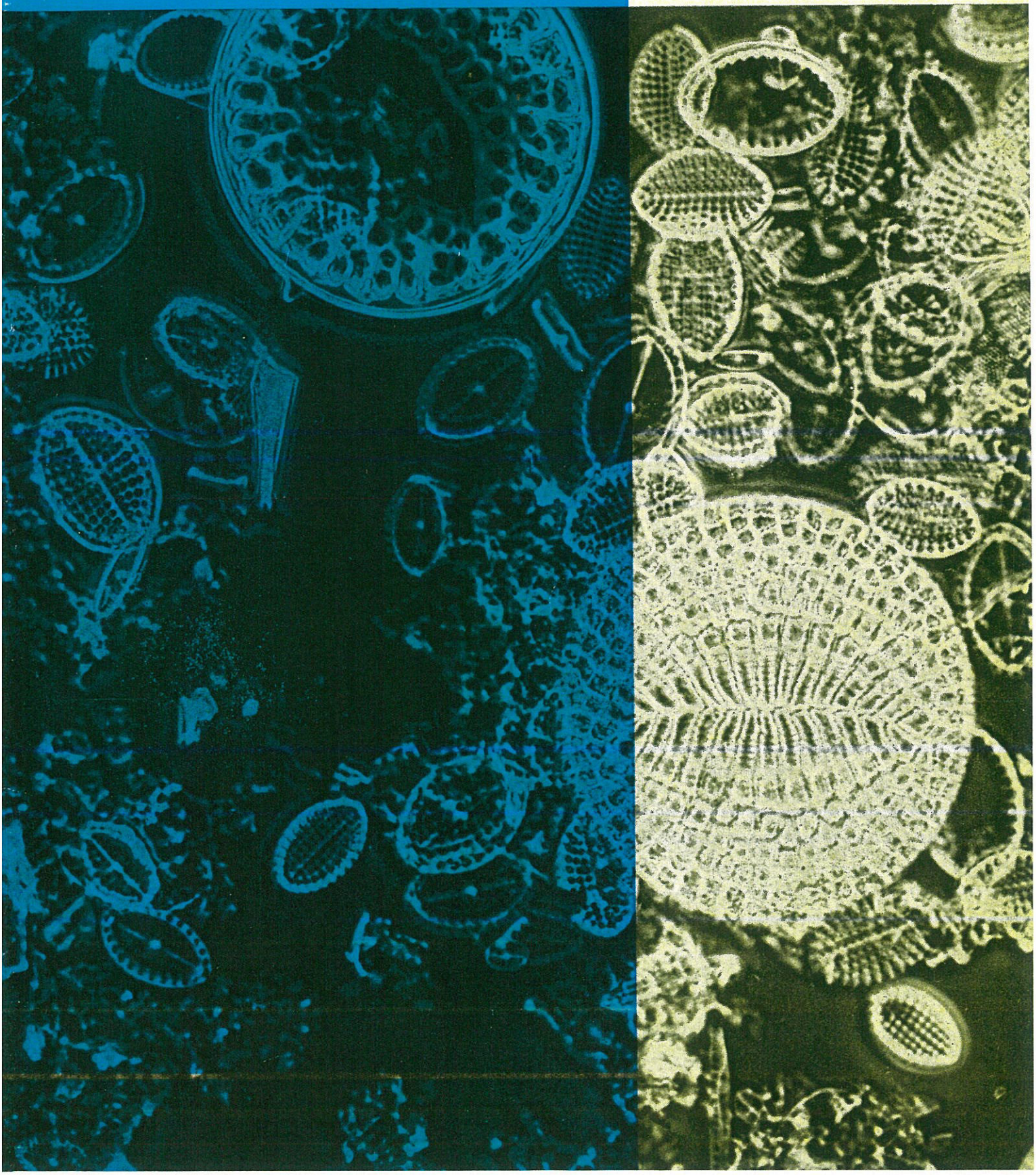
CSIR

annual report 1964



OUR COVER

A collection of diatoms. There are many thousands of species of these minute aquatic plants. They are being studied in great detail by the CSIR because diatom communities found in water may be used to gauge the quality of the water.

C S I R Periodical Publications

Scientiae	Monthly. Recent events at the C S I R; feature articles on scientific topics: list of forthcoming scientific conferences. Gratis
Research Review	Six-monthly list of articles and reports published under the auspices of the C S I R with author summaries where available. Gratis
TI (technical information for industry)	Monthly. Notes and short articles on aspects of C S I R research with industrial application. Gratis
C S I R Library Information and Accessions	Monthly. News and views on information and documentation; recent translations by the C S I R Information Division; latest accessions to the C S I R Library. Gratis
Psychologia Africana	Journal of the National Institute for Personnel Research, C S I R. R3.00 for three issues
N B R I Information Sheets	Every two months. Brief questions and answers on technical and practical problems related to building. Gratis
Houtim	Quarterly. Technical news for the timber industry, compiled by the C S I R Timber Unit. Gratis
Via	March and September. Summarized reports (mostly of an interim nature) by the National Institute for Road Research, C S I R. Gratis
Register of current scientific research at South African universities	Annual Gratis
Annual Report	Gratis
Monthly basic radio-propagation predictions for Southern Africa	Issued by the National Institute for Telecommunications Research. Gratis
Monthly bulletin of ionospheric characteristics observed at Johannesburg and Cape Town	Issued by the National Institute for Telecommunications Research. Gratis
Enquiries	The Distributor of Publications, C S I R, P O Box 395, Pretoria Telephone: 74-6011 Extension 435

P.O. Box 395
PRETORIA
1 Jan. 1965

Sir,

I have pleasure in presenting to you the Twentieth Annual Report of the Council for Scientific and Industrial Research. This Report covers the period 1 *January,* 1964 *to* 31 *December,* 1964.

Balance sheets and statements of income and expenditure for the financial year ended 31 *March,* 1964, *certified by the Controller and Auditor-General, are included.*

I have the honour to be,
Sir,
Your obedient servant,
S. M. NAUDÉ

PRESIDENT: COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

The Hon. Adv. J. F. W. Haak
Minister of Planning
Private Bag 319
PRETORIA

C S I R

TWENTIETH ANNUAL REPORT 1964

Afrikaans version obtainable separately

Council for Scientific and Industrial Research

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General review

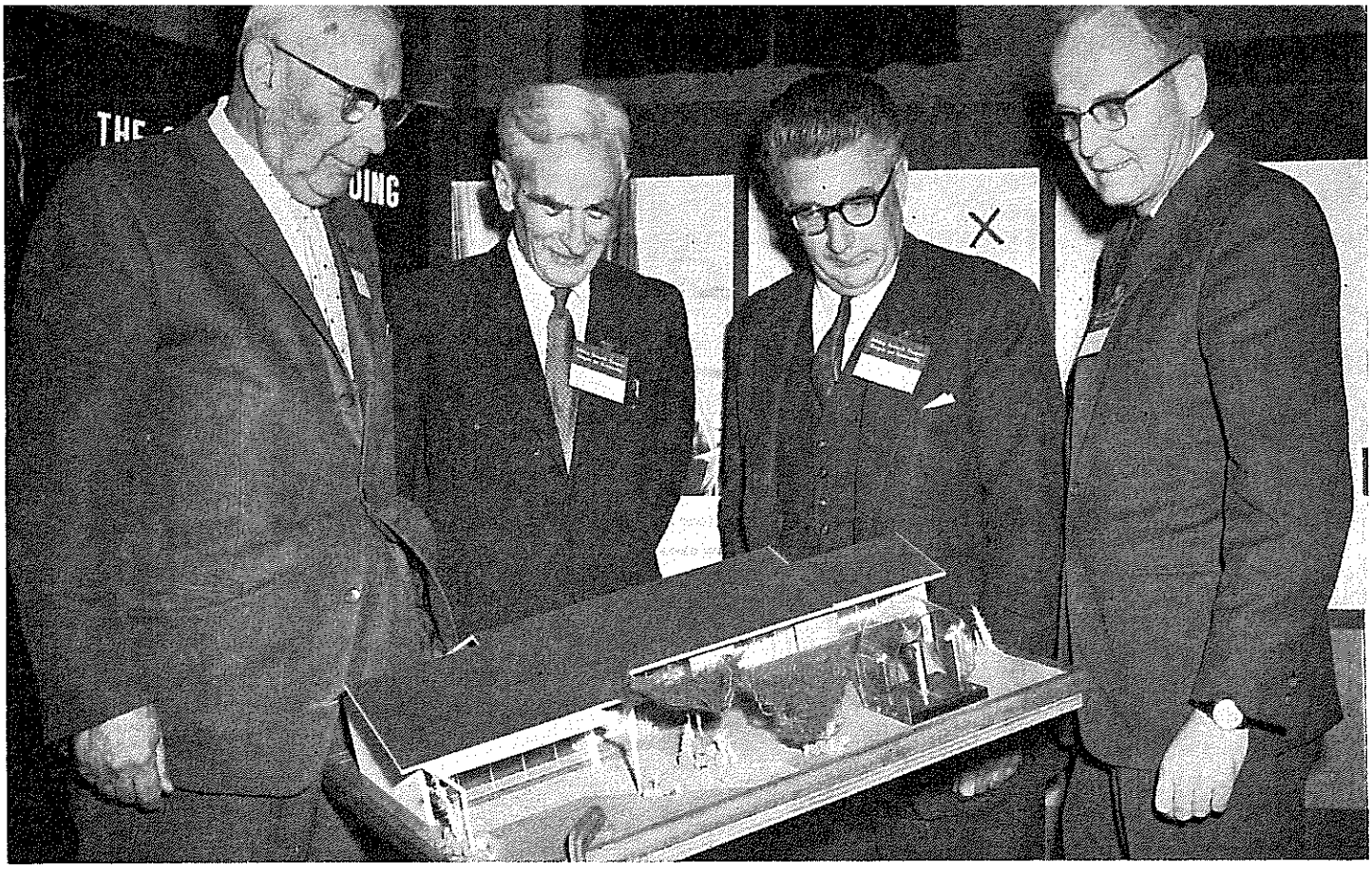
Introduction

During the past year, the Council for Scientific and Industrial Research has continued to press forward along the lines indicated in its Report for 1963. Last year, the Council reported that it looked forward to closer collaboration with the Scientific Advisory Council, the Economic Advisory Council and the Natural Resources Development Council. It is expected that existing links with these bodies will be strengthened as a result of the establishment of a Department of Planning and the appointment of a Minister of Planning, the Hon. Adv. J. F. W. Haak, who is now also the Minister responsible for the C S I R.

The C S I R, in terms of the Research Council Act of 1945 by which it was established, has certain responsibilities in relation to the overall development and co-ordination of research. In discharging these responsibilities the C S I R has explored and developed the whole field of medical research, encouraged and supported post-graduate research at the universities, paved the way for the development of research in nuclear energy, and arranged effective participation by South African scientists in international projects — to mention but a few of its many activities. During the past twenty years, scientific progress in South Africa has been spectacular and the scientific scene has become increasingly complex. While the Council has reason to be proud of the part it has played in stimulating development, it has to some extent been embarrassed by the situation it helped to create. It has thus come to recognize the need for an advisory body such as the Scientific Advisory Council which does not itself engage in research, and for the closest links with those responsible for economic policy.

For the past ten years, the Council's total Parliamentary grant has been limited by Treasury to an increase of 7½ per cent per annum (excluding funds provided for special projects) and the Council has been compelled to apply the same limits in apportioning these funds. During the same period, however, the appetite for research funds in, for instance, the universities has increased rapidly and many deserving applications for support have had to be refused. The situation has to some extent been alleviated by the Government, which this year made an additional sum of R125 000 available to the C S I R for university research grants. In future, on the recommendation of the Scientific Adviser, funds for university research grants will be applied for on the budget of the Department of Education, Arts and Science, while funds for medical research will be made available through the Department of Health. For the time being these funds will be administered by the C S I R as in the past. This new arrangement should confirm the fact that the C S I R has not consciously allocated funds disproportionately in its efforts to stretch a meagre research budget a long way.

