in the fields of photochemistry, fluorescence studies and dye laser excitation.

Some US laser firms have already expressed interest in the devices developed here. Our pending patent applications should provide the necessary protection.

## Absolute radiometer

The absolute radiometer project was started some six years ago with several objectives in view<sup>2</sup>. One of the objectives, namely the establishment of a Standard of Light for South Africa, has now been achieved.

The new light standard represents a scientific advance in both accuracy and speed of measurement and is the result of research which has placed South Africa at the forefront in the field of absolute radiometry.

## Mini-counter for radiocarbon dating

A proportional gas counter has been constructed and set up at the CSIR<sup>2</sup> for the radiocarbon dating of small samples of charcoal or other plant material. It has an active volume of 42 cm<sup>3</sup>, a background counting rate of 0,16 counts per minute and a 'modern' counting rate of 0,44 cpm when filled with 100 ml of carbon dioxide gas.

For this counter a sample of at least 250 mg is needed compared with 6 to 10 g for the routine counter. The mini-counter will obviously not have the precision of larger set-ups and its range is limited to 29 000 years.

One of the uses to which this new detector will be put is the direct dating of prehistoric iron objects. The small amount of charcoal incorporated in primitive metal objects, such as an arrowhead, is sufficient for dating with this mini-counter.

## Classification of geological strata

A means of determining the geological strata from which certain water supplies in South West Africa arise was needed. To assist in this work, a mathematical analysis was carried out on the results of a chemical analysis of water samples which had been provisionally classified by stratum of origin on the grounds of geological knowledge<sup>3</sup>. The poor results of the statistical analysis led to an investigation into statistical outliers amongst the results, and this approach added much to the understanding of the problem and led to the discovery of certain errors in the original geological classification.

## Properties of mathematical models of world systems

The so-called Club of Rome was formed at a meeting in Rome in 1968. This 'club' is an informal association of about a hundred persons from more than thirty countries, with a common concern for the complex of interrelated problems which it has called 'the world problematique'. The problems include such matters as the deterioration of the environment, bureaucratization, uncontrolled urban spread, etc.

After a search for techniques which would take into account both the scale and time dimensions of the global problematique, it was decided that the systems dynamics group of Prof. Jay Forrester of the Massachusetts Institute of Technology should undertake the construction of a world dynamics model. The project was carried out by an international team led by Prof. D Meadows, and their book *The Limits to Growth* appeared in 1972. It predicted a world catastrophe and gave rise to considerable criticism, especially in regard to certain assumptions and approximations.

It has been realized, however, that the model is not unassailable from a mathematical point of view either, and consequently a CSIR staff member<sup>3</sup> undertook a sensitivity analysis of the Meadows model in co-operation with a lecturer in applied mathematics at the University of Pretoria. By analyzing the model it was possible for them to identify those quantities which have the greatest influence on the model's predictions. Further it could be shown that if the values of a few of these quantities are modified only slightly (a difference of not more than a few per cent) the model's predictions are significantly altered. Consequently one may tentatively draw the conclusion either that the 'real world' can be adequately controlled by appropriate small adjustments, or that the high sensitivity of the model is not a characteristic of the 'real world' and is an idiosyncrasy of the mathematical model. Further research and accumulation of modelling experience are needed in order to resolve these questions.

## Expansion of computing facilities

The CSIR's computing capacity has continued to grow ever since the computing service was established in 1958, and increasing demand has led to a recent expansion of the Computing Centre<sup>3</sup>. In particular, the existing IBM 370/158 system was equipped with a modern control system known as MVS (multiple virtual storage). The architecture and organization of this computer system are such that it is suitable for input/output-intensive computations such as those involved in information and data processing. Scientific and engineering computations, on the other hand, are more computation-intensive and these tasks can be performed better with the Control Data CYBER 174 multiprocessor computing system which has been in operation together with the IBM system since April 1976. The computing load is therefore distributed between the two systems on this basis.

## Cepheid variables in the Magellanic clouds

The long series of photographic observations of cepheid variables in the Magellanic clouds<sup>4</sup> has reached a stage where a considerable publication has been submitted by the Royal Astronomical Society for publication in its *Memoirs*. It describes the light curves of 95 of these variables.

## Infrared photoelectric observations

An infrared photometer which is capable of observing out  $3.5\mu$  has been constructed<sup>4</sup>. The interstellar absorption in this spectral region is so small that observations can be made into the central parts of the galaxy which are heavily obscured in ordinary wavelengths.

## Pulsating stars

Observations have been made at Sutherland<sup>4</sup> of two short-period variable stars (RX Eridani and UV Octantis) in the near infrared. The light curves obtained were excellent and it may be taken that the radius deduced from the pulsation using these colours need not be corrected for apparent changes of gravity (due to accelerations in the atmosphere), as had been predicted theoretically. Also, it has been shown that the classical method (so-called Baade-Wesselink method) can be replaced with advantage by another method suggested by Van Hoof many years ago but not so far exploited.

The radii of a number of classical cepheid variables were determined from a large number of photoelectric and spectrographic observations made over several years at Sutherland.

## Geophysical station, Tsumeb

In accordance with an agreement between the CSIR and the Max-Planck-Gesellschaft (MPG), the CSIR<sup>5</sup> assumed responsibility for the maintenance and operation of the MPG's geophysical station at Tsumeb on January 1, 1976. This well-equipped observing station (officially known as the Forschungsstation Jonathan Zenneck) was erected by the MPG at considerable cost in 1963-64. During the ensuing eleven years it served as a base for a variety of ionospheric and related aeronomical investigations.

The monitoring programme at Tsumeb under MPG management included the operation of a magnetic recording station on behalf of the CSIR<sup>5</sup>. The take-over of the Tsumeb station by the CSIR has provided opportunities for other South African scientists to extend their investigations to that latitude. The current and proposed activities at this station include geomagnetic and ionospheric monitoring programmes and the operation of a cosmic-ray neutron monitor. The South African research institutions involved in these programmes are the Magnetic Observatory (Hermanus), the National Institute for Telecommunications Research (Johannesburg) and the Cosmic Ray Research Unit of the CSIR (Potchefstroom).

## Magnetic information for aeronautical charts

The gradual (secular) changes in the Earth's magnetic field necessitate the periodic revision and updating of magnetic charts. One of the functions of the Magnetic Observatory during the past forty years has been the provision of up-to-date magnetic data for aeronautical charts.

The magnetic data compiled at Hermanus during 1976 for the South African Airways' air routes to the Far East and the USA were based partly on the CSIR's<sup>5</sup> own field observations and partly on the latest world charts. An opportune meeting between the head of the Observatory concerned<sup>6</sup> and the compilers of the world charts while attending a conference in France resulted in the world charts being received in good time.

## Geomagnetic research

In studies of geophysical phenomena and of solar-terrestrial relationships the maximum entropy method of spectral analysis has successfully been applied to several more geophysical time series<sup>5</sup>. Recent findings include the detection of a 60-year signal in the power spectra of length-of-day records and of magnetic observatory data. The correspondence between the two signals suggests a causal relationship and supports the view that both phenomena are produced by large-scale movements in the Earth's core.

An analysis of the 'aa' index of magnetic activity by the same method yielded several harmonics of both the 11-year solar cycle and the 22-year solar magnetic cycle. The results agree closely with those obtained from an analysis of the mean annual values of the magnetic elements. As yet no explanation has been forthcoming for the strong anomalous signal at 3,37-years in the power spectra of both magnetic activity and absolute element data.

## Model study of Saldanha Bay harbour

Several large-scale exercises to determine the current circulation in Saldanha Bay were undertaken in June and July<sup>6</sup>. These involved tracking of tidal currents using floats and drogues, as well as fixed-position measurements using current meters.

From the data obtained it has been decided to use a mathematical model as a first approximation towards predicting circulation patterns under various natural conditions. In addition, this model will be used to assess the validity of certain assumptions inherent in a physical model. A decision will then be made regarding the necessity of constructing such a physical model for further and more accurate predictions of water movement.

### Satellite-tracked buoys

Buoys are tracked at regular intervals by the Nimbus VI satellite and the positions are transmitted to the United States National Aeronautics and Space Administration (NASA) and then relayed to the CSIR's laboratories in Durban<sup>6</sup>. Data from three of these buoys are now available and will be published shortly.

There is evidence of large free-drifting eddies in the Mozambique Basin, a quasi-zonal transport of water from the northern Mozambique Basin to the Agulhas Current through a large anti-clockwise gyre, and the instability of the Agulhas Current and its transverse meandering as it passes Port Elizabeth. Very high velocities of the Agulhas Current have been confirmed.

### Refrigeration of meat

The South African Hygiene Act requires carcasses to be chilled down to a deep bone temperature of 7 °C before leaving the abattoir premises. The choice of 7 °C was adopted from the European Community Hygiene Regulations and is perhaps unfortunate because South African meat export to these countries is practically nil. To comply with this requirement and at the same time ensure a high-quality product, a two-day chilling period is required as opposed to the one-day hitherto used. The economic implications of this are, of course, considerable, as double the cold storage area has to be provided.

Recently a visit was paid to research centres and abattoir installations in Australia and New Zealand and an international conference on food science and refrigeration was attended<sup>7</sup>. From discussions there it was generally felt that the 7 °C requirement was not only impractical but also unnecessary, especially when applied to meat intended for local consumption only. This aspect of meat refrigeration will therefore be the basis for further research in co-operation with the Veterinary Research Institute at Onderstepoort. Substantial capital investment savings in new abattoir projects in South Africa can be achieved by adopting a higher bone temperature, if permissible from a health point of view.

### Lightning research

An extensive study of the characteristics and distribution of lightning discharges is being undertaken<sup>8</sup>. One of the aims is to draw up a map of the Republic showing the average number of lightning strikes to ground per square kilometre per annum which can be expected in various regions of the country.

A knowledge of this figure, the lightning ground flash density, is necessary in order to be able to estimate the number of discharges which can annually be expected to strike power transmission lines, communication networks, radio and television towers and buildings. This knowledge is of great importance in the design of protection systems.

Accordingly a national survey was instituted with the aid of various major organizations to determine the lightning ground flash density in the Republic. The survey is based on the readings of lightning flash counters which collect data at 400 selected sites throughout the Republic and South West Africa. Some counters have also been installed in Lesotho and it is hoped in time to interest other neighbouring states.

The lightning flash counter consists of a receiver which electronically advances a mechanical counter by one digit each time an electromagnetic signal characteristic of a lightning discharge is sensed. The particular flash counter in use was developed at the CSIR and is an improvement on an internationally accepted counter in that it is less sensitive to intercloud flashes, which are not of interest in this survey.

Most of the counters are being read daily, and the readings are processed at the CSIR. A computer program has been developed to analyse the data and to produce contour maps showing areas of similar lightning activity. Data will be collected over a ten-year period.



The more detailed aspects of lightning are being studied by means of a 60-m tower erected on a hill at the CSIR site. The tower is isolated from ground, and special instrumentation makes it possible to measure directly the magnitude and duration of lightning currents when the tower is struck. Currents of up to 70 000 A have been observed. Two remote cameras are trained on the tower so that the actual path followed by a lightning stroke in the air to the tower can be reconstructed in three dimensions.

A closed-circuit television recording system was introduced during the past season and is being used for viewing and recording on video tape discharges which strike the mast or occur in its immediate vicinity. This system makes it possible to examine lightning flashes in detail, and also their separate component strokes.

## Carbon regeneration for water reclamation

Active carbon plays an important role in water purification since it adsorbs organic impurities, such as dyes and pesticides. This type of carbon is not manufactured locally and, consequently, the high import costs make a significant contribution to the total cost of water reclamation.

The CSIR<sup>11</sup> has established that spent active carbon regenerated in a suitable furnace will produce water of the same quality as virgin carbon. During 1975, a regeneration furnace was installed at the Stander water reclamation plant at Daspoort, Pretoria, with financial assistance from the Water Research Commission. The furnace has been operated as an experimental production unit from the beginning of 1976. The initial solution of certain technical problems has at the same time yielded valuable information on design, operation and costs. The furnace has been designed for complete integration into the water reclamation process so that replacement of the spent carbon does not interrupt the process in any way.

The furnace has a capacity of one ton per day, which is more than adequate to supply the reclamation plant using approximately 300 kg of active carbon for the daily production of 4,5 Mℓ of purified water. The present cost of the reclaimed carbon has been estimated at about one quarter of the cost of virgin carbon, and the cost saving on virgin carbon during the past year has already more than offset the capital outlay on the furnace.

## New equipment for testing road materials

When a vehicle travels along a road, its mass, through the wheels, induces vertical and horizontal stresses within the pavement, causing temporary deformation of the road materials. Stress occurs both at the road surface and at the bottom of the asphalt surface layer.

The time in which this stress condition develops at a particular point and then recovers depends on the speed at which the vehicle is travelling and, to a lesser extent, on the stiffness of the materials in the pavement. With normal traffic the cycle ranges from 0,1 to 1 second.

Although most of the deformation in the pavement is temporary, a very small portion is permanent. That caused by one vehicle is negligible but when the load applications are frequent, as along a normally trafficked road, deformation can occur which could eventually make the road unserviceable.

In order to study the permanent deformation properties of pavement materials, it is necessary to reproduce in the laboratory as closely as possible the stress conditions present in a pavement. Triaxial testing, in which both the horizontal and vertical forces are pulsed, is the closest approximation of these conditions. Recently one of the most modern pieces of triaxial equipment, the 'Instron' apparatus which utilizes electronic control and hydraulic pressure, was installed<sup>12</sup>.

The facility is being used in an attempt to correlate laboratory results with those from the accelerated testing of sections of a freeway using a heavy vehicle simulator.

## Standard base for distance measurement

Because of the increasing accuracy of infra-red distance measuring systems there is a need for a standard against which they can be calibrated. For this reason the CSIR<sup>13</sup>, with the co-operation of the Director-General of Surveys, undertook the construction of a standard base to the north of Pretoria. The various concrete structures were completed in December 1974 and were then left to settle.

Early in 1976 two geodesists from the Finnish Geodetic Institute measured the base using the Väisälä method. Basically the method consists of successive multiplications of length, starting with a quartz rod nominally of one metre and calibrated to within  $10^{-8}$  m. The measurements are made by an extremely accurate optical interferometric technique under carefully chosen and monitored atmospheric conditions.

A group from the office of the Director-General of Surveys assisted in the final preparation of pillars and underground markers, and with various surveying operations involved in the measurement. A number of problems arose; for example, it was found that the pillars which support the measuring equipment over the underground markers were bending as a result of differential heating by the sun. However, all the problems were solved, and measurements were begun during February. Six complete measurements of the 432-m section of the base had been made by the end of March. Because of unfavourable atmospheric conditions (mainly the lack of clouds during the day) it was not possible to measure the full 864-m base as had been hoped.

The provisional results indicate that an accuracy of 50 to 80  $\mu\text{m}$  was achieved. Preparations for the extension of the measurement to 864 m and then to 1 728 m have been started. This will be done by means of infra-red distance measuring equipment.

## Facility for remote sensing

In accordance with an earlier decision by America's National Aeronautics and Space Administration (NASA), the satellite tracking station at Hartebeesthoek, which was run by the CSIR<sup>13</sup> on behalf of NASA, ceased operation at the end of October, 1975.

The station was originally established at Esselen Park in 1958 in order to track satellites as part of the USA's scientific space programme during the International Geophysical Year. Later, after the newly established NASA had set up a deep space tracking station at Hartebeesthoek, the station was moved there and considerably expanded. Over the years the station operated on a total of 253 satellites; 216 000 radio commands were transmitted to satellites and 8 550 000 minutes of data were recorded on magnetic tapes.

The station was one of the busiest in the world network and also became known as one of the most efficient. Even after the announcement of the forthcoming closure the personnel continued to maintain a high standard of performance until the end.

When closure of the station was announced it was decided to develop it as a facility for the acquisition and processing of data from remote sensing satellites. Such data, derived from multi-spectral radiometric observations of the earth's surface and atmosphere, are of national importance. In the initial phase meteorological data from the METEOSAT satellite will be provided to the Weather Bureau.

The CSIR<sup>13,21</sup> has been given the responsibility for the establishment of the facility and its operation. Operation is expected to start shortly after the launching of METEOSAT in the second half of 1977.

## Extraction of volatile components from foodstuffs

Foodstuffs normally contain a large number of volatile organic components which contribute to the food flavour, and the initial step of a flavour investigation is to obtain a representative extract of these volatiles for examination. An efficient new method for obtaining volatile extracts has been found<sup>15</sup>.

The foodstuff is placed in the lower cell of a specially designed two-chambered glass 'bomb' apparatus and at the temperature of liquid nitrogen Freon 12 solvent is added. The system is sealed and the 'bomb' is placed in a protective shield; it is then allowed to warm to room temperature, and is mechanically shaken. The following steps may then be repeated as often as necessary:

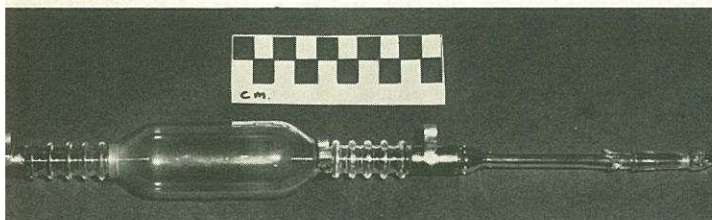
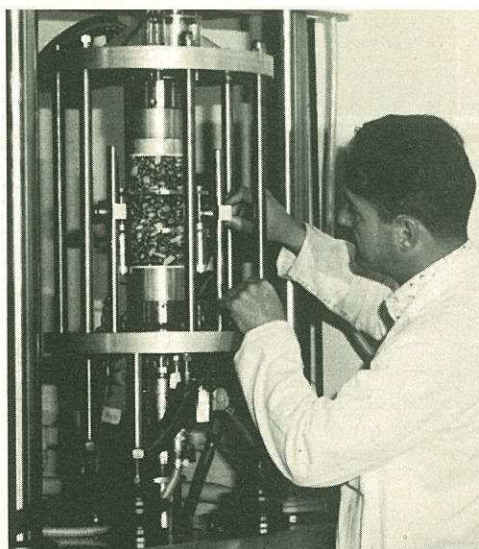
- refreezing the 'bomb'
- decanting the liquid solvent into the upper chamber while the frozen food product remains in the lower chamber
- allowing the upper chamber to warm to room temperature while maintaining a cold lower chamber, which allows clean Freon to return to the lower chamber by distillation
- shaking the food/solvent mixture

Finally the 'bomb' is frozen, opened, and the Freon solution of volatiles is removed from the upper chamber for concentration and analysis.

The procedure is relatively fast and simple to perform. Good extracts of several fruit pulps, including granadilla, papaya, mango and strawberry, have been obtained.

**New equipment for testing road materials** (p. 20): The stress conditions present in a pavement are reproduced in the laboratory (top right).

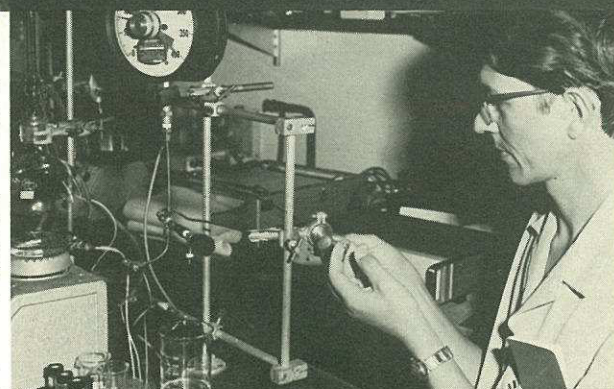
**Lightning research** (p. 19): An extensive study of the characteristics and distribution of lightning discharges is being undertaken (right).



**Mini-counter for radiocarbon dating** (p. 16): One of the uses to which this detector (above) can be put is the direct dating of prehistoric iron objects containing small amounts of charcoal.

**Improved techniques for food analysis** (p. 23): A small, prepared sample is injected by means of a syringe for analysis by means of high-speed liquid chromatography.

**Extraction of volatile components from foodstuffs** (p. 21): The Freon 'bomb' used to extract volatile flavour substances from foodstuffs (bottom).



## Dry matter digestibility of foods

The energy values of foods are usually estimated from the results of a chemical analysis including the determination of the indigestible crude fibre content of the food. However, a more reliable estimate of the amount of indigestible dry matter present in foods intended for human consumption is obtainable from the results of *in vivo* determinations of dry-matter digestibility involving the use of monogastric animals.

The rat would have been an excellent experimental model for the estimation of dry matter digestibility had it not been that in this animal the caecum is exceptionally large, whilst a significant quantity of the indigestible food residues accumulating in the caecum is converted into intestinal gases by microbial fermentation. When gas-forming fermentation takes place, indigestible food residues cannot be determined quantitatively and consequently dry matter digestibility cannot be estimated accurately.

In investigations aimed at the conversion of the rat to a more suitable experimental model for assessment of dry matter digestibility, attempts were firstly made to suppress microbial growth in the caecum through administration of broad-spectrum antibiotics<sup>15</sup>. This attempt was not successful as the antibiotics inhibited only certain organisms, whilst others increased in number to such an extent that the total counts in the caeca of treated animals exceeded those obtained with control rats. Consequently a more drastic method was applied, viz surgical removal of the caecum. As the published techniques for caecectomy in the rat had proved impractical and time-consuming, a more suitable method had to be devised. The result was a technique which enables the worker to perform as many as 25 operations a day.

The successful development of a technique for rapid caecectomy in the rat facilitated a wider use of the *in vivo* method for determination of the dry matter digestibilities of foods.

The magnitude of error involved in the estimation of the energy values of certain foods or the determination of digestibility by means of *in vitro* techniques can be assessed on the basis of the following examples:

According to chemical analysis of a sample of the presscake obtained in the production of apple juice, the presscake contains only 19 per cent crude fibre. It could therefore be deduced that the product contains a large quantity of digestible matter capable of serving as a source of energy. With use of the *in vivo* technique with caecectomised rats it was found, however, that 74 per cent of the product is indigestible, i.e. the nutritive value of the product is much less than could be deduced from the results of a chemical analysis.

On the basis of *in vitro* digestibility studies it was believed that the cooking of maize meal increases the digestibility of this food. In an investigation by means of the *in vivo* method no difference could be found in digestibility between cooked and uncooked maize meal. This means that the effect of heat treatment is of significance only in respect of taste and texture but not in that of digestibility.

## Improved techniques for food analysis

The analysis of foodstuffs to determine the quantities of the wide range of nutrients present — protein, fat, carbohydrates, fibre, minerals and vitamins — as well as other substances of importance in the study of foods, in many cases still involves laborious and time-consuming procedures.

The development of methods to apply new, faster instrumental analytical techniques to the analysis of foods is of great benefit to laboratories involved in a large volume of food analyses.

Progress in this direction has been made by the acquisition of automated equipment for the determination of protein content and by improving the facilities for amino acid analysis through the addition of an automatic sample dispensing device to the existing amino acid analysing equipment and linking the system to a computer for direct processing of the analytical results<sup>15</sup>.

Much attention was also given to the application of high-speed liquid chromatography to the analysis of foodstuffs. A reliable and fast method was developed for the determination of the tocopherols and tocotrienols which act as natural anti-oxidants in foodstuffs. These substances are known also as Vitamin E. This analytical method is a great improvement on older, very tedious techniques. The same technique has now also been applied for the determination of  $\beta$ -carotene and Vitamin A, but problems encountered with certain types of foods will still have to be solved. The application of this technique in food analysis has been further improved by linking the spectrofluorimeter and spectrophotometer, used as detectors, to a computer. Instrumentation was also developed to apply this technique in the determination of organic acids present in foods by using a special glass electrode pH-meter as detector. The method is satisfactory for most organic acids occurring in foods.

## Antarctic research

During the past year an important project has been the preparation of research proposals for the fourth five-year period of the South African Antarctic Research Programme<sup>21</sup>. Its commencement in 1978 will coincide with the commissioning of a new Antarctic relief vessel to replace the ageing *RSA*.

The new ship is a dual-purpose vessel, designed to be used for oceanographic and atmospheric research when not engaged in relief work. It will be larger than the *RSA*, and will carry two long-range helicopters.

To make the best possible use of the much more sophisticated logistical support system based on the new ship and its helicopters, the programme had to be completely reviewed and adapted.

The earth sciences programme in Antarctica has been affected most by this new development. Up to the present earth science activities have been undertaken by, of necessity, relatively inexperienced geologists, geophysicists and surveyors who had to spend a total of 14 months away from South Africa to enable them to do two or three months' field work in Antarctica during the early summer. The only transport possible was by means of oversnow vehicles. With the new system, all field work will be done during summer seasons and field parties will be transported by helicopter. In this way the total time away from South Africa can be limited to some three months, with the result that larger numbers of experienced scientists may be expected to participate in the programme.

# development of service infrastructure

## Comfort studies for air conditioning design

A comfort laboratory, designed by the CSIR<sup>7</sup> and equipped with air conditioning and controlled air distribution is being used to determine the influence which the environmental conditions in air-conditioned spaces have upon persons seated in such spaces and doing light work, with the object of finally establishing a more practical design temperature than that at present used.

Results obtained so far have indicated that comfort conditions lay in the temperature range of 24,5 to 25,5 °C. Up to the present, however, the design of air conditioning systems in South Africa has been based upon 22 °C. If design were to be based upon the higher range it is expected that savings in capital costs of 10 to 12 per cent could be achieved.

## Geomechanics investigations

The geomechanics investigations on behalf of the Electricity Supply Commission into the Drakensberg Pumped Storage Scheme, have been completed, and similar investigations into the proposed Elandsberg Pumped Storage Scheme are being carried out<sup>7</sup>.

These investigations involved the construction of extensive exploratory underground test tunnels, a trial enlargement in the machine hall area, an access shaft and a tailrace tunnel test enlargement as well as a penstock trial chamber. Large sums of money had to be spent on instrumentation and equipment, and for exploratory underground drilling for geological and rock mechanics purposes; yet the total cost of the study, including the cost of excavations, is about 4,5 per cent of the estimated civil engineering construction costs of the scheme. The results of these investigations will provide design data for the safest and most economical underground excavations, and should achieve considerable savings because the item 'unforeseen conditions' should be removed from the contractor's bidding, which could result in substantially lower contract prices.

## Wind forces on cooling towers

The new Duvha 3 600 MW Power Station will have six 130 m tall cooling towers and it was feared that interaction between the towers in a strong wind could result in the collapse of one or more of them, as has recently happened in Britain.

A model of the Duvha Power Station was built to a scale of 1:500 on a special turntable and tested in a windtunnel<sup>7</sup>. The pressures on the surfaces of the cooling towers and stacks for various wind conditions and directions were determined. The results of the tests showed that there was very little difference in the results when the towers were spaced one and a half or two tower diameters apart. By adopting the former layout, however, considerable savings could be effected.

## Wind resistance of railway trucks

The specially designed trucks used by ISCOR to transport ore from Sishen to Saldanha will each weigh 20 tons and carry 80 tons of iron ore. A train will consist of 200 trucks of a total length of 2,2 km and will be drawn by six diesel-electric locomotives. When operating such large trains even their wind resistance has to be considered and can have a significant effect on the power required to pull the train. The wind resistance of both full and empty trucks was determined, including the effect of side winds, using a 1:50 scale model of the train mounted on a turntable in a wind tunnel to measure the wind resistance for various wind directions<sup>7</sup>.

It was found that, irrespective of the wind direction, empty trucks had a higher wind resistance than full trucks. The wind resistance of the empty trucks could be reduced by covering the open truck with a flat plate, which could also be used to cover the strengthening ribs on the outsides of the trucks when running full and so eliminate the wind resistance created by the ribs.

## Architect's brief for design of compact school buildings

At the request of the provincial authorities the CSIR<sup>10</sup> has prepared an architect's brief for the planning of compact primary schools. This has been submitted to the provincial administrations for comment and approval.

The briefing manual is made up of three parts.

The first is a design guide which includes an outline of design criteria and planning considerations in the light of educational requirements. The guide discusses the changes which have taken place in education and draws the architect's attention to the nature of teaching and learning activities. Site planning and building layout are considered in the light of environmental requirements, as well as furnishing and equipment for the various spaces. An appendix discusses audio-visual equipment and related aspects. A second appendix indicates the accommodation needed for a typical primary school for 750 pupils.

The second section is a plan of work which outlines the various stages of the design and building process and the tasks, responsibilities and decisions required to be undertaken at each stage by both the design team and the provincial administration.

Finally, in the third section, technical information is given which outlines planning criteria for suitable indoor environmental conditions.

An architect's brief of this nature is a direct means of communication between the education department, the works department, architects and other consultants.

## Foundations investigation for nuclear power station

The CSIR<sup>10</sup> was requested to advise Escom's consultant on certain aspects of the proposed nuclear power station at Koeberg in the Cape Province, especially with respect to specialized tests relating to the foundation conditions. This information was required urgently by the three foreign consortiums who were to submit tenders for the complete project. The investigation called for great precision in the execution of certain standardized tests and the use of specialized apparatus for shear strength determinations.

A small investigating team was appointed to undertake this task. Automatic recording equipment was used for the long-term tests while a number of ancillary computer programs were developed to assist in the analysis of the data which were presented in graphical form by the computer. Undisturbed soil samples which were carefully transported from Koeberg were provided to the consulting engineers for the testing programme.

Because of the presence of thick sand layers on the underlying rock and the high ground water table close to the coast, precautionary measures will have to be taken against the possible liquefaction of the sand following earth tremors. Studies of the problem were undertaken in the consultant's laboratories in the United States because the necessary equipment was not available locally.



**Windhoek water reclamation plant** (p. 28): At this plant in Windhoek (top) purified sewage effluent is reclaimed for domestic use.

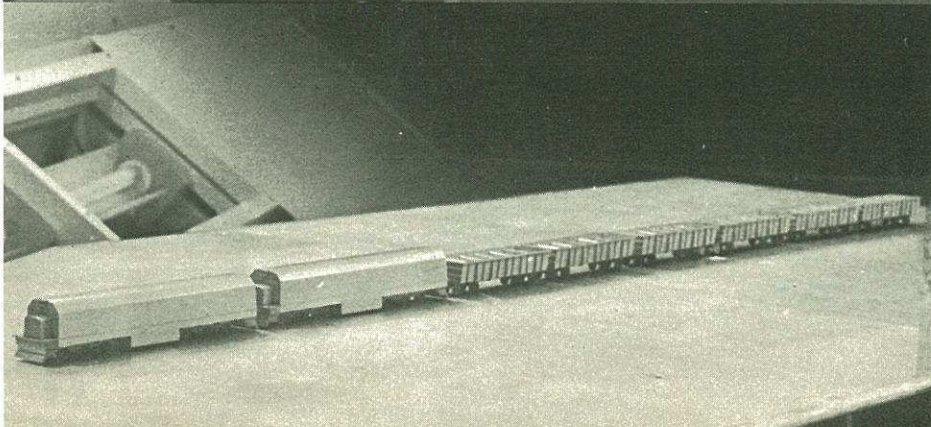


**Rubber balls for sewer cleaning** (p. 28): The use of rubber balls for routine cleaning of sewers is put to the test (left).

**Geomechanics investigations** (p. 25): Investigations at the Drakensberg Pumped Storage scheme in progress (right).

**Architect's brief for design of compact school buildings** (p. 26): A quiet room in a compact-plan primary school (left) has visual links with the main teaching area while retaining a degree of isolation.

**Wind resistance of railway trucks** (p. 26): The wind resistance of both full and empty trucks and the effect of side winds being determined, using a scale model of a train in a wind tunnel (bottom).





## Durable rubber products for building

The CSIR's<sup>10</sup> research on the durability of artificial rubber exposed to the atmosphere began several years ago. The purpose of the investigation was to develop products based on locally produced rubbers that could compete with the best imported rubber material. In practice a great deal of success has been achieved but the improved weather resistance of the new products has not yet been fully explained.

Rubber formulations derived empirically showed that saturated hydrocarbons increase the resistance of rubber against oxidation by atmospheric oxygen and ozone. On closer investigation it appears that these saturated compounds slightly retard the vulcanizing process and lead to the formation of sulphur links in, rather than between, the polymer chains. This produces an undercured product with few unsaturated bonds which, although they can still be oxidized by ozone, tend to develop less ozone cracking and are thus physically better able to withstand exposure to the atmosphere.

## Rubber balls for sewer cleaning

The use of rubber balls for routine cleaning of sewers is a technique which is fairly generally in use in American cities. However, this is a maintenance method which is virtually unknown to South African local authorities.

A number of sewer cleaning balls were imported from the USA by the CSIR<sup>10</sup> for testing in South African sewers. The tests were also designed to yield information on the design and development of winches and other equipment for the handling of the balls.

The results of the tests were encouraging and proved that this technique is a very efficient method of cleaning sewers. The equipment is relatively cheap and can be handled easily by small unskilled maintenance teams. Imported sewer balls were available only in sizes of 150 mm diameter and larger and the CSIR<sup>10</sup> therefore formulated suitable rubber for the balls and test manufactured these in 100 mm diameter size in order to test sewers of this diameter. These balls are now being made in South Africa.

A number of maintenance departments of South African municipalities showed great interest in this development. One local authority's department of organization and methods recommended the immediate adoption of this method as a preventive routine maintenance measure.

## Windhoek water reclamation plant

In 1969, Windhoek became the first city in the world to reclaim purified sewage effluent for domestic reuse on a continuous basis. Under the sponsorship of the Water Research Commission, the original plant has been extended and modified in accordance with the latest research expertise developed by the CSIR<sup>11</sup>.

Independent quality control testing is carried out on the reclaimed water by four organizations — the CSIR, the Municipality of Windhoek, the South African Institute for Medical Research and the Department of Water Affairs in South West Africa — to ensure that the quality of the reclaimed water meets the microbiological and chemical requirements of the World Health Organization for drinking water at all times. Studies to date have failed to establish any relationship between epidemiological patterns and the water supply in Windhoek.

The results obtained in this plant will be of vital importance to the Republic since water reclamation will play a key role in the country's future water budget.