During the past twenty years, South Africa has outgrown its 'pre-science' culture and has become the first country on the African Continent to join the ranks of the 'science based' societies of the world. The C S I R therefore welcomes the steps taken by the Government in recognition of the new status of science in our society. Through the policy-making machinery which has been created, it believes that the Government will now be able to give more effective consideration to questions such as the conditions of employment of scientists, the balance between basic and applied research and the extent to which the different fields of science should be supported.



Overseas visitors to the Building Research congress looking at a model illustrating the use of the solar shadowscope — from left to right Prof. C. A. Lobry de Bruyn, Dr. F. M. Lea, Mr. I. Langlands and Dr. N. B. Hutcheon.

Decisions on the measure of support for different fields of scientific and academic research can have far-reaching effects on the allocation of scientific manpower. Too strong support for some of the fashionable fields of research (which are nearly always more expensive) could result in an undue proportion of the best brains being drawn from fields of work that could perhaps be more profitably developed in the South African context. In the meantime, the accelerating tempo of industrial development creates an ever increasing need for research, and the country's research effort is already lagging behind. Our universities are not producing enough graduates in science or engineering and this, in turn, has created a shortage of properly qualified teachers at all levels. These, obviously, are difficulties which are closely related also to questions of educational policy.

The rapid development in South Africa during the past 20 years has created an unprecedented need for research to solve the numerous problems associated with concentrations of industry and population, which are the inevitable concomitants of economic advance through industrialization. In the absence of satisfactory solutions, there is a very real danger that further economic growth will strangulate in the products of its own progress.

Many national problems arise from local circumstances which affect nutrition and health, sanitation, buildings and housing, air pollution, road construction and road safety, the treatment of industrial effluent, and the host of similar problems which are part of the challenge of growth. Research in these fields inevitably leads to studies aimed at the improvement of materials, equipment and processes and so to research for industry. It will be obvious that much of the research that must be undertaken by a national research organization like the C S I R is not spectacular but is geared to national problems, and this is characteristic of any steady advance over a wide front.

A good example of progress in this kind of research was afforded by a conference on the implications of air pollution control, arranged by the C S I R in Durban during September. The conference set out to "clear the air" before the expected promulgation next year of the Bill on the Prevention of Atmospheric Pollution, and also to prepare industry, local authorities and the public for the measures they will be expected to take to keep South Africa's air clean. About 200 delegates attended.

Another example was a congress on the challenge to the building and construction industry posed by the new and revolutionary demands of rapid urbanization and the inflow of immigrants. This congress was organized by the National Building Research Institute in Pretoria in July. It dealt with a wide range of building problems like shortage of skilled manpower, industrialized techniques, co-ordinated planning, etc., and at its conclusion adopted a number of far-reaching recommendations dealing with the formation of a National Building Council, the training of professional staff, uniform building regulations and the study of building failures.

About 300 delegates attended from South Africa and Rhodesia, and four distinguished visitors were invited from overseas:

Dr F. M. Lea, Director, Building Research Station, D S I R, England;

Prof. Dr C. A. Lobry de Bruyn, formerly of the Instituut voor Bouwmaterialen en Bouwconstructies, T N O, Delft, Holland;

Dr N. B. Hutcheon, Deputy Director, Division of Building Research of the National Research Council, Canada, and

Mr I. Langlands, Head of the Division of Building Research of the C S I R O, Australia.

Dr T. L. Webb, Director of the N B R I, served as a member of a ministerial committee appointed by the Hon. P. W. Botha, Minister of Community Development, Coloured Affairs and Public Works, to investigate and report on pre-constructed building methods, techniques and elements.

International co-operation in Science

For the promotion of international scientific co-operation (with which the C S I R is entrusted in terms of its Act) the C S I R maintains scientific liaison offices in London, Washington and Cologne. During the year, the Council, after consulting the Department of Foreign Affairs and the Scientific Adviser to the Prime Minister, recommended to the Government that a scientific liaison office should also be opened in Paris. The services of these offices are available to all South African universities, scientific organizations, industries, and to individual South African scientists. Their main objective is to promote the flow of scientific and technical information by facilitating personal contact between scientists. A Science Co-operation Division in Pretoria co-ordinates the activities of the overseas liaison offices and C S I R co-operation with international scientific organizations and many individuals.

The C S I R has been responsible for co-ordinating the participation by South African physicists and geophysicists in an international project for the study of the upper atmosphere known as the International Quiet Sun Years (1964-65). The South African programme was highlighted this year by four research flights from Cape Town into the South Atlantic magnetic anomaly areas.

Plans for the participation by South African geologists and geophysicists in the 'Upper Mantle Project', an international study of the outer thousand kilometers of the earth's crust and mantle, have progressed well. A co-ordinated South African contribution has been formulated and the provision of financial support to translate the proposals into practical research is being considered by the Government.

Advisory services to the Department of Transport on the planning and co-ordination of the scientific aspects of the South African Antarctic Research Programme have been maintained. Liaison with the Royal Society, London, and with the South African authorities concerned led to the reconnaissance of Bouvet Island in April 1964. A biological expedition to Marion Island from December 1964 to March 1965 is being planned.

In June the C S I R's Science Co-operation Division and the University of Cape Town arranged a three-day Symposium in Cape Town on the preliminary results of South African oceanographic research during the International Indian Ocean Expedition. At this Symposium 22 papers covering all aspects of oceanic research were presented and plans were made for a national programme of oceanic research.

During the course of the year, the C S I R, on behalf of the scientific community in South Africa, became a member of the International Union of Nutritional Sciences and the International Mathematical Union. In addition, the C S I R has been nominated by the Government to serve as the adhering body to the International Metric Convention, to which the South African Government became a signatory during the course of the year.

Arrangements were made for South African representation at general assemblies or congresses of international scientific unions, or on scientific committees of the International Council of Scientific Unions to which the C S I R adheres on behalf of South Africa:

International Union of Biological Sciences (IUBS)—Prague, July 1964
Scientific Committee for Space Research (COSPAR)—Florence, May 1964
Scientific Committee for Antarctic Research (SCAR) — Paris, August 1964.
International Geographical Union (IGU) — London, July 1964
International Biological Programme (IBP) — Paris, July 1964
International Indian Ocean Expedition (IIOE) — Paris, January 1964
Scientific Committee for Oceanic Research (SCOR) — Hamburg, November/December 1964.
International Union of Geological Sciences (IUGS) — New Delhi, December 1964.

Some 200 visitors from overseas and from other territories in Africa visited the laboratories and institutes of the C S I R during 1964. They included:

Mr Albrecht, President of the Dusseldorf Chamber of Commerce;
Mr H. Bienfait, Philips, Eindhoven, Holland;
Dr V. P. Bond, Chairman of the Medical Department, Brookhaven National Laboratory, U S A;
Sir John Gaunt, a Cabinet Minister in the Rhodesian Government;
Drs J. C. Gerritsen, Acting Head of the Economical Technical Department of the Netherlands Organization for Applied Scientific Research (TNO), Holland;
Dr V. L. Granger, formerly Scientific and Technical Adviser to the Prime Minister, Rhodesia;
Dr N. B. Hutcheon, Deputy Director, Division of Building Research of the National Research Council, Canada;
Mr I. Langlands, Chief, Division of Building Research, C S I R O, Australia;
Dr F. M. Lea, Director, Building Research Station, D S I R, England;
Prof. Dr C. A. Lobry de Bruyn, Technical University of Delft, Holland;
Admiral Sir Frank Mason, K C B, President, British Institute of Mechanical Engineering;
Dr S. Meier, Member of the Netherlands Ministry of Foreign Affairs and Head of the Atomic Energy Division, Holland;
Dr W. H. Pickering, Director, Jet Propulsion Laboratory, U S A;
M. Pinay, a Cabinet Minister in the French Government;

Dr J. V. Simáo, Rector of the University of Moçambique;
Sir Paul Sinker, Director-General of the British Council;
The Hon. Mr Ian Smith, Prime Minister of Rhodesia;
Prof. Henry Stommel, Professor of Oceanography, Massachusetts Institute of Technology;
Prof. E. W. Titterton, Head, Department of Nuclear Physics, Australian National University.

Senior appointments

Mr J. E. Worsdale, Director and Adviser to White's S A Portland Cement Co. Ltd. and a member of the Council of the C S I R for 17 years, relinquished his membership in October. He was succeeded on the Council by Mr J. D. Roberts, Chairman and Managing Director of Roberts Construction Company Limited. Of the original Council members appointed in 1945, only Prof. S. F. Oosthuizen and Dr H. J. van Eck still serve on the Council.

The following senior appointments took place within the C S I R during the year: Dr F. J. Hewitt, Director of the National Institute for Telecommunications Research since 1957 and a staff member of the C S I R since 1946, was appointed a Vice-President of the C S I R in succession to Dr E. J. Marais who left the C S I R to become Rector of the University of Port Elizabeth. Dr Hewitt was succeeded as Director of the N I T R by Mr R. W. Vice, Chief Research Officer in the Institute.

Mr A. J. Miller-Smit, Secretary-Treasurer of the C S I R, retired after eight years' service. He was succeeded by Mr J. H. Visagie, the Under Secretary-Treasurer.

Dr W. S. Finsen, Director of the Republic Observatory, was seconded to the C S I R to direct the Observatory which has been incorporated into the C S I R. The S A Wool Textile Research Institute in Grahamstown was also incorporated during 1964. It is now a full national institute of the C S I R under the Directorship of Dr D. P. Veldsman.

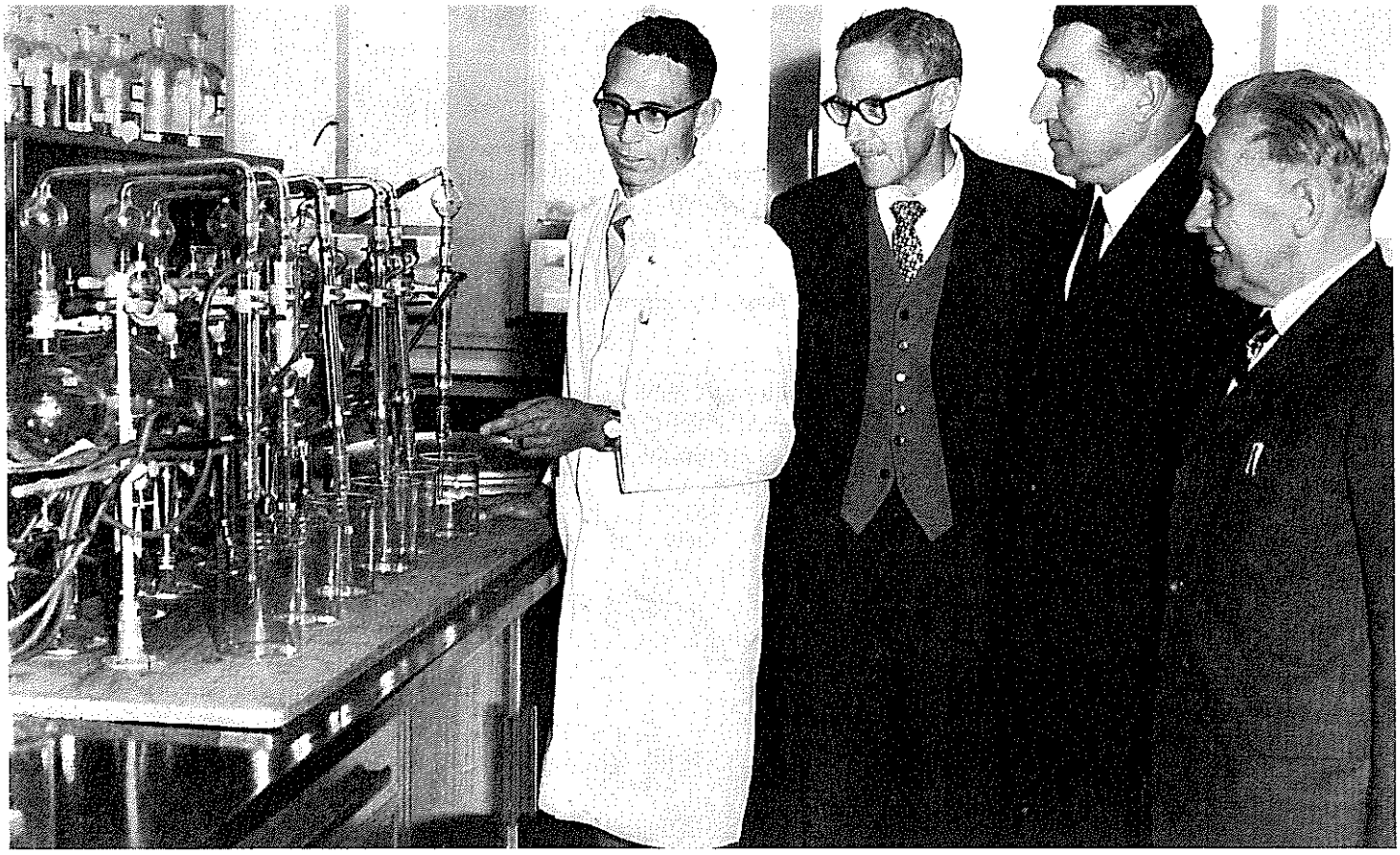
Dr W. H. Craib, Associate Adviser to the C S I R on Medical Research, has been appointed Chairman of the committee of enquiry into the safeguarding of man against poisons. Mr J. P. de Wit, Assistant to the Director of the National Nutrition Research Institute, has replaced Dr F. W. Quass, Director of the Institute, on the committee. The committee met regularly during the last three months of the year and took evidence in the field both in the Cape and the Northern Transvaal.

Mining equipment research unit

In terms of the Mines and Equipment Act, equipment used in the hoisting of men and materials in mines has to be tested at regular intervals—winding ropes, in particular, being tested every six months. In 1903 the Government Mining Engineer established a Government Mechanical Laboratory which, by 1935, was housed on its present site at Cottesloe, Johannesburg and provided a service for this statutory testing.

Because winding problems peculiar to South Africa's deep level mining have necessitated considerable research, the Government Mechanical Laboratory of the Department of Mines has now been expanded into a unit which will also conduct research.

After discussions between representatives of the Transvaal and Orange Free State Chamber of Mines, the steel wire rope industry, the Government Mechanical Engineer, and the C S I R, the Government Mechanical Laboratory was transferred by mutual agreement to the National Mechanical Engineering Research Institute of the C S I R on 1 April, 1964. The facilities of the old laboratory, and its responsibilities, now belong to a Mine Equipment Research Unit being developed by N M E R I. With the establishment of this unit, in which testing and research are combined, the services available to rope manufacturers and the mines will be consolidated.



A staff member of the National Institute for Water Research showing a laboratory installation to (from left to right) Mr. W. G. Bezuidenhout, Mayor of Bellville, the Hon Adv. J. F. W. Haak, Minister of Planning, and Dr. G. J. Stander, Director of the N I W R, at the inauguration of the new buildng of the Institute's Regional Laboratory in Bellville.

Building programme

During 1964, 19 years after the establishment of the C S I R, the original building programme was completed when the National Institute for Road Research moved into its new premises at Scientia in October. Not only are all the divisions of that institute now together for the first time, but all the institutes of the C S I R in Pretoria are now housed at Scientia. The National Institutes for Personnel and Telecommunications Research are accommodated in Johannesburg.

Expansion of the National Building Research Institute's activities has made it necessary to construct a new double-storey block which was completed during December.

The Western Cape regional laboratory of the National Institute for Water Research was officially opened by the Hon. Adv. J. F. W. Haak in June. This laboratory was erected on a site donated to the C S I R by the Municipality of Bellville in recognition of the N I W R's role in solving a serious waste problem which arose in Bellville after the establishment of a new industry.

Alterations and additions to the C S I R's regional laboratory in Durban are being carried out in stages. The first was completed in 1963 and the second in October of this year. A third stage is now being planned as the regional demand for research services has expanded considerably.

The Republic Observatory in Johannesburg was transferred to the C S I R in April and its buildings and installations there and at Hartbeespoort Dam are now the responsibility of the Council. The new main building for the observatory in Johannesburg, erected by the Department of Public Works, was occupied in October and virtually completed by the end of the year. The building brings under one roof the time department, the library, administrative offices, technical offices and laboratories, dark rooms and store rooms. There are domes on the roof for two of the smaller telescopes.

Building plans for 1965 include those for extensions to the N I W R building at Scientia, extensions to the Library and the Administration building, and the construction of a new building in Port Elizabeth to accommodate the South African Wool Textile Research Institute which is being transferred from Grahamstown.

Documentation

In most advanced countries, expenditure on scientific research is increasing at an average annual rate of approximately 16 per cent. This represents a doubling every 5 years. The results of research are recorded in publications and subsequently republished many times to suit the needs of readership at different levels. The rapid growth of research in many of the less developed countries is not only adding to the flood of technical and scientific literature but introducing the complication of many different languages.

Traditional methods of publishing in scientific and technical journals, and of storage and retrieval of information in libraries, have been strained to the uttermost by this unprecedented growth in the output of information. To make matters worse, research organizations in most countries have avoided delays in publication by producing their own research reports. Inadequate attention to the elementary rules of systematic documentation has created its own problem of bibliographic control in libraries and documentation centres.

In these circumstances the Council has found it a formidable task to comply with the injunction 'to establish facilities for the collection and dissemination of scientific and technical information'. For the discharge of this responsibility, the Council has developed a central library to serve its national research laboratories and institutes in such a way that the responsibility for selecting, evaluating and adapting information for use rests primarily with the research staff in the laboratories.

During the year, operational studies were undertaken with a view to mechanizing certain library routines. A limited project for the use of punched-cards, and later the electronic computer, in controlling records in the periodicals section will provide experience in these techniques as a forerunner to experiments in mechanizing the indexing of literature in those technological fields which are inadequately served by international bibliographic services. The long-term objective is to build up a group which will be able to take advantage of mechanized systems of information storage and retrieval like those being developed overseas, and to adapt them to the requirements of research groups and industries in South Africa.

Technical information for industry

The task of a technical information service is to bring about effective communication between research workers and technologists and to help both groups to keep as fully informed as possible. As this communication is most effectively realized through personal contact a number of one-day industrial symposia and conferences have been arranged at the C S I R. These were initiated in 1963 and five were held during the year under review:

1. Some aspects of solid liquid separation.
2. Transducers for the electrical measurement of non-electric quantities.
3. The role of analysis in the Bantu beer brewery.
4. Malting of kaffir corn.
5. Research for the food industry.

Each symposium was attended by more than 100 delegates. In some cases attendance had to be limited as the largest hall at the C S I R can accommodate only 160 people.

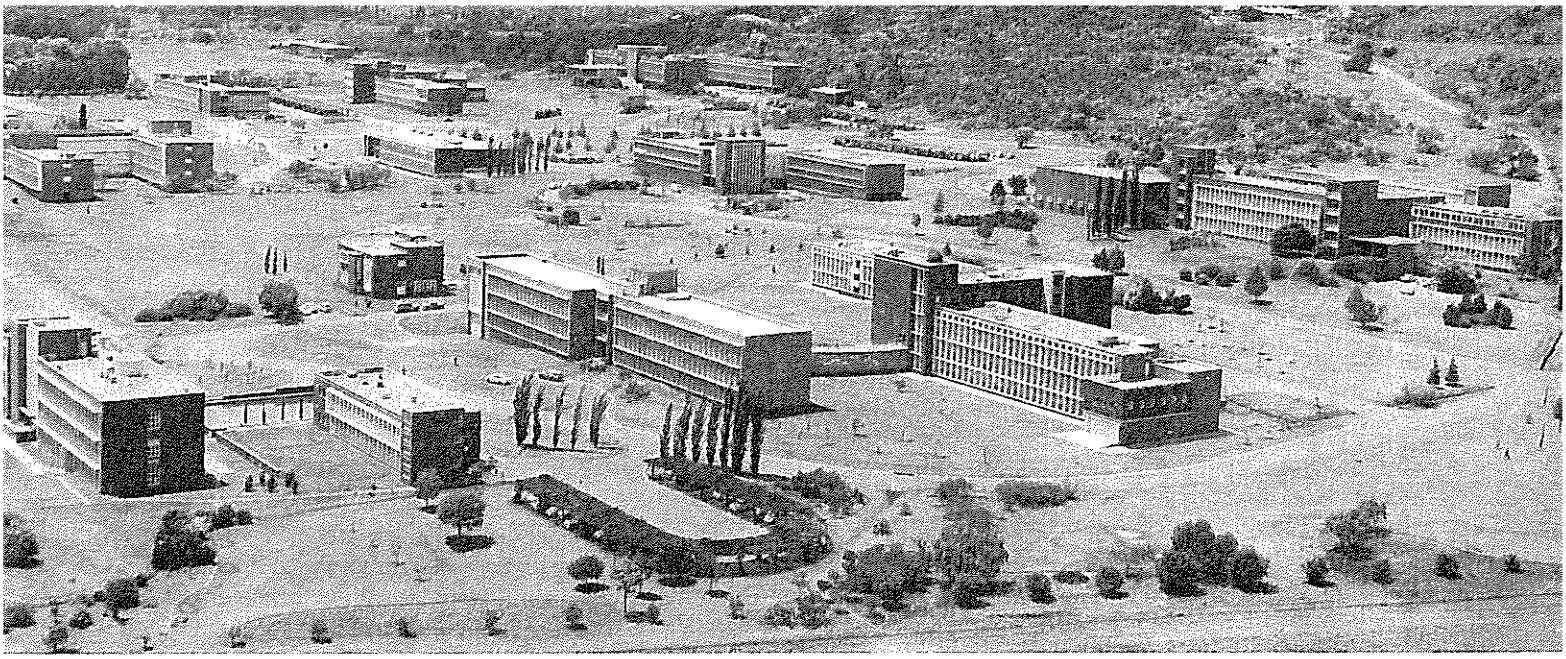
Experience has shown that because of the geographical distribution of industries in South Africa, it is necessary to provide regional in addition to national services. The Industrial Information Centre at the University of Natal, supported by local industries and the C S I R, continues to develop. A survey of the information needs of industries in the Western Cape was undertaken in collaboration with the University of Cape Town. Results were discussed at a symposium at which it was recommended that an Industrial Information Centre for the Western Cape should be established by the C S I R.

Liaison offices have been established by the National Building Research Institute in Windhoek and Cape Town. Funds for the former are provided largely by the South West Africa Administration; for the latter the C S I R is the major contributor, assisted by the national development fund of the National Federation of Building Trade Employers and the local cement industry. The National Institute for Water Research has been obliged to develop regional laboratories in Durban, Cape Town, Windhoek and Bloemfontein to provide the research and advisory services required by the Provincial Administrations, local authorities and industries in these areas. Regional Offices of the C S I R have been established in the Western Cape and Natal in association with the regional laboratories, and regional representatives have been appointed to represent the C S I R as a whole in the Western Cape and Natal.

Research economics

To obtain a more complete understanding of scientific research in its overall economic context, a research economics study group has been established in the C S I R's Industrial Economics Division. Today scientific policy has to be formulated within the limits of government policy with increasing exactness and more detailed knowledge is required of the relationship between research and economic life. Those concerned with science policy as well as those responsible for economic policy are therefore showing increasing interest in research economics. Growing expenditure on research has forced research activities into the sphere of economic policy, and it has become necessary to study the type of economic forces generated by scientific research.

The study of research economics is of great importance to the C S I R. It is expected to shed light on the flow of research funds throughout the economic system and indicate which sectors of the economy benefit most from the impact of scientific research. The information will assist the C S I R in the broader aspects of research management and in bringing the Council's activities into line with the needs of the national economy.