## Expansion of road research

The Government's acceptance of the major recommendations made by the Driessen Committee of Enquiry into Urban Transport Facilities in its report published in 1975, together with the White Paper, held important implications for the National Institute for Road Research<sup>12</sup>. The recommendations relating to the Institute involved an extension of its functions and scope to include urban transport research and the investigation of a number of specific research problems identified in the report.

In recognition of the extended scope of its work, the Institute in 1976 changed its name to National Institute for Transport and Road Research (NITRR). The Transportation Group was expanded to become a full Branch of the Institute. The Branch's research programme differentiates between rural and urban transportation and the urban transport projects are grouped into six major research fields, viz transport planning, transport systems, public transport, traffic restraint, traffic control and goods delivery in urban areas.

Some of the more urgent problems identified by the Driessen Committee are at present being investigated, for example the development of urban transport plans, bus subsidies and traffic control. In addition, attention is being paid to identifying sources of transportation data and to defining other high-priority research requirements. This research is at present being financed through the National Transport Commission from the Treasury.

# industrial development

## Corrosion of galvanized hot water pipes

Pilot scale experiments conducted on simulated circulating hot water systems as encountered in hospitals and many other large building complexes have shown that once the dissolved oxygen in the hot water is depleted to below a particular value by the normal cathodic oxygen reduction reaction, the corrosion process can proceed by the hydrogen evolution reaction<sup>1</sup>.

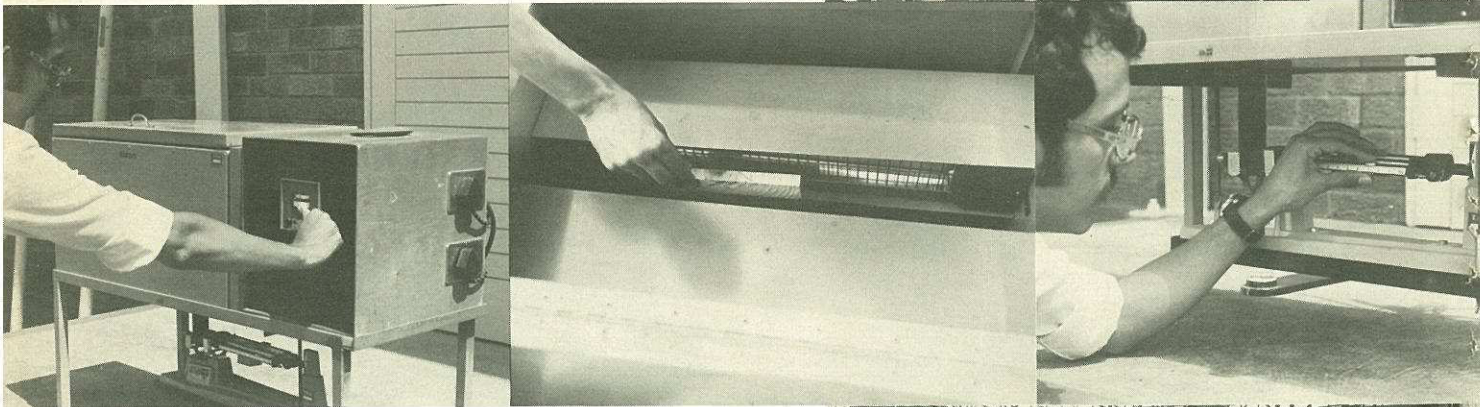
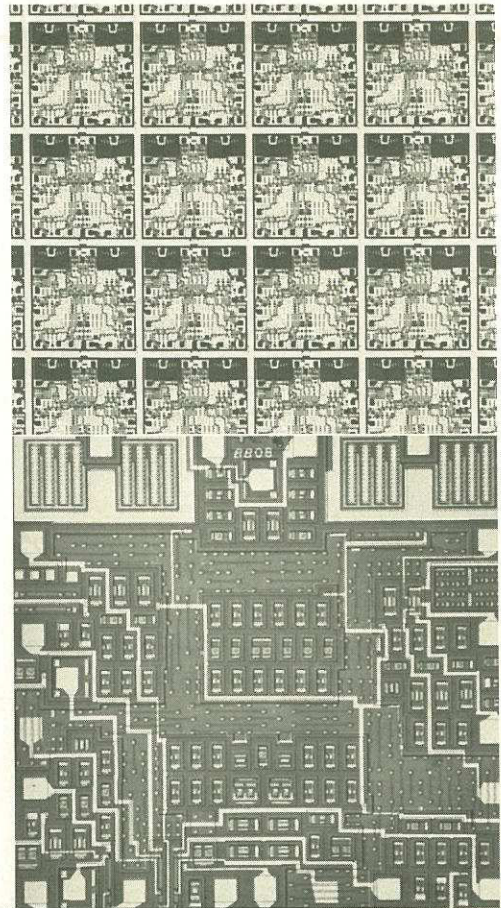
It has been established by overseas research workers that with zinc under conditions of hydrogen evolution, such as in acids, for example, the rate of hydrogen liberation, and thus of the dissolution of zinc, is directly related to the type and concentration of minor, foreign-metal impurities present in the zinc. These impurities play a minor role under neutral pH conditions with sufficient dissolved oxygen available, as the main cathodic reaction is the reduction of oxygen.

Findings to date at the CSIR have indicated that although pure zinc liberates hydrogen under oxygen starvation conditions in hot water, the rate of evolution drops significantly after two weeks. Galvanized pipes, where even the outer surface of the zinc coating is contaminated with iron originating from the galvanizing bath, liberate hydrogen at a much higher rate without any tendency to decrease even after one month. When galvanized pipes are annealed at 400 °C for one hour to increase the iron content of the zinc layer by alloy-formation, the rate of hydrogen evolution is increased considerably. The presence of cadmium stimulates, whilst aluminium in small concentrations initially stimulates, but then retards the evolution reaction.

With magnesium, a metal very similar in its corrosion behaviour to zinc, although more reactive, the tolerance limits of 0,017 per cent iron and 0,0005 per cent nickel as impurities are specified to depress hydrogen evolution. The bad effects of iron and nickel when present in magnesium in concentrations exceeding the above-mentioned limits are neutralized by the presence of manganese. Similarly it may be possible to introduce a metal into galvanizing baths which will inhibit the hydrogen evolution tendencies of subsequently produced galvanized zinc coatings. This aspect is being investigated.

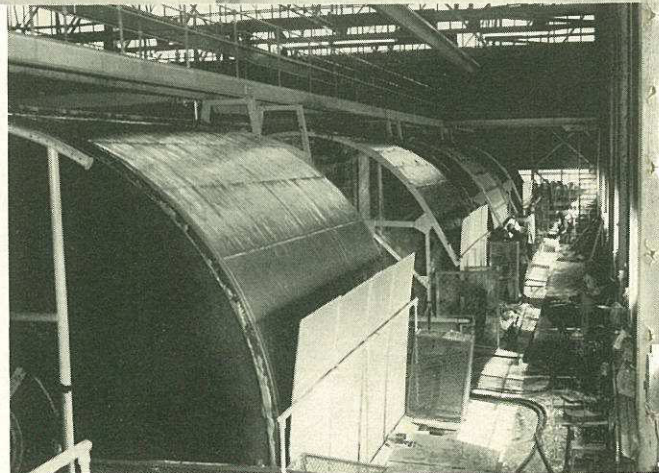
**Maskmaking (p. 32):** Part of a metallization mask (enlarged approximately 5x) for an integrated circuit (top). The actual size of each image (which is repeated many times for mass production purposes) may vary from less than 1 mm by 1 mm to as much as 10 mm by 10 mm.

**Uncommitted integrated circuit (p. 32):** A photomicrograph of an uncommitted circuit chip (right). Actual size 3 mm by 3 mm. The components are so laid out that a large variety of electronic functions can be realized by employing different interconnecting patterns.



**Timber drying (p. 36):** By means of this infra-red oven the moisture content of timber to be kiln-dried can be determined rapidly and accurately. The photographs (top, left to right) show the complete oven, the sample being introduced and the mass of the sample being determined.

**Process control in industry (p. 31):** A general view of the filtration plant at a gold mine where the possibility of improving the efficiency of filter units by means of automatic control was investigated (right).



## Process control in industry

In co-operation with a gold mining company a research project was undertaken, aimed at improving the efficiency of filter units used in gold reduction works, by means of automatic control<sup>9</sup>. It was estimated that gold to the value of about R12 000 000 is annually lost in South Africa because a small quantity of gold-bearing liquid cyanide remains in the residue of the filters and is thus pumped into the slimes dams. The rotating drum filters generally used by the South African gold mining industry are in fact highly efficient (more than 99 per cent) and therefore sophisticated methods were necessary to further improve this efficiency.

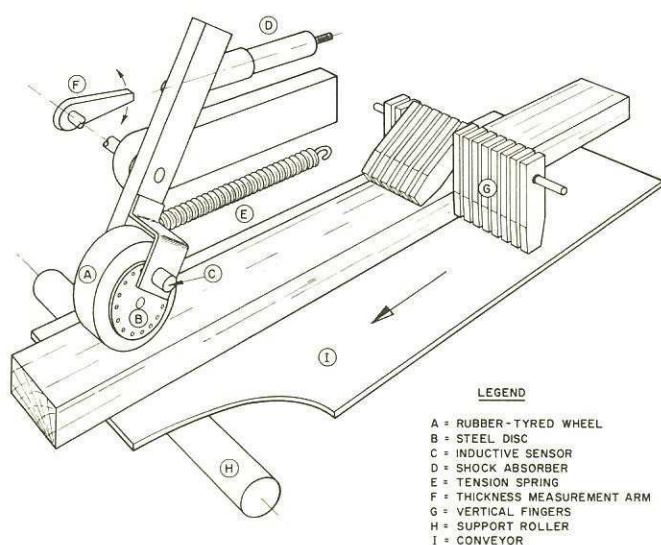
Continuous data on the efficiency of an operational filter under various working conditions were obtained by isolating a filter in one of the company's mines. Measuring and control instruments were installed by the company, and the CSIR supplied automatic data recording equipment to record slurry input, filtrate outflow, density, etc. Gold concentration was determined by the metallurgical laboratory attached to the mine in question.

These data were processed in the CSIR's computing centre, and an accurate mathematical model of the filter was made. For a given slurry throughput, it could be used to find the operational point at which the gold losses resulting from incomplete filtration would be reduced to a minimum.

It was found that the rotation speed of the drum has a very marked effect on the losses, and a recommendation was made that variable-speed motors should be installed so that the speed would be adjustable according to the required rate of production. This procedure may reduce the residual losses by as much as 50 per cent.

The filtering efficiency could be further improved by controlling the filter automatically by means of a computer. Such a procedure is, however, at present impracticable because no suitable industrial instrument for automatically determining gold concentrations is as yet available.

A second project concerned with industrial process control is being undertaken in collaboration with a sugar company, involving the development of an automatic control system for part of a sugar refinery. Research staff of the CSIR will assist with the construction of a mathematical model of the process and the development of a control strategy. In addition a process computer is supplied by the CSIR, while the company will provide and install measuring and control equipment.



**Production planning and control in sawmills**  
(p. 36): Diagram showing the device for measuring sawmill output on a continuous basis in terms of length, thickness and width of the boards produced.

## Production facility for integrated circuits

Integrated circuits for special purposes are now produced industrially in South Africa at a facility which is located at the CSIR in Pretoria<sup>a</sup>. The official opening took place in August 1976, and since then trial runs have been undertaken to establish proper transfer of the technology, for which a license agreement has been signed with a semiconductor manufacturer.

The main purpose of this facility is to satisfy the strategic requirements for locally manufactured custom-designed integrated circuits. The plant was established at the CSIR because much of the know-how and specialized support facilities were already available there; local industry was not yet in a position to undertake this task. A service is therefore offered by the CSIR to industry for the design and manufacture of such custom-made integrated circuits as are required for more modern and cost-effective electronic equipment. Design contracts currently being undertaken on behalf of industry indicate that there could be a considerable impact in some sectors.

## Uncommitted integrated circuit

The cost of designing and making masks for integrated circuits represents a fixed amount, irrespective of the number of circuits manufactured, and for short runs it contributes significantly to the unit production cost. This factor thus tends to inhibit the use of custom-designed circuits, when such are required in relatively small numbers, as is often the case in South Africa.

In order to overcome this problem the CSIR<sup>a</sup> designed an uncommitted integrated circuit containing numerous components which are so laid out that a large variety of electronic functions can be realized by employing different interconnecting patterns. A customer using the uncommitted integrated circuit need only specify the connecting pattern; hence the amount of custom work to be carried out is reduced, resulting in an equivalent reduction in unit cost.

In order to assist customers, a design kit was developed which will make it possible for engineers to fully exploit the concept. Using this kit, the designer can verify and check his circuit, and can lay out the final mask for metallization himself. Various different custom-designed integrated circuits based on the uncommitted circuit have already been designed and manufactured; amongst them an 8-bit digital-to-analogue converter. It is envisaged that this design aid will greatly enhance the usefulness of the integrated circuit production facility to local industry.

## Maskmaking

The computerized system for laying out masks is in full operation and during the year various sets of masks have been designed for both internal and external organizations<sup>a</sup>. The system has also been used for designing and laying-out multilayer printed circuit boards.

During the year new maskmaking equipment was acquired. A numerically controlled pattern generator automatically produces the master masks on photographic plates, using data on a magnetic tape from the computerized system. These plates are then inserted into a step-and-repeat camera, which can cope with chips up to 10 mm by 10 mm in size. The camera is a high-quality instrument capable of producing photomasks for 'state-of-the-art' large-scale integration (LSI) circuits and will for many years to come satisfy the need in the Republic for high-quality photomasks.

## Catalysts from local raw materials

In the petroleum and petrochemical industry, where oil and coal are used as raw materials, the majority of the products are obtained by catalytic chemical reactions. At present South Africa is importing catalysts to the value of several millions of rands per annum.

The technical feasibility of manufacturing these catalysts from locally available raw materials is being investigated<sup>a</sup>. This comprehensive project was undertaken in consultation with the appropriate national industry and with other researchers in the field of catalysis.

Catalysts which are already used on a large scale in the South African industry are being given priority. The need for catalysts arising from new processes that may be of importance to South Africa is also taken into consideration.

## Training and occupational adjustment of Black workers

The increasing need for trained Black workers in South Africa demands careful attention to the development of suitable training techniques and procedures to facilitate the adjustment of workers with an industrially unsophisticated background. A modified approach is necessary for the training of Black workers since traditional industrial training techniques do not in all cases make provision for the relatively low educational level of the Black population and the cultural and social differences between Black and White groups. The CSIR<sup>14</sup> has consequently adopted an approach to training which is based on the principles of programmed instruction and which makes provision for the following:

- the placing of training needs within the perspective of the total organization so that factors such as selection, supervision, communication, remuneration, etc. contribute to the optimal utilization of trained manpower
- the efficient preparation for training including precise determination and definition of training needs, determination of training aims, collection of relevant information concerning the skills and characteristics of persons who must be trained, clear description of training content and the determination of the requirements which persons must fulfil before they can be trained in specific skills
- the development of tests for admission to training and in order to determine the success of training; development of training methods and strategies and the development of suitable training aids
- the evaluation of training and the adaptation of training policy and techniques whenever it appears that the results of training are not satisfactory.

In addition to the development of this general approach to training, particular attention is also given in the training research programme to the cultural and social factors which could possibly handicap the efficient training of the Black person, as well as to the development of efficient instruction methods and strategies for the training of Black workers. In the latter area, for example, an experimental closed circuit television programme has been developed for the orientation of Black workers in a border industry.

In collaboration with the industrial sector training centres have been established by the Department of Bantu Administration and Development. An example is the Boithusong Training Centre in Bloemfontein. On behalf of this Centre an experimental training programme for Black supervisors was developed<sup>14</sup>. The programme is now being used by the Centre for the training of supervisors in local industrial organizations.

At the request of the Forestry Council the training programme is being modified for use in the forestry industry. The programme will be offered by the training unit of the Forestry Council.

In collaboration with the Transkei Development Corporation training systems have been developed for a newly established forest products company in Transkei. In this organization Black workers will be able to progress to management level and the situation therefore demands a modified approach to all aspects of personnel management, including training. Consequently an induction system as well as a short-term training system have been developed in order to facilitate the commissioning of the sawmill activities.

## Motivation of Black workers

Industrial development in the homelands and border areas will be considerably influenced by the adaptation of Black workers to a technological environment. This adaptation is being investigated from various points of view and the opportunity arose to study the mentality of progress of workers in Transkei.

A questionnaire was devised to determine factors which may play an important role in the development of an optimal mentality of progress and thus productivity<sup>14</sup>. These factors are uncertainty in respect of career opportunities, achievement motivation, initiative in the work situation and the so-called 'migrant labour mentality'.

The population concerned is the work force at a new sawmill undertaking in Transkei comprising mainly persons with a low level of education who have, however, no limitations in respect of promotion within the organization structure. It is suggested that the adaptation of such groups to the industrial situation will be determined by the following characteristics: their drive for progress, their willingness to accept Western concepts and norms of work and their motivation to be trained. Therefore a study of the present 'mentality of progress' should give an indication of whether the work force is in fact attuned to progress and to what extent an optimal mentality can be developed through training.

The results of the preliminary application of the questionnaire have been analysed and the questionnaire will, if necessary, be modified for further application.

A second aspect of the adaptation of workers in such situations concerns changes in respect of the domestic circumstances which accompany industrial development. As a first project in this connection a manual on the establishment of a housing scheme is being prepared.

## Brewing technology

The CSIR<sup>15</sup> has developed a process for the concentration and spray drying of wort for the manufacture of sorghum beer. The wort is the product which is obtained when all the different stadia of the brewing process, except the final alcoholic fermentation, have been completed. The process has been patented.

Wort can be produced in larger breweries with spare capacity. The concentrate or dry product is cheaper to transport and this development will make possible the expansion of the brewing industry to outlying areas. The mixing of the concentrate or powder with water and fermenting the mixture to the final product is simple and will require a relatively low outlay in capital equipment. The final fermentation also does not require highly skilled labour.

## Marula juice

Laboratory studies showed that fruit juice with the characteristic aromatic flavour of the marula fruit can be made from fresh marula fruits using conventional techniques<sup>15</sup>. Although the tree is not cultivated, large stands occur in certain regions of the Transvaal. A techno-economic survey was carried out to determine whether these naturally occurring trees could be exploited commercially. The conclusion reached was that if harvesting of the fruit and transportation to existing fruit juice factories could be satisfactorily arranged, commercial utilization of the fruit would be economically feasible.

A large quantity of the juice was prepared in the laboratory to assess its market potential. The marula juice was offered for sale in a retail commercial outlet over a number of months. Consumption of the product built up over this period until sales were only exceeded by those of orange and granadilla juices. From this study it was concluded that acceptability of the product was good and establishing a market for the product should be no problem.

## Dyeing of wool with chrome dyes

Chrome dyes are by far the cheapest dyes for the production of dark colours, such as blacks, navy blues and browns on wool; other dyes can be five to ten times more expensive. Due to the high chrome content of their effluent, dyehouses find it difficult to conform to the municipal regulations aimed at the prevention of water pollution. Currently a chrome level of 0,5 ppm is the maximum permissible in effluent. The International Wool Secretariat, through the South African Wool Board, requested the CSIR<sup>16</sup> to search for a solution to this industrial problem.

First of all, dyers should use the minimum amount of dichromate required for complete complexing with the chrome dye — it was established that dyers use excessive amounts of dichromate. After dyeing, the effluent should be treated with a small amount of sodium bisulphite to reduce the chrome to the trivalent state. The pH is then increased to 7,0 to precipitate the trivalent chrome as the hydroxide. The process is accelerated by the addition of 300 mg of aluminium sulphate and 1 mg of a cationic polyelectrolyte per liter of effluent. A final sedimentation or filtration process of the hydroxide precipitate almost completely removes residual chrome from the effluent.

## Transfer printing of wool and cotton fabrics

Natural fibres such as wool and cotton have for years been at a disadvantage due to their inability to be transfer printed with disperse dyes (which sublimate at 190 to 200 °C).

The CSIR<sup>16</sup> recently developed a technique whereby the wool or cotton fabric is first pre-wetted to a moisture content of 70 to 100 per cent, depending on the fibre type and the cloth finish. The fabric is then brought into contact with a specially prepared print paper carrying the reactive dyes and by heating at 40 to 60 °C in a press for about 60 seconds, the print is transferred quantitatively on to the fabric. Fixation of the dye is effected by steaming the fabric under atmospheric pressure for one to four minutes; no further wash-off is required. This process appears to be economically viable, especially from the point of view of paper utilization, as 100 per cent transfer of the dye is obtained. The IWS laboratories in Ilkley, England, are at present evaluating this technique for possible implementation in the wool textile industry.

The CSIR<sup>16</sup> has also shown that wool-rich or cotton-rich blends with polyester fibre, knitted or woven, can be successfully transfer-printed with commercial transfer paper carrying disperse dyes if the fabric is designed and constructed in such a way that the synthetic component appears predominantly on the face of the fabric onto which the pattern is to be transferred.

### Lightweight cotton and/or wool fabrics

The use of leno structures in the production of lightweight wool worsted fabric for shirts and safari suits was announced by the CSIR<sup>16</sup> some time ago. These structures not only lend themselves to interesting designs, but certain mechanical properties of these pure wool fabrics are also superior to those of normal plain weave structures.

The International Wool Secretariat is planning a special brochure containing sample fabrics in order to distribute these research results world-wide.

The CSIR<sup>16</sup> has also achieved success in the utilization of cotton/wool blend yarns, in particular those consisting of 67 per cent cotton and 33 per cent wool, which are spun on machines designed for the processing of cotton, and then woven into lightweight fabrics. These blends are ideally suited for shirts, safari suits, etc. after durable press finishing. A local manufacturer has produced a limited number of shirts for wearer trials.

The CSIR<sup>16</sup> has also established that such blends of wool and cotton can be improved in terms of dimensional stability and general appearance after domestic machine laundering by a pretreatment with liquid ammonia on a laboratory merceriser. Pure cotton fabrics, mercerised with liquid ammonia by way of pretreatment for the application of durable press resins, also suffer less fibre damage than with the use of other agents.

These lightweight cotton-wool blends can also be effectively flame-resist treated by the THPOH process, i.e. by means of tetrakis(hydroxy-methyl)phosphonium hydroxide treatment.

### Mohair core yarns

The CSIR<sup>1</sup> has established that a certain unique new commercial spinning frame can be used for spinning mohair core yarns by feeding a nylon filament from just behind the front drafting rollers. An additional filament, i.e. replacing one of the mohair rovings, can also be fed adjacent to the other mohair roving, and this filament wraps around the yarn. In this manner quite fine yarns of 16 tex can be spun from kid mohair of 23  $\mu\text{m}$ , which is much finer than is possible if conventional spinning processes are used.

The technique was demonstrated during the visit of members of the International Mohair Association, and was exceptionally well received.

### Fibre properties of South African cotton

The CSIR<sup>16</sup> is of the opinion that more information on the variation in fibre properties between cotton bales within a lot, as well as variations between lots, is of the utmost importance to local processors.

In collaboration with seven local gins, samples considered representative of the 1974-75 South African crop were analysed and typical values for micronaire, maturity, fineness, length, uniformity, trash content, tensile strength and elongation were determined, together with typical coefficients of variation and confidence limits. Data obtained in this manner not only allow processors to determine, in advance, what differences are significant, but also give information on the type of test and the number of repeats necessary for a given or required degree of accuracy in predicting the processing performance of the cotton.

### Wrinkling of fabrics

It is generally known that wrinkle resistance and wrinkle recovery of fabrics tend to improve with time after commercial finishing. This ageing process may be accelerated by means of various types of treatment, for example by exposing the material to conditions of high humidity and temperature. Nevertheless, this process can be easily reversed by any wet treatment, and consequently methods have been investigated whereby the advantages of ageing can be made permanent, i.e. to resist treatments such as drycleaning which are normally encountered in practice.



It has been established in the case of polyester cloth that fabric ageing has little effect on wrinkling properties, whereas the effect in the case of wool fabric is considerable<sup>16</sup>. In the case of cotton and cotton-polyester blend fabrics it has been observed that the effect of ageing becomes less pronounced as the amount of polyester in the blend increases.

The different methods of either subjectively or objectively assessing wrinkling have also been evaluated, and it has been found that one parameter, namely the mean wrinkle height or H value, is a sufficient measure of the wrinkling propensity of a fabric.

### Adhesives research

In collaboration with the Leather Industries Research Institute at Grahamstown, the University of the Orange Free State and the wattle industry, work is continuing on the refining of the wattle-based adhesives which have been developed to replace many of the expensive imported products<sup>17</sup>.

Work on the development of adhesives from pine bark (hitherto a waste product) which was started by a visiting scientist from Colorado State University during his sabbatical leave in South Africa, is continuing. Since pine species in South Africa and the southern states of the USA are very similar, the results of this research will also be of importance to the USA.

### 'Truspac'

The 'Truspac' computer program which has been developed by the CSIR<sup>17</sup> is being used successfully in industry for the competitive design of timber trusses.

'Truspac' provides a facility for the design of the members and the joints of plane timber frames. The input data describe the frame, its restraints and loading conditions, while the output may include the size and grade of the members required, the size and position of the connectors, the camber, material quantities, cutting bills, jig settings and costs.

The program is continuously being expanded and updated to include other plane structures such as portal frames.

### Timber drying

Work has been finalized on an infra-red drying oven enabling a rapid and accurate moisture content determination of timber to be dried in kilns<sup>17</sup>. This knowledge of moisture content is important if optimal drying schedules are to be applied in order to increase kiln drying efficiency. A number of kilns at various sawmills are being surveyed, and drying efficiency is being determined. A device for the constant monitoring of the moisture content of timber during kiln drying is under construction.

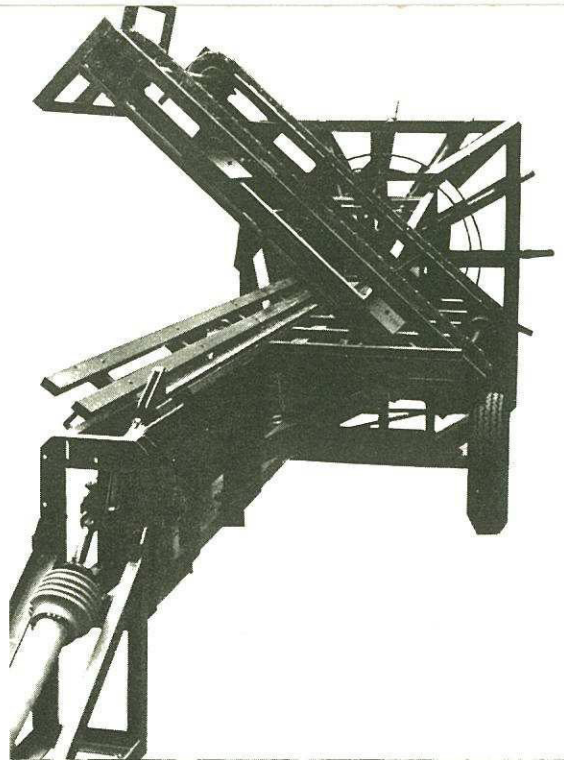
### Production planning and control in sawmills

The development phase of a production planning and control system for sawmills was completed<sup>17</sup> and during a very successful demonstration at Barberton a prototype sawmill output measuring device was shown to some 100 sawmillers. Five of the bigger sawmilling groups asked that the possibility of installing such a device in their sawmills be investigated. The first commercial unit is now being developed.

A multi-disciplinary approach was followed in the development of the production planning and control programme, and contributions came from various CSIR institutes<sup>3,8,18</sup>.

### Pulping of sugar-cane bagasse

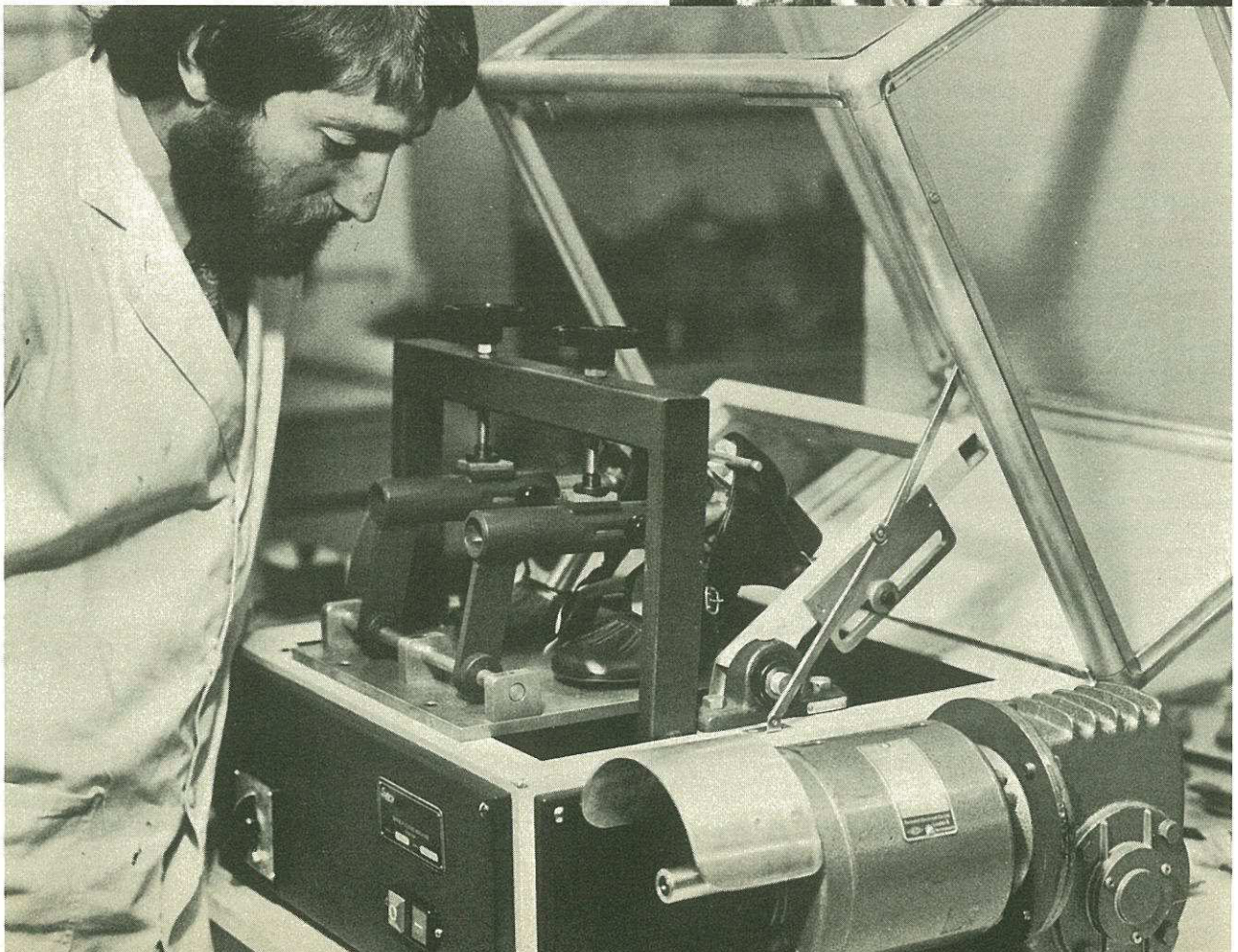
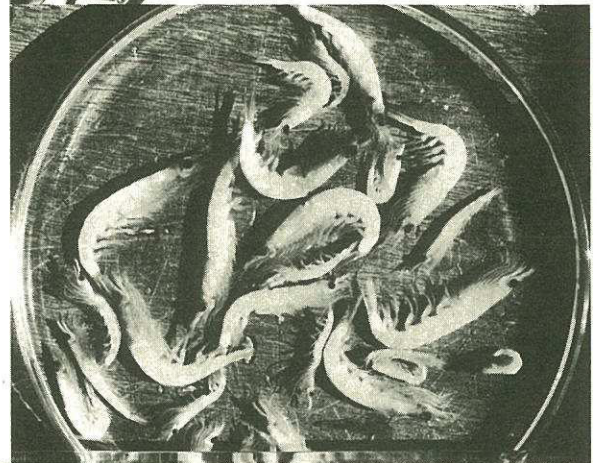
An investigation into the semi-chemical pulping of sugar-cane bagasse showed that the lignin contained in bagasse possesses a very high reactivity<sup>17</sup>. It was also established that bagasse can be successfully pulped, irrespective of the type of pulping process used. This project is closely related to research done on the use of sugar-cane bagasse in the paper manufacturing and pulping process. Research in this field is not only of importance in the national context, but has also aroused international interest.



**Wattle debarking machine** (p. 38): *The mobile wattle debarking machine developed by the CSIR (top).*

**Products from krill** (p. 38): *The potential of krill, both as an economic raw material and as a foodstuff is being assessed (right).*

**Footwear research** (p. 39): *Shoe flexing tests being conducted in the laboratory (bottom).*



## Wattle debarking machine

Wattle bark used for the production of tanning solution, has to be removed in strip form from the logs and branches of felled wattle trees to avoid drying out of the bark and the consequent formation of chemicals which cause discoloration of the tanning solution produced. At present, manual debarking methods are used.

Although debarking machines are in existence, these were designed mainly for removing bark from the logs of other species of trees with a view to cleaning the logs. These machines remove the bark in chip form only and are, therefore, not suitable for yielding bark in the form required for the tanning solution extracting process.

At the request of the Wattle Research Institute of the University of Natal and sponsored by the Wattle Growers Union of South Africa, the CSIR<sup>18</sup> developed a unique, relatively simple low-cost mobile wattle debarking machine which can be towed into a plantation and be driven from the power take-off of a tractor. This machine has been successfully used in the debarking of wattle and certain species of eucalyptus and is capable of debarking logs 75 mm to 250 mm in diameter at the rate of 0,4 m of log per second.

Further wattle debarking machines of the type developed by the CSIR are now being manufactured by an industrial concern for growers of wattle and eucalyptus trees.

## Survey of the Sugar Milling Research Institute

The CSIR partially supports three industrial research institutes representing the sugar milling, the fishing, and the leather, footwear and related industries. These autonomous institutes are funded by the industries they serve and by a contribution from the CSIR of up to 50 per cent of their total incomes.