Aerial view of the C S I R buildings at Scientia.

National laboratories and institutes

Astronomy

The Republic Observatory was established in 1903 as the Transvaal Observatory, the headquarters of the Transvaal Meteorological Department. In the early years astronomy was only a side-line, but in 1912 the Observatory became officially an astronomical institution and was re-named the Union Observatory. In 1961 it was re-named the Republic Observatory.

Like most national observatories, the Republic Observatory is not limited in function to pure research, but also performs astronomical duties of a civil nature, in particular, the maintenance of the national time service. This is based on a battery of quartz crystal clocks or frequency standards and is made available to the public by the time signal and standard frequency transmitters ZUO (one, of low power, operated by the Observatory, and another, of high power, by the Post Office). In addition, these signals are distributed by land line to the Post Office, the S A B C and other public institutions.

Astronomy figures in everyday life in many unsuspected ways and the Observatory receives frequent calls for its services from Government departments, public bodies and institutions, the press, lawyers, and individual members of the public.

The research programmes of the Republic Observatory fall under two main heads: long-term programmes generally of a highly specialized nature and of fundamental importance but seldom yielding spectacular results, and temporary or *ad hoc* projects occasioned by unusual or rare astronomical phenomena.

The principal long-term programmes are observational and theoretical researches in the field of visual double stars (recently extended to include eclipsing binaries) and photographic observations of minor planets and comets. For half a century the Observatory has been identified with these programmes to such a degree that they have almost become international commitments. The Observatory's leading role in double star research requires no emphasis, but it deserves to be better known that the minor planet and comet programme has yielded, as by-products, not only several new comets, but also more than 500 new minor planets, many of which have been given such typical South African names as Pretoria, Transvaalia, Nerina, Gaika, Umtata, Outeniqua, etc.

Among the many short-term projects of the Observatory were the successful search for Proxima Centauri, still our nearest known stellar neighbour apart from the sun, the detection and measurement of the rotation of the minor planet Eros, the "splitting" of Nova Pictoris, the publication of a photographic star atlas of the southern sky, and the series of colour photographs of the planet Mars.

Building research

About 450 million rand is spent on building and construction (excluding roads) in South Africa annually, and the chief objectives of the National Building Research Institute (N B R I) are to serve the industry and the professions behind this multi-million-rand investment. The N B R I is in essence a practical, applied research organization maintaining close contact with the building and construction industries. Its research is

directed towards improved building design and services; improved structural and foundation engineering, lighting, ventilation, heating and cooling in buildings; improved performance of building materials such as concrete, stone, paint and plastics and a better understanding of the effect of climate and weather on both building materials and the environment within a building. Special service has been rendered to the community in the planning of schools, hospitals and housing for all population groups. The N B R I earns about one quarter of its budget by undertaking contract work for sponsors. Research findings are actively applied by means of publications, lectures and central and regional information activities.

In this report three of the fifty-two research projects on the Institute's research programme are described briefly.

Chemical research

The National Chemical Research Laboratory (N C R L) serves as a centre where the latest developments in chemical science are brought to bear on problems of national significance. The N C R L is organized into divisions of organic chemistry, biochemistry and physical chemistry, the last-named taking in physical chemistry proper as well as inorganic and analytical chemistry. The N C R L also supervises a chemical engineering group. Since chemistry is a meeting ground for many other sciences and technologies, priority is given to collaborative projects with Government departments, with industry and with other institutes of the C S I R.

Mathematical sciences

The National Research Institute for Mathematical Sciences keeps abreast of developments in the mathematical and electrical engineering sciences. These two disciplines are vitally involved in the refinement of methods of measurement and analysis of data demanded by science and technology, by industry, commerce and public authorities. The Institute has established specialist divisions to this end.

The Mathematical Sciences Research Department consists of divisions for mathematical analysis, statistics and numerical analysis. These deal with the various branches of mathematics and their application to theoretical and computational problems in fields like engineering, theoretical physics and biostatistics.

The Electrical Engineering Research Department consists of five divisions: for automation, applied electronics, solid state electronics, electronic instrumentation and power electrical engineering. These operate in such diverse fields as those of data processing and analogue computing, ultrasonic analysis and processing, dielectrics, semiconductor applications, and earth resistance and heat conduction studies for heavy current applications.

Mechanical engineering

Research in the National Mechanical Engineering Research Institute (N M E R I) is devoted largely to the development of promising new engineering techniques, to the improvement of machinery used in industry, so that production costs can be reduced, and to research fields such as rock mechanics, where the aim is to improve efficiency and safety in mining. A large proportion of the Institute's work is done on a contract basis for South African industries, for Government departments and for provincial or local authorities. To meet the growing demand for its services, N M E R I is, *inter alia*, installing two new wind tunnels (low-speed and supersonic) for aerodynamic testing. The Mine Equipment Research Unit (formerly the Government Mechanical Laboratory) at Cottesloe, Johannesburg, is part of N M E R I and deals with investigations related to mine ropes and winding equipment.

Nutrition research

The National Nutrition Research Institute is concerned mainly with applied research to improve the nutrition of the South African population, and advises government and other authorities on ways of combating malnutrition.

The activities of the Institute include:

Investigations into the nutritional status of all groups of the South African population.

The study of methods for combating malnutrition and controlling deficiency diseases.

Research on the nutritional value and improved utilization of foods produced in South Africa.

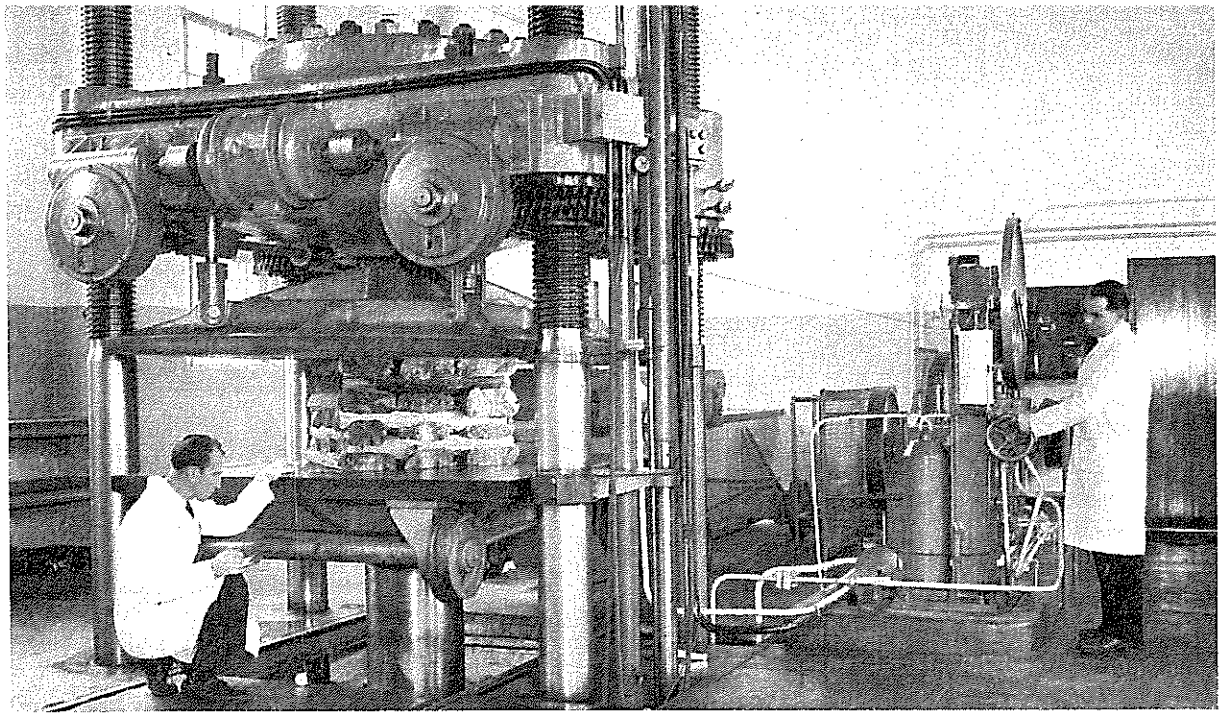
Research on the harmful substances found in some foods.

Research on food processing, including investigations on behalf of private industries.

Personnel research

In any work situation there are certain factors directly affecting the worker's productivity and happiness. The National Institute for Personnel Research (N I P R) is concerned with these factors, which include the following:

Definition of the characteristics of work, i.e. physical and psychological demands on the worker; job description, the value of a specific task in relation to others, and the performance of duties; placing the right man in the right job (use of apti-



Compression test on a mine timber support pack in the 1000 ton testing machine of the Mine Equipment Research Unit.

tude tests, interest tests, and others) and giving him the necessary training;
improvement of working conditions and equipment in order to suit the task to the worker and to eliminate unnecessary strain, fatigue and risk;
studying the socio-psychological aspects of work, e.g. manpower shortages, human relations in the work situation, work motivation and the worker's attitude towards his job, his fellow-workers and his superiors;
investigating problems arising from maladjustment to work e.g. absenteeism, accidents, occupational disorders and group conflicts.

Physical research

The main function of the National Physical Research Laboratory (N P R L) is to contribute to the development of physical science in the Republic through research aimed at the adaptation of existing knowledge as well as the creation of new knowledge for the solution of technological and industrial problems of national importance. In addition the N P R L has statutory responsibilities for maintaining national standards of physical measurement for mass, length, electricity, radiation, etc.

Within the N P R L groups of research workers constitute a nucleus of research manpower for both basic and applied research in the following fields: optics, nuclear physics, solid state physics, acoustics, spectrochemistry, infra-red spectroscopy, electron microscopy, geophysics, electron spin resonance, geochronology, oceanography and high-pressure physics.

Road research

Work at the National Institute for Road Research is aimed at developing economic methods of building and maintaining better, safer roads in the Republic. This includes research on soil mechanics and road foundations; bituminous binders; instruments for accurate control of the various processes used in road building; the economics of road building; traffic engineering and road safety.

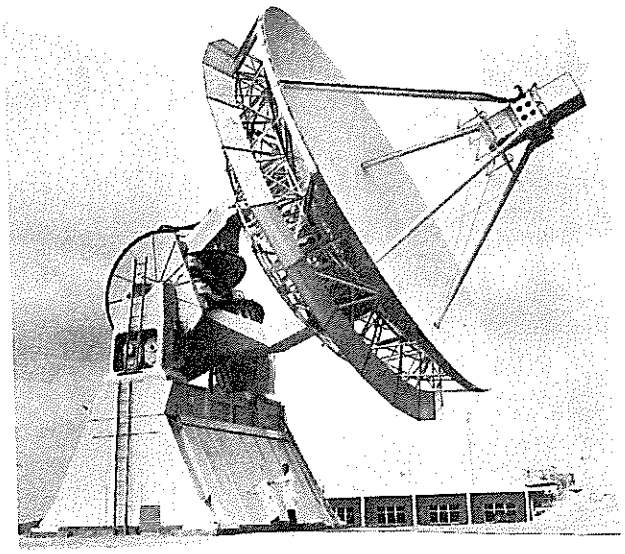
The Institute works in close co-operation with national and provincial road departments and other authorities responsible for roads, on a wide range of problems relevant to their task of designing, building and maintaining roads and streets.

These road authorities, including the South West Africa Administration, provide nearly all the funds needed to carry out this research work.

Telecommunications research

The programme of the National Institute for Telecommunications Research (N I T R) is directed towards the solution of problems confronting the various users of radio waves in South Africa for civil or military purposes.

Important parts of this programme are the study of the propagation of radio waves through the lower and upper atmosphere and an investigation into the nature of atmospheric disturbances and their effect on radio-receiving systems as far as radio communication and radio aids to navigation are concerned. More recently, the N I T R has investigated ionospheric absorption and



One of the new antennae at the Minitrack station operated by the N I T R at Hartebeesthoek.

high frequency radio noise, in order to facilitate the reliable planning of high frequency communications systems.

The N I T R has investigated the application of semiconductors at high frequencies and the development of very low noise receiving systems. Such techniques are appropriate to specialized types of radio equipment such as the "Tellurometer" system of distance measurement invented by the N I T R, and now applied throughout the world.

The N I T R operates two advanced radio systems for tracking artificial satellites and space research vehicles as part of the U S A programme for the peaceful exploration of outer space.

Water research

South Africa is unfortunately not endowed with abundant water, and a growing population as well as rapid industrial development will in course of time be straining water resources to the utmost. Available supplies must therefore be used as effectively as possible. This involves not only judicious planning of industrial complexes with progressive research into control of water pollution, and into effective re-use of water, but also a comprehensive study of the flora and fauna in South African waters, since these play a vital role in the self-purification of waters and can supply valuable information on pollution levels. Giving effect to this programme is to a large extent the responsibility of the National Institute for Water Research.

Wool research

The South African Wool Textile Research Institute (S A W T R I) was established in 1951, in association with Rhodes University in Grahamstown. The Institute was registered as a company in 1953 and operated under a Board of Control consisting of representatives of the member organizations supplying financial support, of the C S I R (subsidizing guaranteed grants) and of Rhodes University. At the request of the Board, S A W T R I was transferred to the C S I R on 1st August, 1964, as a national institute for research on wool and mohair.

S A W T R I is basically concerned with the behaviour in processing of the South African wool and mohair clips, with the fibre and fleece characteristics that may influence processing and with relevant aspects of production. The Institute therefore assists the entire line of industries responsible for South Africa's major agricultural product. Its research programme covers the field from fibre to fabric and includes fundamental as well as applied work. Separate but closely co-operating sections have been formed for Raw Materials, Protein Chemistry, Textile Physics, Mathematical Statistics, Mechanical Processing and Enquiries.

In the processing field aspects of scouring, carding, gilling and combing, knitting, dyeing and finishing are investigated. It is intended to expand these activities to include drawing and spinning as well as weaving when the Institute is resited in a new building complex in Port Elizabeth during the coming year. Close collaboration will then be established with the Technological Division of the S A Wool Board which will have a pilot laboratory on the same campus.

It is also envisaged that future training of textile technicians and technologists by the Technical College, and by the new University of Port Elizabeth, will come about with the assistance of S A W T R I staff and facilities.

Technical services

The function of the Technical Services Department is the design and construction of specialized instruments for the laboratories of the C S I R and also for industry, when these are not readily obtainable elsewhere. During the year liaison with industry was improved and there was an increased demand for these services.

It is evident from a survey made among the universities and certain big industries conducting applied research, that there is an urgent need for instrumentation technicians of the type trained by the C S I R. This is an indication of the national demand for manpower of this kind and partly explains the constant loss of technical staff from the C S I R. A training centre for instrumentation technicians, which will be unique in the Republic, is now being planned and it is hoped that it will assist in relieving the shortage.

Progress in research

— a selection of projects

Interferometer survey

During the past fifteen years more than eight thousand bright stars have been systematically examined for possible duplicity. There is, of course, nothing novel about such a survey, but this is the first time that it has been carried out with a stellar interferometer, which has the property of virtually doubling the resolving power of the telescope with which it is used. It therefore permits the detection and measurement of double stars too difficult to be seen otherwise. The "eyepiece interferometer" used in the survey was designed and made at the Republic Observatory and is a considerable improvement on earlier forms of the instrument.

All the stars in the selected list have now been examined, often on two or more occasions, yielding 73 new close binaries. Repeated measurement of these pairs has shown, not unexpectedly, that many are in rapid orbital motion, and in four cases it has already been possible to compute their orbits. One of them, Epsilon Ceti, has a revolution period of 2.6 years, the second-shortest known for a visual binary.

Notwithstanding the surprisingly high incidence of duplicity revealed by the survey, it is certain that some double stars were overlooked, perhaps because they were in unfavourable positions in their orbits, or merely because of poor observing conditions. The survey is therefore being repeated, at least in part, as a control.

Concurrently with the survey approximately 5 000 measurements were made of double stars, previously known as well as new, within the range of the interferometer. Most of them would have been too difficult to measure without its aid.

The "eyepiece interferometer" was the subject of a paper by its originator at a Symposium on Instrumental Astronomy held by the American Astronomical Society in 1963.

Double star catalogue

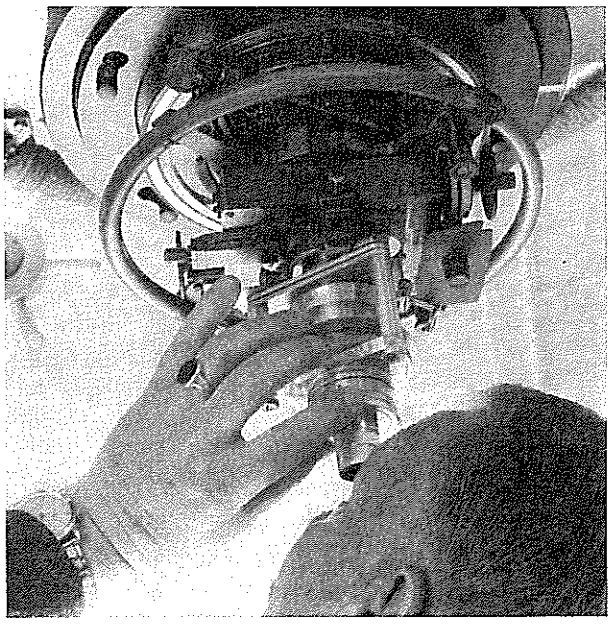
Publication of the long-awaited *Index Catalogue of Visual Double Stars*, 1961.0 by the University of California will be hailed by astronomers as a milestone in the history of double star astronomy. The authors are Dr H. M. Jeffers and Mrs F. M. Greeby of the Lick Observatory, California, and Dr W. H. van den Bos, former Director of the Union Observatory. The catalogue is the first of its kind to cover the whole sky and lists 64 247 double stars with the necessary descriptive data.

No general catalogue of double stars had been published since those of Aitken (Lick Observatory, 1932) and Innes (Union Observatory, 1927). The spate of new discoveries and observations during the past three decades has made these catalogues hopelessly out of date, and it has become very difficult for even the specialist to keep track of the known double stars and almost impossible for the non-specialist.

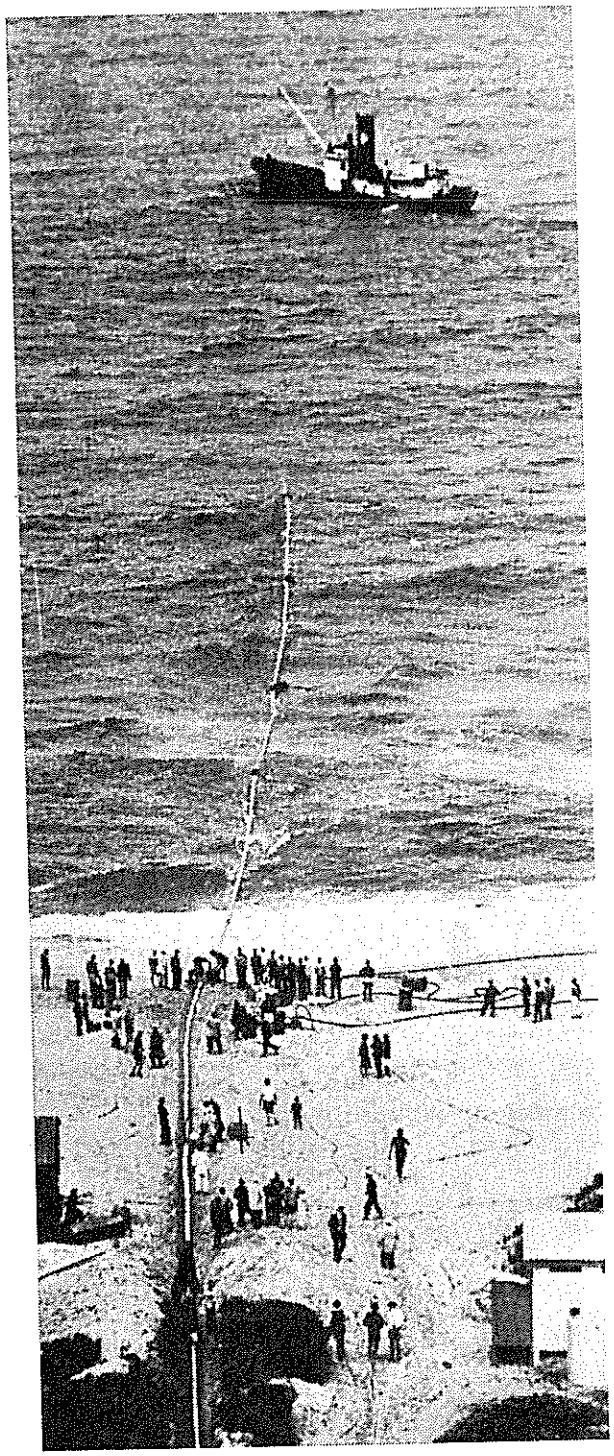
The new catalogue makes it possible to ascertain very quickly whether a particular star is known to be double or not, and if so, gives sufficient condensed information, including orbital motion, for most purposes. For more detailed information the parent card catalogues at the two observatories may always be consulted.

Not only will the catalogue serve as a valued work of reference in every astronomical library, it will certainly also provide comprehensive and expertly edited material for important statistical investigations on stellar duplicity.

— *Republic Observatory*



The eyepiece interferometer in use on the 26½-inch telescope at the Republic Observatory.



A double-walled plastic pipe for a marine outfall sewer being towed out to sea by a whaler (see 'Pipelines').

Commercial and technical high schools

School buildings should be designed to allow for the use of new teaching methods, new teaching aids and new types of equipment. With this object in view the C S I R has carried out research into the planning of vocational school buildings. The investigation is being sponsored by the Department of Education, Arts and Science and undertaken with the guidance of a Steering Committee on which this department, the C S I R and the Department of Public Works are represented.

Two reports have been issued, one concerning commercial high schools and the other concerning technical high schools. A report on school hostels should be available soon.

These reports deal with the principles of design and planning as opposed to the development of standard type plans and cover such matters as the choice of site, sizes of the various types of teaching spaces required, planning for flexibility to meet changes in teaching methods and the introduction of new educational aids, the elimination of wasted space, and the achievement of these *desiderata* without increasing the cost of the buildings. Special consideration is given to lighting, ventilation and thermal conditions in order to create the most favourable environment for study.

Several new commercial and technical high schools are now being planned which will incorporate the recommendations and principles derived from this research.

Pipelines

The C S I R has now developed a double-walled plastic pipe for sewage, industrial and other effluents, which promises to overcome many of the disadvantages of conventional pipelines and should also result in a saving in cost. The use of marine outfall pipelines for these purposes has hitherto generally proved very costly, because of the elaborate equipment, facilities and organization necessary and the high risk of damage to the pipeline when being laid.

The pipe consists of two concentric tubes of rigid polyvinyl plastic which are held in position by spacers attached to a welded steel cagework fitted into the space between the tubes. After the pipe has been positioned in its final bed, this space is pumped full of a cement grout which sets to provide a heavy reinforced concrete body for the pipe. The plastic tubes thereafter serve as anti-corrosive coverings.

The components of the pipe, being relatively light, can easily be assembled on site and the pipe can be quickly towed out to sea and then flooded with sea-

water to sink it into a trench ploughed or jetted into the beach and seabed. The cement grout can then be pumped into the space between the plastic tubes to provide the necessary weight and rigidity.

This form of double-walled plastic pipeline is being developed in collaboration with certain South African plastic manufacturing firms and pipelaying contractors.

An experimental length of double-walled sewer pipeline, which was laid at the C S I R's site at Scientia has demonstrated that this form of pipe can also be used for land pipelines. It would undoubtedly be very suitable for pressure pipelines as the amount of reinforcement can be adapted to withstand the pressure to which the pipe will be subjected.