The income from industry is guaranteed for five-year periods and the CSIR grants to the institutes are also reviewed by the Council's Advisory Committee for the Development of Research for Industry every five years. The reviews are undertaken by a subcommittee assisted by the CSIR's Group for Techno-economic Studies<sup>19</sup> which undertakes a comprehensive survey of the research institute concerned. The surveys cover the institute's achievements, its projected future development and its relationship to the industry it serves.

This year the Sugar Milling Research Institute<sup>24</sup> in Durban was reviewed. In discussions with the Institute's Board of Control it was noted that much of the success in stabilising the quality of South African sugar and in securing major export contracts was the direct result of the contribution made by the Institute.

It was recommended that the CSIR should continue to support the Institute at the same level as in the past but that the possibility of extending its mechanical engineering strength should be examined to meet the development needs of the industry.

## Industrial research bursaries

On the recommendation of the Advisory Committee for the Development of Research for Industry, the CSIR has initiated a trial scheme for the establishment of industrial research bursaries to provide young graduates with opportunities for training in research in an actual industrial environment and to strengthen links between industry, universities and research organizations by involving them in joint ventures. The firms concerned employ the bursars to work on an agreed project and the CSIR contributes to the bursar's salary up to a specified limit. Two bursaries have been awarded to companies and two more are under consideration.

## Products from krill

Cape Town is one of three possible fishing bases in the Southern Hemisphere for catching Antarctic krill, the small crustacean on which the filtering baleen whale feeds and which concentrates in enormous swarms near the ocean's surface.

The major fishing nations of the world have for some 10 years past shown an interest in krill both as a potential animal feedstuff and as a source of protein for man. Russian, Japanese, Polish and German research vessels net the small crustaceans by mid-water trawling and the potential of krill, both as an economic raw material and as a foodstuff for human consumption, is currently being assessed.

In research conducted at the Fishing Industry Research Institute<sup>22</sup> some years ago the protein fraction was separated from the chitinous shell material by two methods, namely by pressing the slurry through a fine mesh, or by enzymic treatment followed by clarification by straining. Both methods gave a good spray-dried product of light pink colour and a sweet crustaceous flavour.

The Institute recently received frozen blocks of krill from two expeditions which fished the waters between South Georgia and Southern Africa. A sample was minced with shell to form a raw slurry which was then cooked, pressed and dried into a krill meal, or hydrolysed with a mixture of organic acids and then separated by centrifuging the solids from the liquid followed by spray-drying.

Of the four products made at the FIRI from the Antarctic krill all three spray-dried powders would be suitable for human consumption. The krill meal is being investigated for animal feeding.

## Bacteriology of wet and thawed frozen fish

Tests were carried out on the rates and type of bacterial growth causing spoilage during chilled storage of thawed frozen hake and wet hake<sup>22</sup>. Factors investigated which might affect the chilled storage life of thawed fish included pre-freezing chilled storage times, ranging from freezing immediately at sea to two weeks in ice, and frozen storage up to several months. The effects of different temperatures of chilled and frozen storage were also studied. In the former case storage in melting ice was compared with storage in a refrigerated cabinet at 5 °C, a temperature likely to be found in chilled display cabinets or counters in shops. Freezing temperatures ranged from -7 to -29 °C.

In general the rate of deterioration and bacterial growth was slower for thawed frozen than for wet fish. This appeared to be due to the reduction in numbers of bacteria during frozen storage, especially of *Pseudomonas* species. The latter are responsible for many of the off odours which develop in frozen fish, and it is possible that the results obtained from odour and taste panels will prove to correlate statistically more significantly with *Pseudomonas* count, than with total psychrophilic bacterial count. These observations were particularly marked in the case of storage at 5 °C, an important point in view of the rapid rate of deterioration at this temperature (about three times the rate at 0 °C) and the fact that most commercial and domestic chillers operate around this temperature.

## Hides and skins

In the field of hides and skins research activities at the Leather Industries Research Institute<sup>23</sup> have been marked by a high degree of collaboration with industry and associated research organizations. The main emphasis has been on obtaining suitable antiseptic compounds for use in the salt-free preservation of hides and skins to minimise the salt pollution problem arising in local raw stock transportation and storage. Field trials conducted with local industry are playing an important role in the development of practical and economic antiseptic treatments and it is anticipated that these methods will provide alternatives to salt curing.

The availability of controlled hides from animals of known breed, sex, age and environmental origin, arising from meat production studies at the Animal and Dairy Science Research Institute at Irene, has afforded an opportunity of carrying out a collaborative investigation of hide and leather quality and its relationship to certain meat quality factors. These studies have also been extended to cover the role of animal nutrition in hide and leather quality.

Work with the Karakul Board of South West Africa has continued in studies aimed at improving the market value of Swakara pelts and promoting scientific methods of pelt evaluation, particularly the measurement of fur durability. Current studies have included examination of the effects on fur abrasion resistance of pelt type, hair quality, processing treatments and fibre structure with a view to promoting the characterising and grading of available pelt types.

## Footwear research

Footwear factories have recently started using woven nylon fabrics for shoe uppers, and found it difficult to obtain good sole bonds. A primer which was developed for the purpose, gives excellent results under laboratory conditions<sup>23</sup>. The formula has been patented and development has been taken over by the South African Inventions Development Corporation. An international adhesives company has been given the option to produce the primer.

## Decolorization of sugar

The use of ion exchange resins for a number of different purposes is well known throughout the sugar industry. Since these resins are very prone to fouling by organic matter it has not been possible until recently to use them as a primary decolorizing agent. However, with the advent of macro reticular resins, which were found to have good stability, it was felt that ion exchange could replace the char process in the local refinery. In order to acquire data for cost calculations a pilot plant was set up at the Sugar Milling Research Institute<sup>24</sup> where the operating conditions could be closely controlled.

The plant was designed to approximate, as closely as possible, an actual refinery operation and filtered carbonated liquor (brown liquor) from a large refinery was used in the experiments. During each cycle the procedures of sweetening off, back wash, regeneration and rinse were carefully carried out.

To date forty cycles have been carried out on one of the resins. Although there has been a drop-off in performance of the resin, it is still quite acceptable. Two other resins have also been tested but were found to be unsuitable since they fouled within twenty cycles.

Brown liquor colour values varied between 700 and 1 300 with an average of 850. With a fixed run length the fine liquor colour value at the end of the run varied in accordance with the original colour value. However, the fine liquor colour value was always below 450 which is the maximum allowable at the refinery.

Boilings made from ion exchange decolorized liquor have shown no signs of needle grain or any other abnormalities, and further tests showed that apparently both char and resin remove essentially the same colour components.

Cost studies indicate that decolorization by ion exchange may be roughly half the cost of decolorization by char. This is dependent on a reasonable resin life, the break-even point under local conditions being 75 cycles. The effluent from regeneration, while high in organic matter, can be discharged into the municipal sewer at a modest cost.

# promotion of general welfare

## Voice pitch exerciser

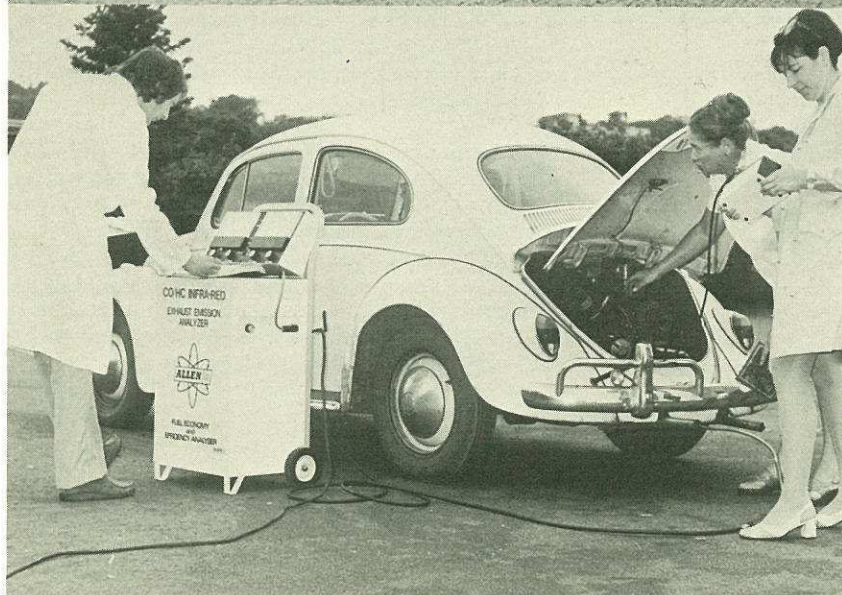
A speech training device has been developed which will encourage a deaf child to practise intonation, an element of speech he is incapable of observing — hence his difficulty in producing natural speech sounds.

A method has been found to isolate voice pitch from the complex sound produced by the human voice and to display this information in visible form<sup>2</sup>. Not only can the child compare his effort with the model produced by the teacher, but he can also practise intonation in the form of a game. The instrument has been enthusiastically received and production at a reasonable price is at present being planned.

## Siting of industrial and residential areas

The CSIR<sup>29</sup> was approached to determine the general atmospheric stability pattern and long-term wind data in the Sasol II area. From the work done, it was evident that this area had a typical Highveld climate, which allows for a good dispersion of pollutants during the day and the summer months but bad dispersion during winter nights.

As a result of this investigation, as well as additional measurements at two other points, the general layout of the Sasol II-Secunda complex was found to be very good except for two problem areas, i.e. the western part of the proposed urban area, Secunda, and the proposed Bantu township west of the Sasol II area. Recommendations with regard to more suitable locations for these areas, as well as areas for further industrial development, were made.



**Hepatitis virus in effluent** (p. 44): The bushbaby, *Galago senegalensis* (top), may be a suitable test animal in studies aimed at ensuring that reclaimed water is free from the hepatitis A virus.

**Pollution from motor vehicles** (p.43): As part of a programme aimed at measuring the primary pollutants associated with motor vehicles, this instrument is used to analyse exhaust emissions.

## Pollution from motor vehicles

The two specially equipped mobile laboratories of the CSIR<sup>28</sup> have completed a fourth survey in Pretoria, Johannesburg and Durban, and a first survey in Port Elizabeth, Cape Town and Bloemfontein. These surveys involved the measurement of the primary pollutants associated with motor vehicles, viz carbon monoxide, hydrocarbons, nitrogen oxides, oxidants, ozone and lead.

The pollutant levels recorded in Pretoria, Johannesburg and Durban are very similar to those recorded during the surveys made in 1968, 1971 and 1973, whilst the levels recorded at Port Elizabeth, Cape Town and Bloemfontein are generally lower than those of Pretoria, Johannesburg and Durban. The average pollutant levels compare favourably with those levels that are regarded as permissible for city atmospheres in the USA and Europe, and consequently there appears to be no immediate need for the introduction of control measures in South Africa.

## Population dynamics

Population dynamics is concerned with the processes that determine the size and composition of animal populations, which are considered to consist of single species. The populations are characterized by birth and death rates, and also by the ratio between the sexes and between the numbers of individuals belonging to different age classes. It is frequently important to be able to control a given population: in the fishing industry, for instance, there is overexploitation, the long-term yield will be reduced.

In attempts to understand population-growth processes, mathematical models have become prominent and even decisive tools. These are mathematical abstractions of reality which frequently enable new results and insights to be gained, and although certain risks are involved in decisions based on models, the risks are usually not as great as when no models are made.

Earlier models were, however, based on underlying assumptions which have proved to be unrealistic for certain systems, and for this reason a more general non-linear model was developed at the CSIR<sup>3</sup>. In this model not only individuals, but also groups are allowed to migrate simultaneously between colonies, and the rate of migration between two colonies is dependent in a non-linear way on the number of individuals in the colonies concerned. It is likely that the model will find application in population control studies and, for example, in determining optimal harvesting policies.

Related mathematical modelling was done as part of the National Programme for Environmental Sciences. This is one of several co-operative national scientific programmes administered by the CSIR, and includes research designed to meet local needs and also contributes to the international programme of SCOPE (Scientific Committee on Problems of the Environment), the body established in 1972 by ICSU (International Council of Scientific Unions) to act as a focus of non-governmental international scientific effort in the environmental field. The Savannah Ecosystem Project, in particular, is part of that National Programme. It is a joint undertaking being carried out at Nylsvley in the Transvaal, and more than thirty scientists from the Department of Agricultural Technical Services, from the Transvaal Provincial Administration, the National Parks Board, the CSIR, the Transvaal Museum and eight universities are involved.

As a first modelling step in this project, a CSIR<sup>3</sup> staff member, in collaboration with a member of the Department of Applied Mathematics at the University of the Witwatersrand, developed a simple linear model of the ecosystem which made a preliminary sensitivity analysis possible.

## Training of army officers

The basic set of rules for an army war game was laid down in 1970 by the CSIR<sup>3</sup> in co-operation with the South African Defence Force, and the rules were then tested out for several years as a handgame. In view of the great number of computations it became evident that automation would be necessary, and in 1973 computerization of the game was begun on behalf of the South African Army College.

This computerization was completed in 1976 by the development of a suitable minicomputer system. The hardware consists of a minicomputer and seven terminals.

The software, which was developed by the CSIR<sup>3</sup>, consists of a specialized real-time operating system with supporting modules and eight simulation subsystems for handling the game. In the system use is made of a digitized map for computing mobility, visibility and contact between combat units.



## Medical electronics

In the field of medical electronics the CSIR<sup>®</sup> has completed its study together with a sponsor for the automatic recording and computer analysis of electroencephalograms used in sleep studies. In addition, the development work on telemetry devices for relaying physiological data has been completed and these are now being used in projects to assist in medical studies.

## Hepatitis virus in effluent

The type A (infectious) hepatitis virus is transmissible by water and several hepatitis epidemics caused by sewage-contaminated water have been described. The classic example is an epidemic of 40 000 cases which broke out in New Delhi in 1954.

Our knowledge of the survival of the hepatitis A virus in water and its resistance to water purification processes is very limited since the virus cannot be cultivated and studied by conventional methods in the laboratory. However, available information indicates that it is extremely resistant and therefore of vital importance to the CSIR's<sup>11</sup> research on the reclamation of potable water from purified sewage effluent. Accordingly, high priority studies aimed at ensuring that reclaimed water is free from the hepatitis A virus are in progress.

An important discovery by researchers abroad was that chimpanzees and certain species of South American marmosets are susceptible to the virus and can be used for experimental purposes in the laboratory. Unfortunately, the demand for these animals increased to such an extent that exports had to be discontinued to protect them from extinction. Consequently, the CSIR is attempting to find other suitable test animals susceptible to the virus. Preliminary results indicate that bushbabies, *Galago senegalensis*, which are found in South Africa and can be bred with ease, may be suitable.

Also under investigation is the development of tissue cultures for cultivation of the virus.

# transfer of scientific and technical information

## Particle characterization

There is hardly any process industry which does not encounter problems because of the presence of particulate matter in one or more process streams. To overcome these problems the characterization of these particles by size distribution, shape, surface area, porosity, etc. is an essential step.

Jointly with the South African Institution of Chemical Engineers, a comprehensive five-day course and an evening symposium on the subject were presented<sup>9</sup>. The course leader was an expert from the University of Bradford, England, and the course was completed by 40 attendants from a wide variety of industries and some research establishments.

## Use of solar energy

At the request of the regional engineer of the Department of Bantu Administration and Development two CSIR staff members<sup>10</sup> visited South West Africa to investigate problems related to the use of solar energy for the supply of hot water in buildings. During the visit a number of applications making use of absorbing surfaces with areas between 300 m<sup>2</sup> and 500 m<sup>2</sup> were investigated. The general conclusion was that a number of installations failed because of faulty design or poor maintenance. It is disturbing that these unnecessary shortcomings should have such an unfavourable influence on the efficient application of a freely available source of natural energy. The visit showed that there is a clear requirement for the education of users, designers and contractors and for the distribution of information on the subject.

A series of lectures and workshops have therefore been arranged in collaboration with the Solar Energy Society of Southern Africa. Instruction on the installation of solar water heaters was given in Pretoria and in Johannesburg to architects, planners, construction engineers, plumbers, quantity surveyors, representatives of government departments and local authorities, and other interested people. If there is sufficient demand these workshops will also be offered in other centres.

### Conference on tall buildings

The South African Conference on Tall Buildings, held in Johannesburg in November 1975, was organized by the CSIR<sup>10</sup> working in collaboration with a special steering committee and the international Joint Committee on Tall Buildings. Some 280 delegates, of whom 15 were from overseas countries, attended the conference. The chairman of the joint Committee, Prof. L S Beedle, was invited to the conference as guest of honour. The conference led to the establishment in South Africa of a permanent committee on tall buildings to promote good practice in this sphere of building in South Africa and to liaise with the international committee.

### Manual of Southern African diatoms

The algal group known as the diatoms is an integral constituent of any water body in which the association of species is characteristic of a certain type of environment. A knowledge of the specific ecological requirements of each species in an association therefore enables the diatomist to give an indication of the water quality and pollution in a particular environment.

Making such inferences, however, necessitates the precise identification of the species composing the diatom association or community, since incorrect identification of species leads to misinterpretations of water quality.