Solar heat gains through windows

To investigate the problems associated with solar heat penetration through windows, a large window-testing calorimeter has been designed and built by the C S I R.

These problems have acquired new importance with the increased use of large glazed areas in most types of buildings and particularly as a result of the present trend towards the use of lightweight curtain walling for multi-storeyed buildings. Lack of proper data on this subject has frequently resulted in the design of inefficient shading devices for windows or mistaken ideas about the improvements possible with the use of new glazing materials.

The window-testing calorimeter consists of a well-insulated box with an open side over which can be fitted a window complete with any desired type of shading device or glazing material. The device is mounted on the roof of a small laboratory in such a manner that it can be turned and tilted to allow the window to face any required direction. Special instrumentation enables the outdoor thermal conditions to be measured and also the heat entering through the window by direct sunlight penetration, by re-radiation from the glazing and shading devices, and by convection from the glazed surfaces, all at the same time.

Measurements carried out with this device should be of great value to building designers and planners.

— National Building Research Institute

Research on Bantu beer

The brewing of Bantu beer has progressed from a tribal art to a big modern industry as a result of the success of local authorities in providing the urbanized Bantu with his traditional drink. Since 1953/54 production has risen from 20.7 million gallons to 69.1 million gallons (worth over R13m), in 1962/63. Such rapid development brought with it many problems both technical and scientific.

Acting on request from the brewing industry, Bantu beer research started in 1953 with a preliminary investigation of the micro-organisms concerned in the process, which was soon followed by a detailed investigation of the best method for producing kaffircorn malt. At the same time, a method of testing the quality of the malt was developed. This method has now been accepted as a standard method (S.A. Bureau of Standards, Method 235) for kaffircorn malt analysis in the Republic. All this has led to a great improvement in malt quality and the elimination of one of the main difficulties experienced by the Bantu beer industry.

The next step was a study of the most effective use of the malt in the brewery, and many improvements and economies were found possible once a full understanding of the fundamental functions of the malt had been obtained.

To investigate the brewing process a pilot brewing plant was commissioned in 1961. This is used to test new recipes and processes under carefully controlled conditions and to make it possible to scale up discoveries made in the laboratory.

Surveys of Bantu beer quality, particularly the vitamin content, are made from time to time to ascertain the general trend in the industry. One source of vitamin loss was traced to the loss of foam occurring during fermentation. The development of a foam breaker ensures that breweries can prevent foam from flowing to waste down the outside of the tanks. Another source of loss has arisen through the substitution of an ingredient poor in vitamins for one rich in vitamins. It has been established in collaboration with the National Nutrition Research Institute that the average consumption of beer can form a significant proportion of the daily protein requirement of adults.

In co-operation with the Microbiological Group, investigations of fermentation are proceeding in more detail than was necessary in 1953 when knowledge of the process was rudimentary. Progress is also being made in determining the nature of the substances responsible for the typical flavour and aroma of the beer with a view to improving quality control.

Advice to and special contract investigations for both the brewing and malting industries constitute part of the Bantu Beer Unit's services. A portion of the Unit's finances comes from these contracts as well as from regular grants from many of the municipalities. Recent legislation providing for the imposition of a levy on Bantu beer for research purposes will do much to ensure that development in research will keep pace with that of the industry.

— Bantu Beer Unit
National Chemical Research Laboratory

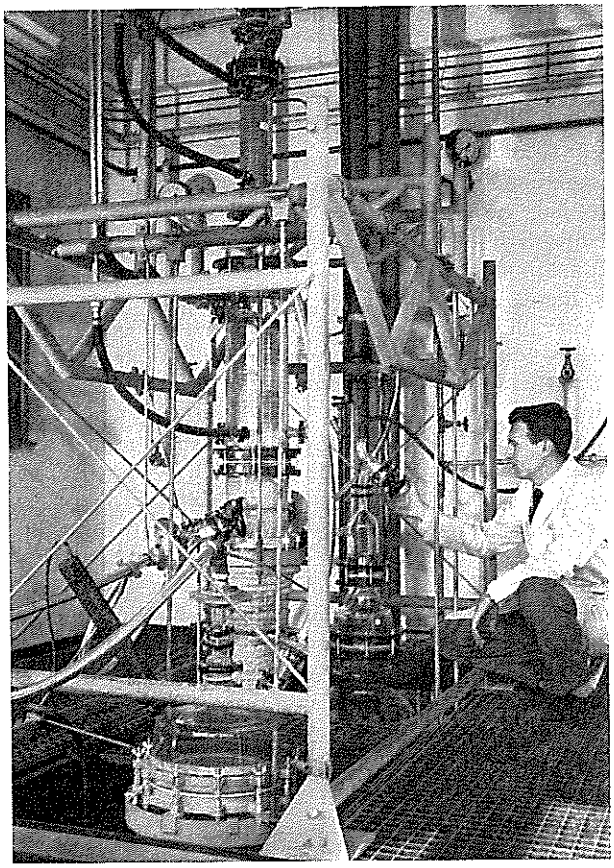
Survey of South African alkaloids

The systematic survey of alkaloids in South African plants, which is being sponsored by an American pharmaceutical firm, continues and has already covered some 4000 species of plants. A number of new alkaloids have been isolated.

Certain alkaloids, like quinine, morphine and cocaine, have been used in medicine for many years but interest in the pharmacological properties of alkaloids was re-awakened when the sedative properties of reserpine were discovered about ten years ago and recently again with the discovery of alkaloids which can counteract leukemia.

There is an abundance of plant varieties in South Africa and the Botanical Research Institute of the Department of Agricultural Technical Services is able to render valuable assistance in the collection and identification of the plant species. Large quantities of almost every type in which signs of alkaloids have been found have been collected for the extraction of alkaloid fractions which are tested for pharmacological activity.

The increasing interest in substances which can counteract carcinogenic growths in human beings has recently led to expansion of the work. All the plants collected are now being examined for the presence of such substances.



Apparatus for large-scale extraction of alkaloids from plants.

The fractionation of extracted alkaloids in pure components has resulted in the isolation of several new alkaloids. In the case of alkaloids found to be pharmacologically active, the structure is determined so that these can be synthesized in the laboratory for the preparation of analogous substances with modified properties. This part of the work is particularly important in view of the current practice to synthesize the valuable alkaloids rather than to rely on natural sources and — more important — to prepare analogous compounds with properties superior to those of the natural alkaloids.

Some of the new alkaloids which have no pharmacological application are important to science. These are being studied in the Chemistry Departments of various South African universities.

De-salting of brackish water by electrodialysis

It is evident that, although brackish water can be effectively de-salted by means of electrodialysis, the method like others used for water de-salting is very expensive and only justified under special circumstances where costs are not a consideration. The C S I R has now terminated its research on this project.

In 1954, an extensive programme of research into the de-salting of brackish water by electrodialysis was initiated because it was felt that this method would be relatively inexpensive. A good deal was achieved in the following ten years.

The special ion exchange membranes which form the heart of the de-salting process were extremely expensive and not commercially available. The C S I R developed a method of making new, inexpensive membranes which were used in all the ensuing research work and have been patented in the major industrial countries.

A number of technical problems had to be solved in the design of suitable apparatus for water de-salting and various patents resulted from the work. One objective was to develop a large installation for the de-salting of 2.5 million gallons a day of the brackish water pumped from gold mines in the Orange Free State, and another was to develop a simple unit which could be supplied with electrical power by a diesel generator for treating small amounts of water in remote areas. Both these undertakings were successful.

Although the de-salting process cannot be justified economically, it appears from a recent report of the United Nations on water de-salting in developing countries that no other system can provide water at such low cost as the South African systems and that South Africa is the first country to develop a membrane installation which can treat millions of gallons a day.

— National Chemical Research Laboratory

Auxiliary apparatus for dielectric heating

The C S I R has developed an extremely sensitive calorimeter for use in dielectric heating, a process which is finding increasing application in industry.

In dielectric heating the physical properties of the materials being heated are of great importance. The new apparatus makes it possible to determine not only the dielectric characteristics but also the specific heat, transition heat and heat generated by external processes. A new principle of "dynamic quotient calorimetry" is applied, in terms of which measurement is made independently of changes in the heat conductivity and heat capacity of the materials used.

The calorimeter consists of an electric oven in which there are three identical sample containers, of which one is empty, the second contains the sample and third contains a standard material. The temperatures of the three containers are measured by means of resistance thermometers. The temperature of the oven is increased at a constant rate by means of an electronic control system. The temperature differences between the empty container and the container with the sample and those between the empty container and the standard container are ascertained with an electrical bridge.

The apparatus is highly sensitive and can measure heat as low as 0.0005 calories. Only 0.001 gram to 0.1 gram of the sample is necessary.

Although this instrument is intended primarily for the determination of heat characteristics in dielectric heating, it can also be used in other spheres, e.g. in the energization of chemical reactions such as polymerization.

New technique for accurate measurements of temperature

The C S I R has developed a technique which increases the scope of semi-conductor thermistors for the accurate measurement of temperature.

Accurate measurement of temperature is of great importance in industrial processes, agriculture and many scientific experiments. The semi-conductor thermistor is one of the best devices for the purpose but has the disadvantage of becoming heated by the current flowing through it.

To overcome this difficulty, use was made of a so-called pulse technique. A current of very brief duration (e.g. 3 milliseconds) is sent through the thermistor and its resistance, which provides an indication of the temperature, is measured during this period. In this way, the self-heating of the thermistor is kept within limits so that it can cool to the environmental temperature in the intervals between measurements.

The technique is particularly useful in cases where temperatures are automatically recorded at different points and at regular intervals.

Statistics in the biological sciences

Mathematical statistics are finding increasing use in research in the biological sciences. Examples of the successful application of mathematical statistics in this field are given below.

- The effect of dietary treatment on patients suffering from heart diseases is reflected in the change in the fatty acid level of their blood during treatment. On behalf of the National Nutrition Research Institute, the glucose tolerance values, which give an indication of the fatty acid level, were compared statistically before and after treatment.
- Statistical analyses were carried out on behalf of the National Nutrition Research Institute for an investigation into the importance of fats in the treatment of acute cases of kwashiorkor. An experiment to investigate the influence of various concentrations of urea included in the diet of recuperating kwashiorkor patients was planned and the results were analysed. Extensive statistical tests were conducted in connection with the increase in weight of three groups of recuperating kwashiorkor patients who were fed with two kinds of fish flour and one type of milk powder. A difference in weight among the three groups at the beginning of the experiment was taken into consideration.
- An investigation into the prediction of lung function among normal mineworkers was undertaken on behalf of the Pneumoconiosis Research Unit. Lung function is measured in terms of 21 different physiological variables which, in turn, are influenced by certain physical variables such as height, weight, etc. Correlation and regression techniques were used to determine from which of the eight given physical variables, the physiological variables can be predicted.
- Surveys were planned on the incidence of bedsores and their symptoms among patients in the Pretoria General Hospital and the results were analysed. This work was undertaken for the South African Wool Board which was investigating the efficacy of specially treated merino skins for preventing bedsores among patients in hospitals. Although strict control of the experiment was difficult, useful results were obtained.
- Data on cervical carcinoma collected by a doctor were statistically analysed in order to compare its incidence in different age groups.

— National Research Institute for Mathematical Sciences

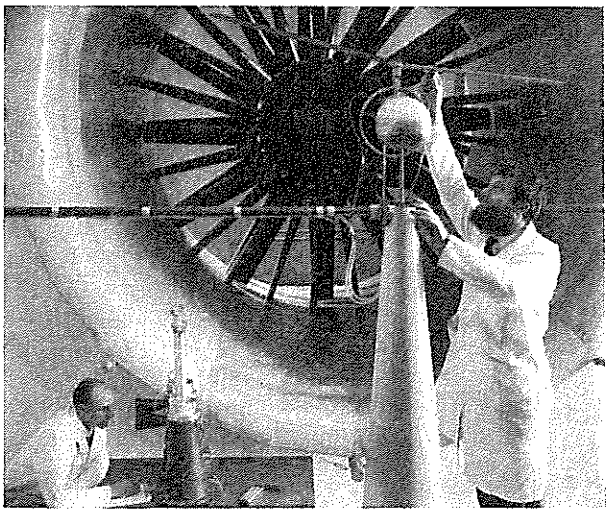
Development of an autogyro

A research programme aimed at the production of a prototype light autogyro has been commenced at the C S I R. Primarily the project will provide research personnel with valuable training and experience in the problems likely to be associated with the formation and expansion of a South African aircraft industry. The possibility of the commercial production of the autogyro in the Republic is envisaged as a later development. In view of the vast extent of the country such an aircraft would be of inestimable value to agriculture, to businessmen and in patrolling duties generally.

Before embarking on the project the general trends in the development of modern autogyro construction were thoroughly investigated. As a result the two-seater autogyro has been chosen as the prototype as its design and construction are such that its manufacture should be well within the present scope of local facilities.

The rotor is to be of the relatively simple two-bladed teetering type. A shrouded propeller is envisaged as the most suitable form of propulsion unit. Theoretical studies of two-bladed teetering rotors and shrouded propellers have been made in order to obtain further data for use in the final design, The aerodynamics of rotating wings and the effects of propeller slipstream interference have been studied by means of wind tunnel models.

A mobile rig for aerodynamic and stability tests on full scale rotors is being constructed. Tests with this rig should yield further valuable information for use in the final designs of the rotor and propulsion unit.



Windtunnel test on a model of an autogyro being developed at the C S I R.

The final form of the autogyro has been more or less decided, and in spite of a shortage of design staff, the detailed design of several components is proceeding. Stress analyses of structural components, such as landing gear, fuselage and rotor pylon are being carried out as far as is possible with available data. Certain components, such as the wooden rotor blades and the propeller shroud, which will be required for aerodynamic and structural testing in the immediate future, are being designed and stress analysed in detail.

Tests on components of a proposed spin-up drive for the rotor are also being undertaken.

Resonant Combustion

Resonant combustion chambers with various possible applications e.g. in gas turbines, pulse jet engines (for motive power) and the drying of crops, are at present under development at the C S I R.

For a number of years research has been conducted on resonant combustion chambers for gas turbines with the object of achieving a pressure gain in the combustion chamber instead of the pressure loss associated with conventional combustion chambers. In view of the considerable improvement in the general efficiency resulting from such a pressure gain, a combustion chamber of this nature should have numerous applications in gas turbines. A prototype of a resonant combustion chamber with multiple resonance tubes, which gives a slight pressure gain has already been tested successfully and a second prototype incorporating a number of improvements is at present being made. The possibility of utilizing combustion chambers of this type as valveless pulse jets for propulsion is also being investigated. An experimental model without moving parts has already been developed to the stage where the ratio of fuel consumption to thrust (specific fuel utilization) is equal to that of a modern jet turbine engine.

Attention is also being given to the development of a valveless pulse jet for the drying of crops. As the required air movement is effected by the combustion process the need for fans and heat exchangers is obviated, thus making it possible to construct simple drying equipment at low cost. At present, a dryer with a resonant combustion chamber is being built which will be used in experiments on the drying of crops in the Department of Agricultural Engineering of the University of Pretoria.

— National Mechanical Engineering Research Institute

Food composition tables for South Africa

The C S I R is compiling food composition tables for South African foods. Such tables are of great importance to nutrition research workers, dieticians and others who have to work out balanced diets. Tables of this kind are in existence overseas but they are incomplete and do not cover foods peculiar to South Africa.

In recent years the composition of maize and maize products from the most important maize-producing areas in South Africa has been determined as well as the composition of white, brown and whole-wheat bread baked by the largest bakeries in Pretoria. A start has also been made with the analysis of various vegetables, fruits and cereal products. The possibility of seasonal variation has been taken into account in the statistically planned sampling.

South Africa has an abundance of wild fruits and plants which are used for food, mainly by indigenous tribes, and the composition of these foods, with few exceptions, is entirely unknown. A tremendous field has to be covered, therefore, and the investigation will take a considerable time to complete.

New food mixtures as protein supplements

Increasing quantities of skimmed milk powder are at present being distributed by the Government in order to supplement the inadequate protein in the diet of the Bantu child and to combat deficiency diseases. The available supplies of milk powder are, however insufficient and attention is being given to the formulation of other food supplements which contain adequate usable proteins.

The typical diet of the Bantu (predominantly maize porridge) not only has a low protein content but the protein is of low quality and can only be partially utilized by the body. Attention is being devoted to methods of improving protein quality as well as protein content.

The protein values of a great variety of foods and of mixtures obtained by mixing certain proteins in specific combinations have therefore been investigated. Among other things, it has been established that 40 parts of sesame protein (55% usable) mixed with 60 parts of soya protein (70% usable) yields a protein blend of which 73% can be absorbed by the human body, i.e. as much as in the case of animal proteins like that of meat.

The results of these investigations are at present being applied with a view to the preparation of relatively inexpensive food supplements from available South African foods.

Good progress has already been made in the development of a formula for a suitable supplement with soya meal, fish flour, egg powder and milk powder as the principal ingredients. All these ingredients can readily be produced in this country.

Nutritional status survey among children

Work continued on the comprehensive survey of the nutritional status of primary school children in Pretoria started in 1962. In the first year the nutritional status of White children was studied, in 1963 that of Bantu children, and in the past year that of Coloured and Indian children.

The mass of data on more than 2000 children collected in the course of the three surveys has only been partially processed but it is already clear that much valuable information has been obtained on the nutritional status of the young school-going child.

In addition to the nutritional studies, a study was made of the socio-economic background of the children. This should throw a good deal of light on the relation between malnutrition and socio-economic status.

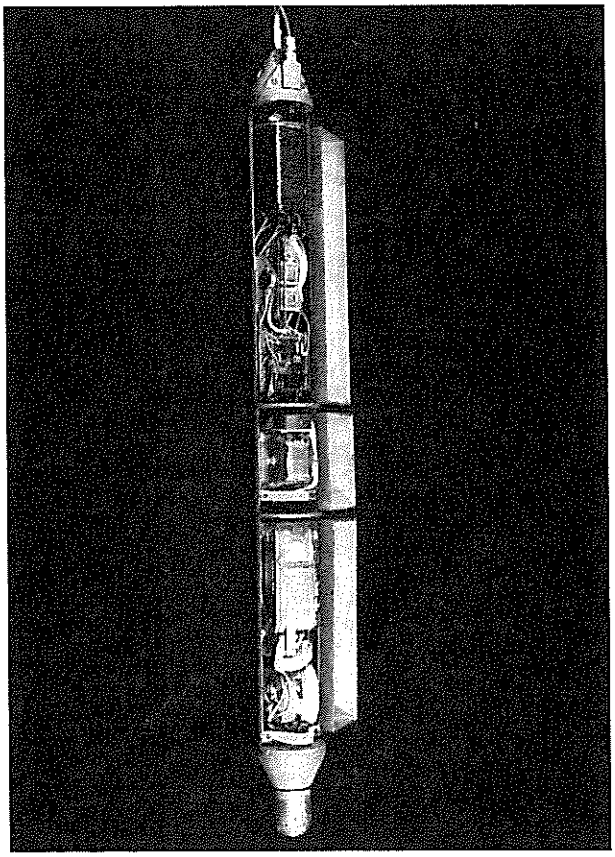
— National Nutrition Research Institute

New six-channel spectrograph head

A number of new spectrographic instruments have been developed at the C S I R in the course of the work aimed at improving methods of spectrochemical analysis. The latest of these is a six-channel direct-reading head which will increase the range of application of the medium prism spectrograph for both research and industrial purposes.

The spectrograph is commonly used for rapid analysis as, for example, in industrial processes like the manufacture of steel. The conventional spectrograph is suitable for routine analytical work but does not meet the needs of the research worker or of the analyst who may wish to modify his programme from day to day, as the instrument is adjusted by the manufacturer for the determination of certain elements in a specific sample. Readjustment for a modified programme is then a complex and time-consuming process which must be carried out by a technician with special training. With the new head, the analyst can himself modify the adjustment of the spectrograph within a few minutes.

The new type of head is being manufactured under licence by an overseas firm and is known as the "Strasheim Attachment", after the leader of the research team which developed it.



The 4-inch borehole camera with cover removed.

New apparatus for investigating sinkhole formation

The problem of the formation of sinkholes like those which recently occurred at Blyvooruitzicht is at present being investigated by various bodies under the sponsorship of the Transvaal and Orange Free State Chamber of Mines. The contribution of the C S I R to this research work is concerned mainly with the development of techniques and apparatus for the tracing and investigation of underground cavities in dolomite areas where sinkholes mostly occur.

An optical measuring apparatus developed for the purpose by the National Physical Research Laboratory was described in the previous annual report. The N P R L has now developed another device — a camera which can be lowered into a borehole in order to make photographic surveys of the underground cavities.

The 35 mm camera with a wide angle lens, electrically driven film transport and a transistorized flash apparatus of high intensity, is operated from the surface by remote control *via* an electric cable. The entire apparatus is built into a light alloy tube which can be lowered by means of robust steel pipes into a borehole 4 inches or more in diameter.

The camera is so constructed that it can take a large number of photographs. These are developed immediately on the surface so that further photographs of any interesting portion of the underground cavities can be taken without delay.

By taking a series of photographs at different stages, research workers are not only able to study the condition of particular cavities but also to obtain a record of the deterioration or changes occurring in the cavity.

Malodorous gases tracked down

The C S I R has shown how unpleasant odours from industries north of Durban can travel over a considerable distance to Durban without much loss in intensity. The Air Pollution Research Group was able to make use of data on air currents above Durban harbour and the North Coast of Natal, obtained in 1962 and 1963, for tracking down the source of the unpleasant odours which sometimes hang over the northern parts of the city. The theory developed on the basis of these data has been confirmed in a series of low-level flights over the northern coastal areas.

The gist of the findings is that a sharp boundary sometimes arises between the mass of cold air flowing from the interior to the sea and the warmer sea air flowing from Mauritius to the mainland. This boundary runs parallel to the Natal coast-line and opposite the shore or somewhere over the sea.

The malodorous industrial gases are borne seawards on the cold air stream from the high land and when this stream collides with the warm air mass on the shore, it flows along the "wall" of sea air to Durban where it is still sufficiently intense to cause a nuisance to the residents of the northern suburbs.

The Air Pollution Research Group, in co-operation with the interested bodies, is now investigating measures to meet the situation.

— National Physical Research Laboratory

Communication of information to Bantu mine workers

A study carried out by the C S I R on behalf of a mining group has shown that the present procedures for communicating information to Bantu workers are not always effective.

The mining group had decided, after a full investigation, to replace its complicated bonus system with a new wage system for Bantu workers which provides for regular increments and promotion. The C S I R was then requested to establish whether the Bantu workers understood the new system and considered it reasonable and whether opportunities for promotion was a factor influencing motivation among these workers.

The C S I R conducted an investigation at two mines and found that the mine authorities had not succeeded at all in conveying the advantages of the new system to the Bantu workers. There was general dissatisfaction among the workers and the majority were in favour of the old bonus system. The finding was that the method of communication used was quite inadequate for imparting information to illiterate Bantu workers.

Moreover, because of the total lack of knowledge and interest in the scope for promotion, its importance in work motivation could not be determined.

Better methods of disseminating information were suggested and proposals for a thorough investigation of work motivation in migratory labourers were put forward.

Motivation in heavy physical work

The development of a method to assess motivation in the performance of heavy physical work was investigated. The job studied involved shovelling and moving broken rock, and detailed productivity records of individual workers covering work periods of up to 70 weeks were available.