Since the first intensive studies and surveys in 1952, initiated by the late Dr B J Chohnoky, considerable contributions have been made by South African diatomists. The information collected on diatom flora of Southern Africa during the past twenty years as well as from surveys covering the whole of Africa has been collated and entered in a diatom reference index housed at the CSIR<sup>11</sup>. To make this information more readily available, the first part of a manual on the diatom flora of Southern Africa was recently published. The entire project will extend over a number of years and will include a description and taxonomic comment on every species recorded in Southern Africa (South Africa, Rhodesia, Botswana, Lesotho, Swaziland and Mozambique) from fresh, brackish and marine littoral waters.

### Estimates of road accident costs

Road accidents cause large material losses to society as well as a great amount of disruption and suffering. The costs of such accidents are difficult to quantify because human suffering is not quantifiable, nor can they be easily translated into monetary terms. An estimate of the magnitude of road accident costs is, however, essential to road and traffic authorities in order that they may have a sound basis on which to determine priorities for implementing road safety measures.

Some years ago two studies of road accident costs in South Africa were carried out, and estimates of accident costs were prepared for the years 1962 and 1963. In 1974 a further study was undertaken to revise and improve the cost estimation techniques in this field<sup>12</sup>. The results of this study were recently published.

In the report a detailed estimate of road accident costs in South Africa is made for 1972, the latest year for which comprehensive input data could be obtained. On the basis of the estimate accident costs were also projected for 1973 and 1974. Only the tangible costs of accidents are considered and detailed estimates are made only in respect of variable accident costs (i.e. costs which vary with the number of accidents), since road safety authorities are mainly interested in assessing minor changes in accident occurrence following the implementation of specific safety measures. Variable accident costs comprise loss of output, property damage costs, medical costs, administrative costs and legal costs. In brief, the results of the study are as follows:

In 1974 the cost per accident varied from an average of R18 450 for fatal accidents to R830 for damage-only accidents.

### Estimated cost of road accidents in South Africa (R million)

	1972	1973	1974
Fatal accidents	114,7	124,7	94,1
Serious accidents	33,7	36,5	31,8
Slight accidents	31,2	33,6	32,1
Damage-only accidents	145,4	163,9	167,4
<b>TOTAL</b>	<b>325,0</b>	<b>358,7</b>	<b>325,4</b>

### Novel conference procedures

Conferences and symposia organized by the CSIR<sup>19</sup> during 1976 in collaboration with national and international bodies included the International Symposium on Analytical Chemistry in the Exploration, Mining and Processing of Materials, organized under the aegis of the International Union of Pure and Applied Chemistry, and a Symposium on Automation in Mining, Minerals and Metal Processing presented on behalf of the South African Council for Automation and Computation (SACAC) under the aegis of the International Federation of Automatic Control (IFAC).

For the registration of the more than 400 delegates attending the latter symposium a minicomputer was used. This facilitated the registration procedure and the general administration to the extent that two staff members could handle all the preparatory work.

Novel procedures were also used at the First Interdisciplinary Conference on Marine and Freshwater Research in Southern Africa which was sponsored by the South African National Committee for Oceanographic Research, the National Programme for Environmental Sciences and other interested bodies in collaboration with the University of Port Elizabeth. In addition to five plenary sessions where review papers were presented in the traditional manner, direct research results were presented at so-called 'poster sessions' where each contributor was allocated an area where he could present his research work and results visually and also answer any questions by and conduct discussions with other delegates. These 'poster sessions' were supplemented by specialized work sessions where no formal papers were presented but where points for discussion and potential participants were previously selected by individual conveners. The reaction of authors and other delegates was generally favourable, and it is felt that this method of presentation offers many advantages, particularly at conferences and symposia of an interdisciplinary nature.

Another feature of this conference was the use of microform for the documentation. Considerable savings were effected by making individual papers available on demand in microfilm or microfiche form instead of duplicating and distributing the total of nearly 100 documents to all delegates.

Application of these procedures and techniques to future conferences and symposia of a similar nature will greatly facilitate matters for the organizers. The success of conferences depends largely on the efficiency of the organizational infrastructure, and in this regard the CSIR has gained much valuable experience over several years. The CSIR is also acquiring an additional facility for this purpose in the form of a well-equipped conference centre which is now under construction and is expected to be completed towards the middle of 1977.

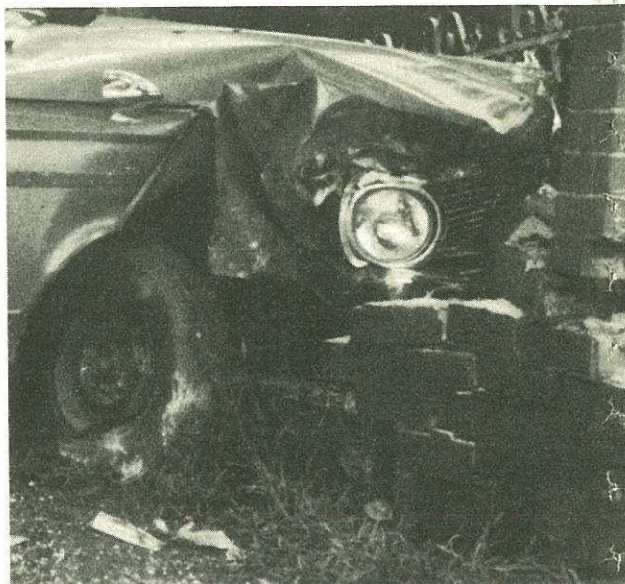
### Conference interpreting service

In June 1976 the CSIR<sup>19</sup> started with the training of interpreters to provide for its own needs for scientific and technical conferences.

The primary objective is to provide for interpreting from Afrikaans into English at national conferences to which speakers or other delegates from abroad have been invited. This will make it possible for Afrikaans speaking scientists to present papers in their mother tongue and at the same time ensure effective communication with all present. It is envisaged that in due course provision will also be made for interpreting from French, Spanish and German for international conferences and symposia organized by the CSIR.

Provision for interpreting facilities is also being made in the conference centre under construction on the CSIR site.

As in the case of its Conference Secretariat, the CSIR may also eventually consider making its interpreting services available to other organizations with which it is closely associated and for meetings in which it has a direct interest.



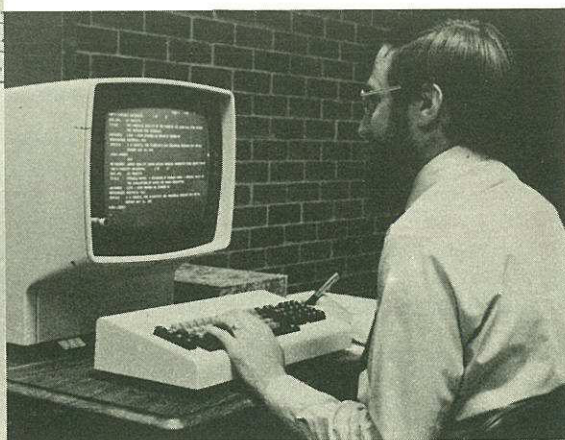
**Estimates of road accident costs (p. 46):** Damage to vehicles and property represents only part of the total costs of road accidents.



**Novel conference procedures (p. 47):** In following the system of 'poster sessions' each contributor is allocated an area (pictures left) where he can present his research work and results visually and discuss these with other delegates, thus supplementing review papers presented in the traditional manner.

(Photographs: South African Biochemical Society.)

**Library and information services (p. 49):** Retrospective literature searches in various fields are conducted from on-line video screen terminals (bottom)



## Regional liaison

In addition to permanent representation in various parts of the Republic and in South West Africa, the CSIR has regional research liaison committees to review activities on a regional basis in consultation with appropriate authorities. During the year meetings of the CSIR liaison committees for Natal, the Eastern Cape, the Western Cape and South West Africa were held in Durban, Port Elizabeth, Cape Town and Windhoek.

At the latter two meetings a new reporting procedure was adopted. Instead of the formal research reports normally submitted by directors of the CSIR institutes concerned, audio-visual programmes were presented with the themes 'The CSIR and the infrastructure of the Western Cape' and 'Science for regional development in an arid area (South West Africa)'. In addition to the Administrator and members of the Executive Committee concerned, the Cape Town meeting was also attended by the Minister of Economic Affairs and local members of Parliament. The reaction to this form of presentation, which was followed by in-depth discussions, was favourable.

## Library and information services

Good progress has been made with the various information services operated by the Centre for Scientific and Technical Information<sup>20</sup>. Subscriptions to the industrial literature current-awareness service rose from 360 firms last year to more than 500 firms this year, while individual subscriptions to the computerized selective dissemination of information service increased from 850 to over 1 100.

The South African Water Information Centre, which was announced last year and which is operated under contract to the Water Research Commission, now offers the following services:

- Selected Journals on Water — a current-awareness bulletin
- Water Patent Bulletin — abstracts of South African patents in the field of water
- a specialized selective dissemination of information service
- retrospective literature searching based on the Centre's own bibliographical data bases

- a register of water research projects and of scientists active in this field.

The computerized on-line retrospective literature searching service, which was announced last year, has now become fully operational. With this service, it is possible to conduct retrospective literature searches from on-line video screen terminals. At present, searches can be done in the fields of chemistry, physics, water, engineering and computers and control systems. These interactive searches are extended by conventional literature searches.

# international co-operation

## Visiting astronomers

A very instructive symposium was held from 15 to 17 March, and was addressed by a number of eminent overseas astronomers: Drs Gascoigne (Australia), Lynden Bell (Cambridge, UK), Tammann (Basel, Switzerland), Graham Smith (Herstmonceux, UK) and Maarten Schmidt (Pasadena, California). This symposium was attended by a number of South African participants.

Later in the year the Observatory\* was visited by Dr A Blaauw (The Netherlands), the new President of the International Astronomical Union, and Prof. Ströhmeier (Federal Republic of Germany).

## Timber and timber products

CSIR staff members attended several international meetings on timber and its various aspects during the year at several of which papers were presented<sup>17</sup>.

The meetings included the first meeting in Paris of Subject Group S6.06: 'Management of Forestry Research' of the International Union of Forestry Research Organizations (IUFRO); the IUFRO Conference on 'Natural Regeneration' in Istanbul and Ankara, Turkey; and the 30th APPITA (Australian Pulp and Paper Industry Technical Association) Conference in New Zealand.

Visits to the Institute for Forestry and Range Lands in Tehran, Iran and the Israel Fibre Institute have resulted in international co-operation and an exchange of publications. Wholetree utilization was discussed with staff members of the Forest Products Research Organization in Rotorua and at various research institutes and private organizations in Australia and in the USA.

## Scientific collaboration with Israel

Following a visit to Israel in 1975 by the President of the CSIR and the Secretary for Agricultural Technical Services and a visit to South Africa in March 1976 by the Director and Deputy-director of Israel's National Council for Research and Development (NCRD) and the Director of Horticulture at the Volcani Institute of Israel's Agricultural Research Organization, a programme for extended scientific co-operation between the Republic and Israel was initiated.

Details of the programme are contained in an agreement concluded between the NCRD and the CSIR, and in a similar agreement between the Agricultural Research Organization in Israel and the South African Department of Agricultural Technical Services. These agreements are additional to the existing ties between the two countries in different fields of science and technology.

The agreement between the CSIR and NCRD provides, among other things, for the exchange of scientists on the basis of 12 man-months of research per year in various fields of science and technology. Scientists not taking part in other joint programmes between the two countries will be eligible for participation in the exchange scheme. Applications from South African scientists will be considered twice yearly by an advisory panel nominated by the CSIR.

The programme also provides for annual joint symposia which will cover topics of mutual interest and be held alternately in South Africa and in Israel. The first symposium within this framework, which dealt with the recycling of waste water, was held in Israel in November 1975.

Discussions at the symposium identified certain fields of research which could profitably be pursued on a co-ordinated basis. These were:

- health aspects of reclaimed water, in particular the identification and evaluation of organic residues such as carcinogens, chlorinated hydrocarbons, pesticides and pathogenic micro-organisms
- the use of ultrafiltration membranes as a unit process in the renovation of sewage effluents
- primary physical-chemical treatment of sewage, followed by biological and tertiary treatment
- algal culture and the harvesting of algae
- the use of algae in the natural food cycle
- improvements in irrigation engineering

Steps are currently being taken to implement these proposals<sup>11</sup>.

## Liaison with the Weizmann Institute

The CSIR also participated in meetings held in Johannesburg during April to mark the centenary of the birth of Dr Chaim Weizmann, the famed biochemist and first President of Israel.

These meetings, which were sponsored and organized by the South African Committee of the Weizmann Institute of Science in collaboration with the CSIR, comprised a conference where scientists from the Weizmann Institute and their South African counterparts presented papers on nuclear physics, isotope chemistry, flavanoid chemistry, cancer research, geophysics and science education, followed by a symposium on science and public policy.

At the symposium, which took the form of panel discussions on science and industry, science and water resources, science and education and science and a small society, the opening address was delivered by the President of the CSIR.

Following these successful meetings, which were attended by some 100 delegates, the CSIR was visited by Professor G Goldrich, Chairman of the Scientific Council of the Weizmann Institute.

## Distinguished British visitor

Sir Ieuan Maddock, Chief Scientist of the Department of Industries in the United Kingdom, visited South Africa in March 1976 as a guest of the CSIR Executive.

In addition to visiting research organizations, universities and industries in the major urban areas and in Transkei, where high level discussions were held, Sir Ieuan led an interesting and stimulating seminar on 'Strategic Planning for Industrial Research and Development' in Johannesburg.



# support of research at universities

## **Increase of wall surface for column chromatography**

A new type of glass tube which allows improved column chromatographic separations has been developed by the Institute for Chromatography at the University of Pretoria.

Glass tubes as long as 100 m, but with an internal diameter of only 0,05 cm, are often used for the chromatographic separation of components in a gas mixture. This gas mixture can, for instance, consist of residual pesticides in agricultural products, dangerous organic substances in purified water or in the metabolites in body fluids. The separation of these products is obtained by depositing a thin, smooth film of a suitable fluid onto the inner wall surface of such a glass tube, and passing the gas mixture through this under controlled conditions.

The efficiency of the method whereby the components of the gas mixture can be separated depends, among other things, on the area of the layer of fluid on the inner tube surface. The Institute has succeeded in growing hairlike silica crystals on the inner surface of the column, thereby increasing the area on which the film of fluid can be deposited.

The South African Inventions Development Corporation has recently applied for a provisional patent to protect this development, which has aroused considerable interest overseas.

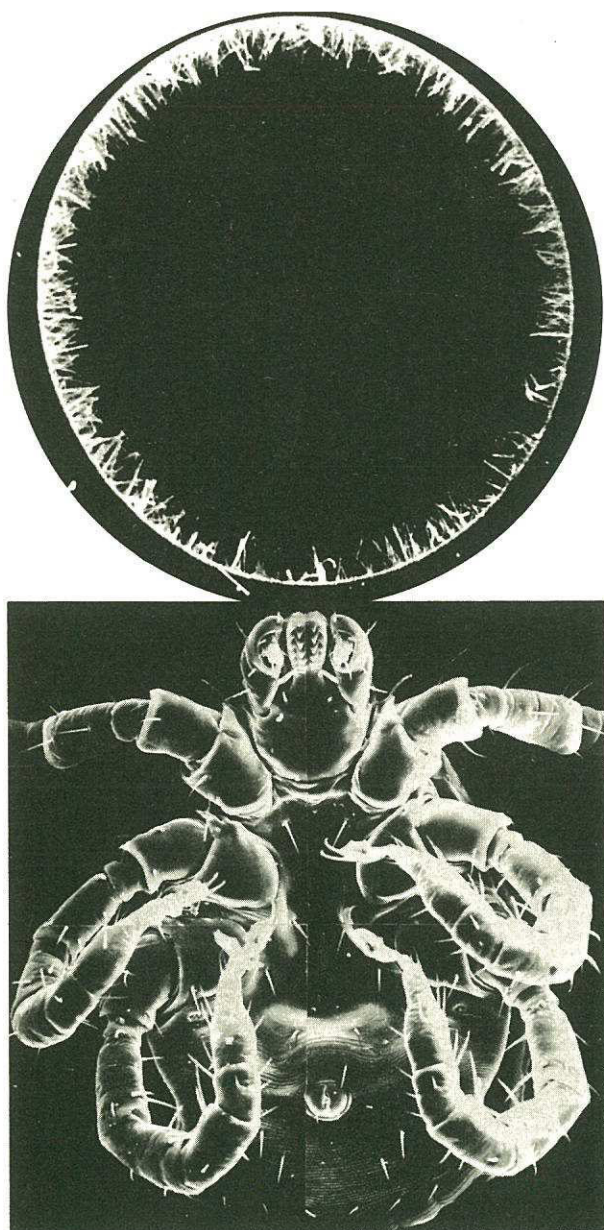
## **Glass with special photochromic properties**

One aspect of research at the University of Pretoria's Institute for Microstructures is that of electro-optics. It is known that certain types of glass exhibit a photochromic effect, i.e. the absorption properties of the glass change under the influence of high intensity light.

A new type of glass has been produced in which the photochromic effect is more intense and faster than was previously attainable. It was also found that the effect could be strengthened and speeded up by the addition of certain rare earth oxides. This investigation is being conducted in close collaboration with the National Physical Research Laboratory.

**Increase of wall surface for column chromatography** (p. 52): A section of a new type of glass tube developed for column chromatographic separation (below). The hairlike silica crystals on the inner surface significantly increase the area.

**Tick research** (p. 53): Scanning electron microscope view of the underside of a tick larva (bottom).



Patent rights in South Africa, the USA and Germany have already been applied for.

## Tick research

The Tick Research Unit of Rhodes University is investigating the morphology, biology and physiology of certain types of ticks; among other things, to discover why the blue tick becomes resistant to certain insecticides.

The scanning electron microscope has been found to be exceptionally effective in the identification of the immature stages of the blue tick types such as *Boophilus decoloratus* and *B. microplus*.

A method has also been evolved whereby the guanine concentration is determined to indicate the metabolic state of the tick embryo, which in turn indicates the probability of the eggs hatching under certain humidity and temperature conditions. In this regard it appears as if a raised temperature was more important than humidity, and this offers a possible explanation as to why the blue tick does not colonise the Fish River Valley.

## Ichthyological research

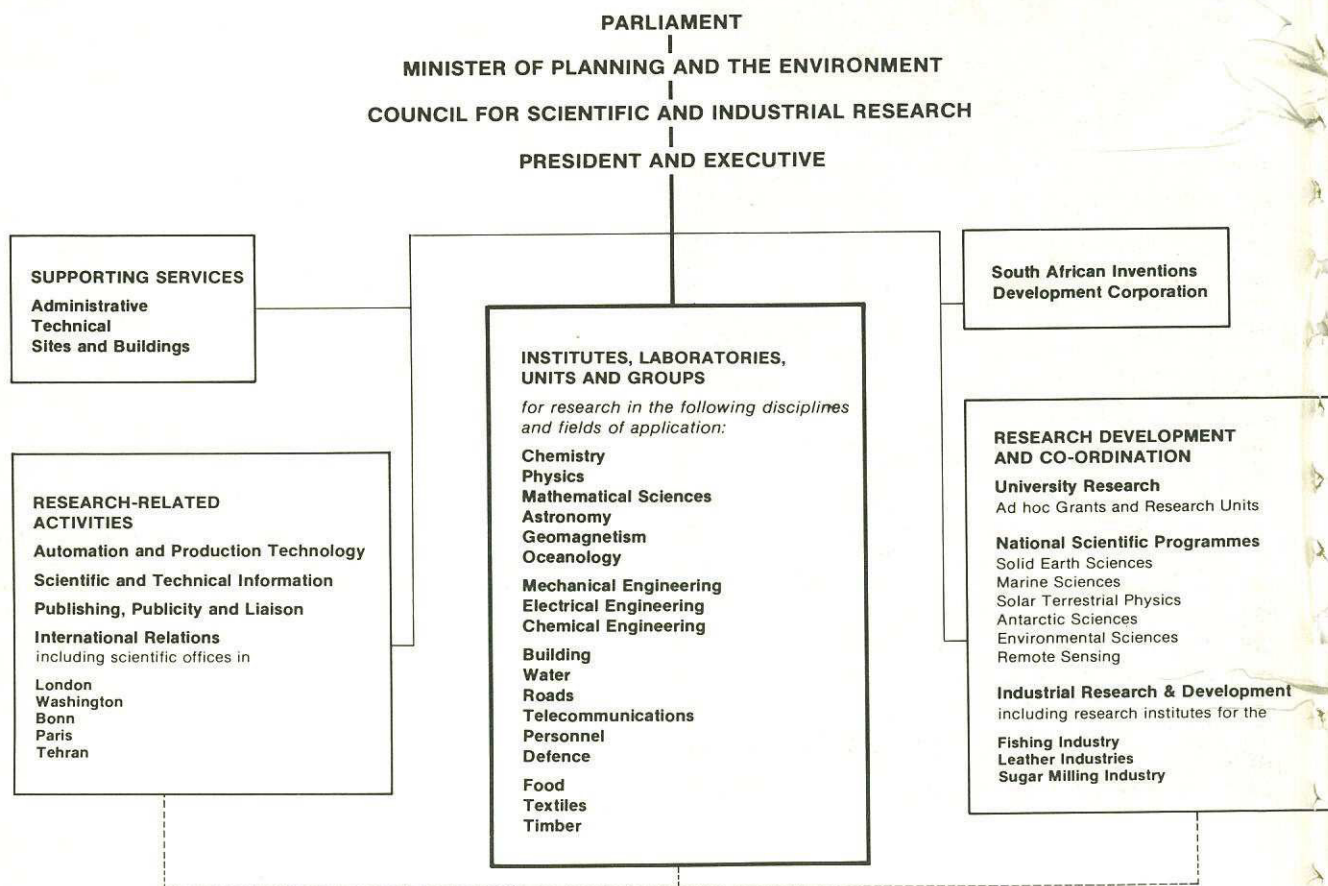
The work which earned Prof. J L B Smith world renown is being continued at Rhodes University by the Ichthyological Institute which bears his name.

The Institute is mainly active in the identification and classification of fishes found in South African marine and inland waters. Furthermore, the fish populations of the Republic's large dams and lakes are studied with a view to determining the most suitable types for breeding.

The Institute maintains one of the finest and most comprehensively documented ichthyological libraries in the Southern Hemisphere which is constantly being used by visiting scientists.

Matters such as the establishing of undersea parks and conservation areas are under review with the Republic's neighbour states.

# organization and functions of the csir



1.

## NATIONAL CHEMICAL RESEARCH LABORATORY

Director — DR P R ENSLIN

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

In accordance with a policy of concentrating on research in fields where a need for more basic knowledge exists, many of its research projects are carried out in collaboration with research organizations that are more directly concerned with the practical problems involved. Well-motivated long-term projects are, therefore, approached from a fundamental point of view.

The NCRL is organized into divisions of analytical chemistry, biological chemistry, inorganic chemistry, organic chemistry, molecular biochemistry, physical chemistry, structural chemistry and corrosion research.

2.

## NATIONAL PHYSICAL RESEARCH LABORATORY

Director — DR A STRASHEIM

The main function of the National Physical Research Laboratory (NPRL) is to contribute to the development of physical science in South Africa through research aimed at the adaptation of existing knowledge and at the discovery of new facts of value in the solution of technological and industrial problems of national importance. In addition, the NPRL has statutory responsibilities for maintaining national measuring standards of mass, length, electricity, radiation, etc.

The successful practice of the science of physics requires proficiency in highly advanced techniques. The personnel of the NPRL have to become fully conversant with these techniques in order to contribute to the solution of industrial and national problems as far as physical measurements and methods are concerned. The development of new techniques gives rise to, amongst other things, the generation of significant new knowledge at the NPRL. This knowledge enables the NPRL to make a vital contribution towards the solution of problems which are referred to the Institute by industry or the State.

3.

## NATIONAL RESEARCH INSTITUTE FOR MATHEMATICAL SCIENCES

Director — PROF D H JACOBSON

The National Research Institute for Mathematical Sciences (NRIMS) consists of the divisions of mathematics, computer science, operations research and statistics, and a computing centre.

Research activities cover the various branches of mathematics and their applications. Typical fields of study are differential equations, statistical decision techniques and design of experiments, numerical computation and data handling on digital computers.

The computing centre provides general-purpose computing facilities and services for all the institutes of the CSIR.

4.

## SOUTH AFRICAN ASTRONOMICAL OBSERVATORY

Director — SIR RICHARD VAN DER RIET WOOLLEY

The South African Astronomical Observatory (SAAO), which is operated by the CSIR in co-operation with the Science Research Council of Great Britain, has been established to conduct astrophysical research. The headquarters of the SAAO have been established in the grounds of the former Royal Observatory in Cape Town. The site for the observing station at Sutherland in the Karoo, at an elevation of 1 760 m, was selected on account of the favourable night sky for astronomical purposes, that is, for the number of fine nights per year, freedom from urban atmospheric pollution, absence of wind and freedom from atmospheric disturbances (the astronomers' 'bad seeing').

The majority of the research programmes undertaken by the Observatory involve massive amounts of observing and reduction time. It is important that observatories such as the SAAO, which have a substantial number of long-term staff, should undertake these programmes which cannot be tackled by university and other small departments.

5.

## MAGNETIC OBSERVATORY

Head — A M VAN WIJK

Situated at the southern tip of Africa, the Magnetic Observatory at Hermanus is an important link in the worldwide network of geophysical institutions engaged in studies of physical processes occurring in the Earth's environment and in the interplanetary medium. Such phenomena are often closely related to the magnetic field extending outwards from the Earth and to cosmic rays incident on the Earth's atmosphere, and the variations of both are thus routinely measured. Besides its various monitoring programmes, the Magnetic Observatory conducts countrywide magnetic surveys, maintains magnetic standards and co-operates in national and international programmes.

Research at the Observatory consists of the analysis and interpretation of a variety of geophysical data.

6.

## NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY

Director — F P ANDERSON

The National Research Institute for Oceanology (NRIO), with its headquarters at Stellenbosch, consists of divisions of physical oceanography, marine geoscience, marine chemistry, marine biology and coastal engineering and hydraulics.

Studies are being undertaken to obtain data in the oceanic areas around South Africa as well as to provide data and knowledge needed in the continued development of our coastal areas for economic and recreational use, and for resource exploitation.

7.

## NATIONAL MECHANICAL ENGINEERING RESEARCH INSTITUTE

Director — DR H G DENKHAUS

While the National Mechanical Engineering Research Institute (NMERI) is concerned mainly with the development of new processes, techniques and equipment in mechanical engineering as well as the improvement of machines and materials used in industry, it is also active in fields such as geomechanics for both mining and civil engineering as well as in civil engineering hydraulics.

Testing equipment, machines, instruments and qualified personnel are available for research in six divisions covering the fields of metal mechanics, strength mechanics, process mechanics, geomechanics, fluid mechanics and heat mechanics (including air conditioning and refrigeration). There are also two research units, the one dealing with aeronautics and the other with mine equipment. The six divisions and the Aeronautics Research Unit are housed in Pretoria, while the Mine Equipment Research Unit is accommodated in Johannesburg. The two units are integral parts of the Institute and are directly responsible to the Director of the Institute.

8.

## NATIONAL ELECTRICAL ENGINEERING RESEARCH INSTITUTE

Director — J D N VAN WYK

The National Electrical Engineering Research Institute (NEERI) is concerned with light-current and heavy-current research in the field of electrical engineering. The Institute consists of divisions for applied electronics, automation, electronic instrumentation, power electrical engineering, signal processing, solid-state electronics, and training and information. Work is done in such diverse fields as computer technology, process control, the application of digital techniques to data processing, information theory and signal processing, medical electronics, semiconductor and thin-film technology and its applications to electronic circuit systems and micro-miniaturization, and the investigation of problems peculiar to South Africa in heavy-current applications.

9.

## CHEMICAL ENGINEERING RESEARCH GROUP

Head — W G B MANDERSLOOT

Chemical Engineering deals with the processes and operations by which the properties or composition of matter in bulk are changed. Thus the activities of the Chemical Engineering Research Group (CERG) cover not only the needs of the chemical industry but also many processing aspects in the petroleum, petrochemical, mineral, food, beverage, biochemical, pharmaceutical, ceramic, paper and textile industries, and in environmental technology (in which water, effluents and air are important). The interdisciplinary nature of chemical engineering provides a useful link in carrying out tasks undertaken in close co-operation with other institutes and organizations.

The research and development items on the Group's programme are selected according to the immediate and anticipated needs of industry. The Group provides a wide range of consulting services to industry. If necessary these services are backed up by applied or fundamental research.

10.

## NATIONAL BUILDING RESEARCH INSTITUTE

Director — DR T L WEBB

The National Building Research Institute (NBRI) was thirty years old in 1976, having been one of the first institutes of the CSIR when it was founded shortly after the Second World War.

With its present staff of about 250, the NBRI operates from headquarters in Pretoria and regional offices in Cape Town, Windhoek, Durban and Port Elizabeth. Its annual budget of about R3,6 million is less than one-tenth of one per cent of the amount spent on building and construction in South Africa every year.

About 60 per cent of its income is from Parliamentary funds and about 40 per cent is derived from research and similar investigations and services undertaken on behalf of central provincial and local government, private industry and individuals with particular building problems.

The emphasis remains on meaningful research and on the efficient dissemination of useful information, both self-generated and derived from work done elsewhere in South Africa or anywhere else in the world. Important advances during 1976 were its work on building norms, solar energy and energy conservation, building services, low cost housing, new building materials and research on the economics of building — activities which saved the country well over three times its Institute's annual cost.

11.

**NATIONAL INSTITUTE FOR WATER RESEARCH**

Director — DR G G CILLIÉ

Water research is vital in a country like South Africa with its relatively scarce sources of water. The National Institute for Water Research (NIWR) therefore strives to develop expertise on the efficient use and conservation of available resources. Its activities include investigation of the purification of water prior to use, treatment of effluent after use to meet specific standards, and the investigation of specific types of pollution in dams, rivers, estuaries and even the sea.

The Institute has a total personnel of 183 and is divided into a number of research groups and regional laboratories. While the regional laboratories in Durban, Bellville, Bloemfontein and Windhoek concentrate on local water problems, research groups in Pretoria undertake basic and applied research on a broad spectrum of problems concerning the optimum utilization of water. Research groups have been established for freshwater biology, water quality, biological treatment processes, physical-chemical treatment processes and desalination. Yet another group deals with practical application of technology developed by the Institute.

12.

**NATIONAL INSTITUTE FOR TRANSPORT AND ROAD RESEARCH**

DIRECTOR — DR S H KÜHN

Road and traffic authorities encounter a wide range of problems in their endeavours to ensure the most economic use of roads 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 road systems, into road safety and the behaviour of road users, and into the role of roads and road transport in society. Another important function of the NITRR is to ensure the effective dissemination and application of research findings throughout the road industry.

The NITRR works in close collaboration with national and provincial road authorities, the South West Africa Administration, the South African Railways, the National Road Safety Council and the road industry, which together provide most of the funds for road research. The Rhodesian Ministry of Roads and Road Traffic is also affiliated to the Institute and makes an annual contribution to research costs.

13.

**NATIONAL INSTITUTE FOR TELLECOMMUNICATIONS RESEARCH**

Director — R W VICE

The work of the National Institute for Telecommunications Research (NITR) in Johannesburg embraces the study of natural phenomena and their effects on radio waves, as well as the development of radio systems for particular applications.

14.

**NATIONAL INSTITUTE FOR PERSONNEL RESEARCH**

Director — D J M VORSTER

The optimum utilization of labour resources is of the utmost importance in South Africa with its acute manpower shortage, especially in respect of skilled labour. The National Institute for Personnel Research (NIPR) in Johannesburg therefore devotes considerable attention to this problem, and there is hardly a sector of industry which has not benefited to some extent from its work.

In any work situation there are certain factors directly affecting the worker's productivity and happiness. The NIPR is concerned with the study of these factors, which include:

- definition of the characteristics of work, i.e. description of the job, analysis of the physical and psychological demands made by the job on the worker, evaluation of a specific task in relation to others, and determination of the skills involved in work
- selecting and placing the right man in the right job (by means of aptitude tests, interests tests, and others) giving him the necessary training, and assessing his performance
- fitting the job to the man by improving working conditions and equipment
- studying the socio-psychological aspects of work, e.g. manpower problems, social relations in the work situation, work motivation and attitudes
- investigation of problems arising from maladjustment to work, e.g. absenteeism, accidents, occupational disorders and group conflicts.

15.

**NATIONAL FOOD RESEARCH INSTITUTE**

Director — J P DE WIT

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 four research divisions: Food Chemistry, Food Technology, Biological Evaluation and Techno-economics. It also administers and is closely associated with the CSIR MICROBIOLOGY Research Group and Sorghum Beer Unit.

Typical fields in which both fundamental and applied research is being carried out are food processing, cereal technology and biochemistry, food packaging and storage, flavour chemistry, food microbiology, food analysis, food chemistry and brewing technology. Biological studies of the utilization of nutrients in foods and diets are also undertaken.

16.

### SOUTH AFRICAN WOOL AND TEXTILE RESEARCH INSTITUTE

Director — DR D P VELDSMAN

The South African Wool and textile Research Institute in Port Elizabeth conducts research into the processing characteristics of natural fibres, alone or blended with synthetics. A most important feature of the research programme is the imparting of easy-care properties to fabrics where a modern society, with little time to spare for domestic maintenance, demands fabrics capable of being cleansed in a washing machine without the drudgery of special care.

Textile research also aims at more efficient processing of the different fibres which involves the development of existing processing machinery and the design of new machines to achieve these aims.

17.

### NATIONAL TIMBER RESEARCH INSTITUTE

Director — DR D L BOSMAN

Having been in existence for almost sixteen years, in February 1976 the Timber Research Unit became the sixteenth National Research Institute within the CSIR. Its aims are:

- the effective utilization of South African timber resources
- the development of satisfactory wood-base products
- the development and improvement of manufacturing processes
- the effective use of timber products.

The Institute offers a wide variety of specialized research services to both producers and consumers of forest products and assists with the application of research results.

About half of the income of the NTRI is derived from sources outside the CSIR. In the 1975-76 financial year the Forestry Council gave the NTRI approximately R180 000 which was a portion of the funds derived from a levy on all timber marketed in the Republic.

18.

### TECHNICAL SERVICES DEPARTMENT

Director — DR T HODGSON

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

The training of instrument-makers forms an important part of the Department's contribution towards industrial development in South Africa.

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

19.

### INFORMATION AND RESEARCH SERVICES

Director — D G KINGWILL

As a central service within the framework of the CSIR the Information and Research Services (IRS) has the following functions:

- providing publishing and publicity services
- liaison with all sections of the community
- maintaining international relations and representing South African science
- undertaking techno-economic studies, which include the economic aspects of research.

20.

### CENTRE FOR SCIENTIFIC AND TECHNICAL INFORMATION

Head — DR R VAN HOUTEN

The functions of the Centre for Scientific and Technical Information (CSTI) within the framework of the CSIR, are to:

- develop and maintain the Central CSIR Library and the information services associated with it
- undertake research and development in the communication sciences related to the transfer of scientific and technical information
- develop and apply techniques for the storage, retrieval and dissemination of scientific and technical information, in collaboration with CSIR laboratories and institutes.

21.

## NATIONAL SCIENTIFIC PROGRAMMES UNIT

The objectives of the National Scientific Programmes Unit (NSPU) are to provide the services required by the CSIR Executive in identifying and defining problems in South Africa amenable to scientific solution through co-operative national programmes. Scientific co-ordinators, in collaboration with scientists at universities and research organizations, are responsible for defining such scientific programmes and stimulating and co-ordinating contributions within a specific programme. The Unit is required to provide the means required for remaining abreast of all research relevant to existing or planned national programmes and to foster South African participation in international programmes, particularly those sponsored by the International Council of Scientific Unions (ICSU).

The national scientific programmes being carried out by the CSIR are collaborative undertakings of official agencies, universities and laboratories in the private sector in planned programmes, with the object of either contributing to an international programme in which South Africa has agreed to take part, or of achieving, by means of a co-ordinated effort within the country, some scientific objective of special national importance.

These national scientific observation and research programmes are normally associated with international endeavours launched from time to time by ICSU or its member unions, to encourage large-scale co-operative enterprises directed towards the solution of problems of world-wide scientific interest and importance which, on account of their magnitude and complexity, are unlikely to be solved by separate organizations or even nations working alone.

22.

## FISHING INDUSTRY RESEARCH INSTITUTE

Director — DR R J NACHENIUS

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 subsidised by 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 Economic Affairs and the Universities of Cape Town and Stellenbosch are represented. The research programme is planned and executed in consultation with committees, the members of which are prominent technical personnel of the inshore and white fish industries.

The principal role of the Institute is fundamental and applied research for the fishing industry. This is concerned with different products and processes such as refrigerated and frozen whole rock lobster and rock lobster tails, canned pilchards and mackerel, fish meal, fish oil, etc.

The Institute acts also as a technical adviser to the industry in connection with the purification of effluent, the control of odour, the testing of packaging material and the purification of water for use in factories. Co-operation with international organizations such as the International Association of Fish Meal Manufacturers and the International Institute of Refrigeration ensure that the industry keeps pace with the progress in every sphere of fish processing.

23.

## 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 African secondary industry. From its early beginnings in 1935 in the Chemistry Department of Rhodes University, the Institute has maintained its steady growth over the past forty years.

A feature of the 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 due to the close personal contact maintained with its many subscribers and the frequency of factory floor contacts between research staff and production staff at all levels.

24.

## SUGAR MILLING RESEARCH INSTITUTE

Director — DR M MATIC

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

The SMRI's main functions are:

- Research: Study of the fundamental aspects of processes such as milling, diffusion, juice clarification, crystallization of sugar and the utilization of by-products, the raising of steam and power and engineering aspects of the design and performance of mills, carriers, evaporators and vacuum pans.
- Service: Advisory work, troubleshooting, analysis of sugar — particularly sugar for export — and statistical compilation of manufacturing data for the sugar industry.
- Training: A three-year full-time course in sugar technology is offered in conjunction with the Natal College for Advanced Technical Education. The cost of the course is borne by SASMAL, and while following the course students are employed by the Institute.

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



## 25.

**UNIVERSITY RESEARCH DIVISION**

*The CSIR also has the function in terms of the Scientific Research Council Act to award grants for the promotion of academic research in the field of the basic natural sciences and engineering.*

*Research grants are awarded from a trust fund which is voted annually by the Treasury for this purpose and is administered by the University Research Division (URD).*

*The trust fund may only be used for research at or by universities and museums and not for the augmentation of the budgets of the CSIR institutes and laboratories.*

*More than R2 000 000 was spent in this manner during 1975-76.*

## 26.

**AIR POLLUTION RESEARCH GROUP**

*Head — DR G P N VENTER*

*The basic aims of the Air Pollution Research Group (APRG) are to determine which pollutants are found in the atmosphere, as well as their concentrations and the possible reactions and transformations which may occur; to monitor specific pollutants (e.g. smoke and sulphur dioxide) on a local, regional and hemispheric scale in order to study trends; to study the physical and chemical properties and behaviour of pollutants in the atmosphere and to attempt to understand the underlying processes; and to advise the authorities and industries concerned on air pollution matters.*

# financial statements

**BALANCE SHEET**  
as at 31 March 1976

**Statement no. 1**  
**Council for Scientific and Industrial Research**

	General Fund	Building Fund	1976	1975
	R	R	R	R
<b>ACCUMULATED FUND</b>				
Balance — 1975/03/31 . . . . .	34 954 453,10	21 747 088,23	56 701 541,33	50 157 714
Transfer from Operating Account . . . . .	965 185,00	630 000,00	1 595 185,00	1 831 122
<b>SUBTOTAL . . . . .</b>	<b>35 919 638,10</b>	<b>22 377 088,23</b>	<b>58 296 726,33</b>	<b>51 988 836</b>
<b>CAPITAL RECEIPTS</b>				
Parliamentary grants:				
CSIR . . . . .	2 474 300,00	1 500 000,00	3 974 300,00	2 864 100
Grants . . . . .	20 540,00	-	20 540,00	900
Contributions:				
CSIR . . . . .	17 750,00	-	17 750,00	12 800
Grants . . . . .	112,37	-	112,37	866
Interest . . . . .	-	256 871,90	256 871,90	295 190
Donations . . . . .	-	-	-	1 000
Sale of assets written off:				
CSIR . . . . .	39 191,41	34 050,00	73 241,41	40 888
Grants . . . . .	-	-	-	125
Investigation and services . . . . .	2 309 040,03	165 478,28	2 474 518,31	1 349 495
<b>SUBTOTAL . . . . .</b>	<b>4 860 933,81</b>	<b>1 956 400,18</b>	<b>6 817 333,99</b>	<b>4 565 364</b>
<b>ADD:</b>				
Excess income . . . . .	555 738,88	-	555 738,88	361 182
Physical assets acquired . . . . .	-	-	-	2 140
	5 416 672,69	1 956 400,18	7 373 072,87	4 928 686
<b>LESS:</b>				
Physical assets relinquished . . . . .	35,00	-	35,00	-
Cost of assets written off:				
CSIR . . . . .	239 247,29	-	239 247,29	188 339
Grants . . . . .	-	-	-	27 642
<b>SUBTOTAL . . . . .</b>	<b>5 177 390,40</b>	<b>1 956 400,18</b>	<b>7 133 790,58</b>	<b>4 712 705</b>
<b>TOTAL . . . . .</b>	<b>41 097 028,50</b>	<b>24 333 488,41</b>	<b>65 430 516,91*</b>	<b>56 701 541</b>
<b>Current Liabilities</b>				
Advance for investigations and services . . . . .			1 329 839,37	584 994
Sundry creditors and credit balances . . . . .			2 299 566,93	2 609 286
<b>Total Current Liabilities . . . . .</b>			<b>R 3 629 406,30</b>	<b>3 194 280</b>
<b>TOTAL ACCUMULATED FUND AND LIABILITIES . . . . .</b>			<b>R 69 059 923,21</b>	<b>59 895 821</b>

**Notes:** \* Contractual obligations against the General and Building Funds as at 31 March 1976 were R2 871 268 and R2 902 631 respectively.  
o Value of assets transferred: To S A Medical Research Council R35,00.

(Sgd.) C v d M Brink, *President*

(Sgd.) J D van Zyl, *Secretary*

PRETORIA  
3 September 1976

1975/76

Nett Additions

	Grants R	CSIR R	Written off R	Physical assets transferred ° R	1976 R	1975 R
FIXED ASSETS (at cost)						
Land and buildings . . . . .	-	4 404 801,13	-	-	25 254 332,96	20 849 532
<b>SUBTOTAL . . . . .</b>	<b>-</b>	<b>4 404 801,13</b>	<b>-</b>	<b>-</b>	<b>25 254 332,96</b>	<b>20 849 532</b>
Books and journals . . . . .	309,18	297 097,90	9 770,00(-)	-	1 896 562,70	1 608, 926
Furniture, fittings and office equipment . . . . .	699,77	321 472,75	30 191,88(-)	-	2 049 386,09	1 757 405
Prefabricated structures . . . . .	-	2 521,29	170,05(-)	-	21 621,57	19 270
Laboratory and workshop equipment . . . . .	37 843,75	4 491 893,34	164 099,57(-)	35,00(-)	30 892 529,39	26 526 927
Vehicles and cycles . . . . .	-	203 565,35	35 015,79(-)	-	1 268 732,99	1 100 183
<b>SUBTOTAL . . . . .</b>	<b>38 852,70</b>	<b>5 316 550,63</b>	<b>239 247,29(-)</b>	<b>35,00(-)</b>	<b>36 128 832,74</b>	<b>31 012 711</b>
Shares in S A Inventions Development Corporation . . . . .					200 000,00	200 000
RSA Stock: 5 1/4% 1978 . . . . .					474 313,01	474 313
<b>SUBTOTAL . . . . .</b>					<b>674 313,01</b>	<b>674 313</b>
<b>TOTAL . . . . .</b>	<b>38 852,70</b>	<b>9 721 351,76</b>	<b>239 247,29(-)</b>	<b>35,00(-)</b>	<b>62 057 478,71</b>	<b>52 536 556</b>
<i>Current Assets</i>						
Stores stock . . . . .					926 959,94	594 113
Saleable stock . . . . .					41 443,71	51 969
Sundry debtors and debit balances . . . . .					2 980 946,12	2 885 828
Advances and deposits:						
Research grants . . . . .				434 351,08		
Other . . . . .				1 739 709,74	2 174 060,82	1 643 264
Cash:						
At Public Debt Commissioners . . . . .				579 361,37		
At S A Reserve Bank . . . . .				250 277,21		
At other banks . . . . .				32 989,08		
Petty cash imprests . . . . .				16 406,25		
					879 033,91	2 184 091
<b>Total current assets</b>					<b>R 7 002 444,50</b>	<b>7 359 265</b>
<b>TOTAL ASSETS . . . . .</b>					<b>R 69 059 923,21</b>	<b>59 895 821</b>

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, as 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.

(Sgd.) E R Savage  
Acting Auditor-General

PRETORIA  
23.11.76

**OPERATING ACCOUNT**

for the year ended 31 March 1976

Statement no. 2

Council for Scientific and Industrial Research

Expenditure	Grants R	1975/76		1974/75 R
		CSIR R	Total R	
Salaries, wages and allowances . . . . .	78 240,50	26 787 189,90	26 865 430,40	23 425 142
Consumable stores and services . . . . .	10 200,00	13 486 827,67	13 497 027,67	9 470 539
Subsistence and transport . . . . .	13 093,85	1 406 936,27	1 420 030,12	1 288 169
General expenses . . . . .	4 843,71	3 463 541,78	3 468 385,49	3 021 325
Grants . . . . .	1 462 583,68	45 426,05	1 508 009,73	1 397 575
Subsidies: Research by industry . . . . .	-	490 289,24	490 289,24	429 040
Levies and depreciation . . . . .	43 778,04	4 977 550,78	5 021 328,82	2 615 115
<b>SUBTOTAL . . . . .</b>	<b>1 612 739,78</b>	<b>50 657 761,69</b>	<b>52 270 501,47</b>	<b>41 646 905</b>
LESS: Income for internal services . . . . .	860,47	10 153 997,05	10 154 857,52	6 556 246
<b>SUBTOTAL . . . . .</b>	<b>1 611 879,31</b>	<b>40 503 764,64</b>	<b>42 115 643,95</b>	<b>35 090 659</b>
<b>TRANSFER TO OTHER FUNDS</b>				
(a) Equipment fund . . . . .	-	965 185,00	965 185,00	1 308 122
(b) Building fund . . . . .	-	630 000,00	630 000,00	523 000
Excess income transferred to Accumulated Fund . . . . .	166 949,64	388 789,24	555 738,88	361 183
<b>TOTAL . . . . .</b>	<b>1 778 828,95</b>	<b>42 487 738,88</b>	<b>44 266 567,83</b>	<b>37 282 964</b>

PRETORIA  
3 September 1976

(Sgd.) C v d M Brink, *President*

Income	Grants	CSIR	1975/76	Total	1974/75
	R	R		R	R
Parliamentary grant . . . . .	1 722 260,00	21 300 600,00		23 022 860,00	20 281 050
Contributions to CSIR projects . . . . .	51 000,00	972 793,60		1 023 793,60	700 325
Investigations and services . . . . .	2 776,40	20 014 311,60		20 017 088,00	16 092 029
Publications . . . . .	2 107,55	58 030,70		60 138,25	48 422
Sundry . . . . .	685,00	142 002,98		142 687,98	161 138
<b>TOTAL . . . . .</b>	<b>1 778 828,95</b>	<b>42 487 738,88</b>		<b>44 266 567,83</b>	<b>37 282 964</b>

(Sgd.) J D van Zyl, *Secretary*

## CSIR BUDGET 1976/77

### Statement No. 3

#### A. OPERATING EXPENDITURE

ACTIVITIES	EXPENDITURE				FUNDS		
	Salaries	Direct running expenses	Awards and subsidies	Total	Recoverable expenditure		
					Parliamentary Grant	Internal	External
R	R	R	R	R	R	R	
CSIR laboratories and departments . . .	30 223 741	24 004 511	-	54 228 252	22 970 553	6 387 907	24 869 792
Grants and subsidies . . .	355 770	462 510	3 456 282	4 274 562	3 516 405	127 157	631 000
<b>Total . . . . .</b>	<b>30 579 511</b>	<b>24 467 021</b>	<b>3 456 282</b>	<b>58 502 814</b>	<b>26 486 958</b>	<b>6 515 064</b>	<b>25 500 792</b>

#### B. CAPITAL EXPENDITURE

ACTIVITIES	EXPENDITURE						FUNDS		
	Books/ Journals	Technical equip- ment	Furniture/ Office equip- ment	Vehicles	Stores stock	Buildings	Total	Parlia- mentary grant	Recover- able ex- penditure
CSIR laborato- ries and departments . . .	202 655	5 381 420	160 480	220	35 000	2 200 000	7 979 775	5 545 600	2 434 175
Grants to univer- sities etc. . . . .	1 000	40 000	1 000	-	-	-	42 000	42 000	-
<b>Total . . . . .</b>	<b>203 655</b>	<b>5 421 420</b>	<b>161 480</b>	<b>220</b>	<b>35 000</b>	<b>2 200 000</b>	<b>8 021 775</b>	<b>5 587 600</b>	<b>2 434 175</b>
					<b>GRAND TOTALS A &amp; B</b>		<b>66 524 589</b>	<b>32 074 558</b>	<b>34 450 031</b>

csir  
periodical  
publications



## 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

Monthly. 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. Gratis. Also contains information on recent translations by the CSIR Foreign Language Service.

### CSIR – organization and activities

Irregular. A directory of the various divisions and services of the CSIR. Gratis.

### CSIR – research for South Africa

Popular general brochure on the CSIR. Irregular. Gratis.

### Calendar of scientific and technical meetings in South Africa

Six-monthly list of conferences, symposia, etc. due to be held in the ensuing 18 months. Gratis.

### Scientific research organizations in South Africa\*

Annual. A guide to government organizations, statutory bodies and industrial concerns which maintain research laboratories. R4,00 per issue.

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

Annual. A guide to societies, giving particulars of their aims and objects, membership, publications, etc. R2,50 per issue.

### Scientific and technical periodicals published in South Africa\*

Annual. A list of current periodicals, giving particulars of fields covered, subscription rates, etc. R1,50 per issue.

### Psychologia Africana

Journal of the National Institute for Personnel Research, CSIR. R5,00 per volume or R2,00 per single number. Subscriptions payable per volume and not per annum.

### NIPR News

Quarterly. Newsletter of the National Institute for Personnel Research, CSIR. Gratis.

### NBRI information sheets

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

### Houtim

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

### VIA

March and September. Summarized reports (mostly of an interim nature) by the National Institute for Transport and Road Research, CSIR. Gratis.

### SAWTRI bulletin

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

### NIWR Information Sheet

Irregular. Information on specific water and waste water problems. Gratis.

### Water Report

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

\* R6,00 per set if all three directories are ordered.

### ENQUIRIES:

Publishing Division, CSIR, P O Box 395, Pretoria, 0001.

Telephone: 74-9111 Extension 2028 or 2062

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