Besides age, education, experience, etc. the principal aspects investigated as possible predictors of productivity on the job were physical strength or work capacity, and "drive level" or strength of motivation (as distinct from the direction of motivation or interests). Physical capacity was measured by a test of maximal oxygen intake per unit of time. To obtain an estimate of drive level a "trade test" was introduced after the brief training of the workers and before the beginning of the actual job. This consisted in using a shovel to fill and empty a one-ton car as often as possible in two hours and, after a break of 15 minutes, to fill and empty the one-ton car six times in as short a time as possible.

The following were among the more important results of this investigation:

- A minimum of physical strength is necessary for the performance of this kind of fairly hard work for any length of time and without endangering health. A man possessing this minimum of work capacity is potentially a good worker but work capacity in excess of the required minimum contributes in general very little to the actual productivity on the job.
- However, large variations do occur in the output of individual workers who have the minimum work capacity required. Since these differences were not correlated with work capacity but with trade test performance, they can be attributed largely to differences in drive level. This is the most important finding of the investigation. It shows that by means of a relatively cheap and simple trade test, the selection of well-motivated workers and, thus, the level of production can be improved.
- In addition to individual differences between workers, large variations in the performance of the same individuals over periods of time were observed. Certain changes in work rate during the trade test were found to be correlated with changes in productivity on the job over longer periods of time. For instance, the productivity of workers, who started off well in the trade test and whose output was at the minimum during the second hour and thereafter showed a persistent rise, tended to increase markedly during their first ten weeks on the job and they tended to maintain a generally high level of output thereafter.

This confirmed, in a practical work situation, what had been found in laboratory research on continuous work tests (mental activities and skill tasks), namely that there are characteristic work rhythms (i.e. periodic changes in work rate) which are apparently determined by the worker's temperamental make-up and which may be helpful in the assessment of individual differences in drive level.

Programmed instruction

Great success has been achieved overseas with programmed instruction, a new technique for the systematic communication of subject knowledge, and the C S I R is at present investigating the possibilities of its application in South Africa.

Programmed instruction methods have the advantage of encouraging active participation by the pupil, keeping him informed of his progress and allowing him to proceed at his own pace. With this method, much time can be saved in instruction in schools, universities and industry.

The C S I R investigation is being carried out on behalf of the Department of Defence and the Chamber of Mines, with the emphasis on research into programming techniques rather than instruction machines. Various types of instruction machines are already available in this country but the technique of programming has not yet been deleveloped to the point where the apparatus can be used to the best advantage.

An important pre-requisite in the development of effective instruction programmes is the progressive testing and improvement of the programmes. The entire syllabus for mathematics (NTC I to ATC I) is at present being processed into programmed form by the C S I R and encouraging results have been achieved with experimental applications.

— National Institute for Personnel Research

Bitumen in road foundations

Bitumen which is used mainly for the surfacing of roads will probably now also be employed increasingly as a binder for road foundations. Cement and lime are normally used for this purpose but the sandy soils in many parts of South Africa lend themselves well to bituminous binding.

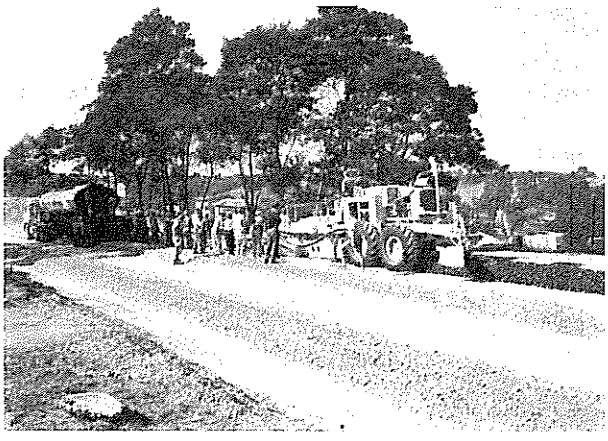
As there are no generally applicable standards for bituminous binding and overseas road authorities have to rely largely on their own experience, overseas methods cannot be applied without modification in South African climatic conditions. The results of overseas experiments, however, can be used as a guide.

The C S I R has therefore initiated an extensive research programme to obtain more information on the properties, especially the strength and elasticity, of mixtures of sand and bitumen.

Tests have already yielded useful data of the most suitable types of bitumen, bitumen content, the properties of sand and the value of different additives.

Bituminous blends have been tested on roads in the Orange Free State and Northern Transvaal and similar tests are planned in the Western Transvaal and South-West Africa. In co-operation with the Natal Roads Department and the Department of Transport, comparative tests with cement and with different types and quantities of bitumen as a stabilizer on sandstone foundations are being carried out on a section of road in Natal.

The tests have yielded satisfactory results and the research work is being continued.



A modern travelling mixer plant preparing a bituminized base layer during tests on a section of road in Natal.

The justification of road works and improvements

The C S I R has surveyed methods used overseas in calculating cost-benefit ratios in road works. (Cost-benefit is the relation between estimated future benefits resulting from a road facility and estimated initial capital and future maintenance costs.) Two aspects meriting further attention became evident during this study. The first was the manner of presenting the results of cost-benefit studies in which no more accuracy is attached to the calculation than is warranted by the uncertainty inherent in the estimation of probable costs and future benefits, while the second was the calculation of a rate of return rather than an index as a basis for assessing the economic returns on investment in alternative road projects.

This led to the formulation of a suggested approach to cost-benefit studies. In these, recognition is given to the indeterminacy of various of the factors in such studies and the consequent presentation of all relevant data (economic and non-economic) in a manner intelligible to the authorities responsible for financing roads. Formulae for the calculation of a rate of return on investments were also derived.

These refinements suggested by the C S I R were illustrated with an application to data on the relocation of the Howick-Mooi River national route in Natal.

The use of computers in road construction

An important aspect of the work of the C S I R is to obtain information from overseas, to adapt it where necessary to South African conditions and to make it available to interested bodies for further development. An investigation of this type which was completed by the C S I R during the past year involves the use of computers in road construction.

Electronic computers have been used for years in the U S A to solve a variety of problems relating to road construction which involve calculations. In view of the obvious advantages, the C S I R has undertaken to promote the use of computers by the major road authorities in this country.

After a comprehensive study of the use of computers in road construction in the U S A, general recommendations were made and a number of programmes were written for the calculation of quantities and the determination of road alignment. For demonstration purposes

these programmes were applied in co-operation with road authorities to illustrate the solution of specific problems.

After adequate information on the use of computers in road construction had been collected, a two-day symposium was held at the C S I R which was attended by a large number of senior road engineers and other interested parties.

At this stage it was apparent that road authorities could play a bigger role and a committee representative of the various road departments was established to correlate the available information and to promote further the application of computer techniques to road construction.

When in April 1964 the Department of Transport accepted responsibility for further development work, the C S I R's work in this regard was concluded.

— National Institute for Road Research

Improvement of radar performance

The National Institute for Telecommunications Research has been investigating the use of the semiconductor diode as the variable reactance element in parametric amplifiers and has been able to develop practical amplifiers at 600 Mc/s with very low noise figures.

Amplification is achieved in parametric amplifiers by varying a circuit reactance. An important feature of this type of amplifier is that its noise figure is much lower — or its sensitivity higher — than that of a conventional amplifier. The sensitivity of a maser is greater still, but, in contrast to the maser, the parametric amplifier is economical in terms of cost, bulk and maintenance.

One of the amplifiers developed by the National Institute for Telecommunications Research was installed in the receiver section of the radar set at Jan Smuts Airport before parametric amplifiers were commercially available. Installation was easy as the amplifier was small enough to be mounted in existing receiver racks. Initial operational problems have been solved and the unit has proved reliable in near-continuous service.

Improved receiver sensitivity has resulted in a significant increase in range equivalent to a fourfold increase in transmitter power. This extended area of coverage in the radar system is of considerable value to the airport.

Radar studies of precipitation

To study the possibility of reducing echoes from precipitation, the National Institute for Telecommunications Research carried out a series of radar observations with equipment having near-circular polarization.

Echoes from rain or other forms of precipitation are a disturbing factor in radar systems because they confuse or even conceal wanted echoes. If raindrops were uniform in shape and orientation, it would be possible in principle to eliminate their echoes by choosing a suitable polarization of the radar system. If, for example, raindrops were spherical, then a circularly polarized incident wave would be scattered as a circularly polarized wave with reversed sense of rotation, to which the system would be insensitive.

The results of these observations showed that precipitation echoes are elliptically polarized with varying degrees of ellipticity and orientation spread about fairly well-defined mean values.

Owing to this ellipticity, the cancellation obtainable by using circular polarization would be limited. The Institute established, however, that the use of a suitable elliptical polarization would give better results. The choice of polarization would be a compromise, because of the spread of values, but the Institute estimates that, in 90% of the cases likely to occur, the precipitation echoes will be reduced in power by a factor of at least 10.

An interesting feature of the results was that hail and rain echoes showed significantly different values of ellipticity. Owing to the scatter of values and the preponderance of rainstorms over hailstorms, it is doubtful whether this effect could be used to identify hailstorms with a view to predicting their course, but with improved equipment and techniques the possibility cannot be excluded.

A companion project was the statistical study of the occurrence of precipitation echoes in order to be able to assess their disturbance of radar systems. To extend the application of this work to different weather conditions, it was necessary to correlate the observed data with rainfall data. Although this project was not directed at measuring rainfall by radar, the results throw considerable light on the problems associated with such an undertaking.

Radio astronomy

The Radio Space Research Station operated by the National Institute for Telecommunications Research at Hartebeesthoek can make a significant contribution

to radio astronomy when it is not tracking space probes. The 85-foot radio telescope at the station operates at a frequency of 960 Mc/s and has a beam width of about 50 minutes of arc.

It is thus particularly well suited to help meet the need for more radio astronomy stations in the southern hemisphere. Because of the inclination of the galactic plane to the earth's equatorial plane, it is essential that the study of our galaxy, which is of great importance to optical and radio astronomers, should be carried out by observatories in both the northern and southern hemispheres.

The initial project was a survey of discrete sources and background radiation in a sector of the galactic plane ranging from 264° to 320° galactic longitude. This coverage supplements that of a similar survey in the northern hemisphere using a radio telescope at the same frequency with similar sensitivity and resolving power.

Receiving equipment was designed and built for use with the 85-foot antenna and its associated parametric amplifier. Observations began in March, 1963, and the survey was completed by May, 1963.

A contour map of galactic radiation has been drawn on the basis of measured data. In regions of overlap, the results of this survey are well correlated with those of the northern hemisphere survey at the same frequency, positional measurements of a number of well-defined sources agreeing to within 5 minutes of arc. The two sets of results constitute the first complete galactic survey made from both hemispheres at the same frequency with instruments having similar resolving powers.

A total of thirty discrete sources was observed. Ten of these have previously been identified by radio astronomers with known optical sources, while the Institute succeeded in making two new identifications. Work on the theoretical interpretation of the results is continuing, and the spectra of a number of discrete sources are being studied. Previous spectral studies in this region have been based on observations at two widely spaced frequencies, 85 Mc/s and 1440 Mc/s, and the survey of the National Institute for Telecommunications Research at 960 Mc/s fills an important gap.

— *National Institute for Telecommunications Research*

Pioneering 'soft' detergents

The majority of detergents at present in use in South Africa are 'hard' i.e. their chemical composition is such that they are not easily digested in sewage purification processes. The result is that they arrive in streams and rivers where they cause unsightly mounds of foam, harm the river life and impair the natural self-purification qualities of the water.

A successful experiment with a new 'soft' base for synthetic detergents, which can be broken down in sewage purification systems, has paved the way for investigation by detergent manufacturers into the possibility of using this base (a Sasol by-product) in their own products, thus helping to preserve the Republic's water resources.

In the course of this experiment, conducted jointly by engineers and chemists of the Johannesburg Municipality and the C S I R's National Institute for Water Research, the results of research sponsored by a chemical firm in the N I W R laboratories was applied on a large scale. Four tons of detergent were introduced into the water in the Northern Sewage Works of the Johannesburg Municipality in order to enable research workers to determine the extent to which findings on the digestibility of the 'soft' detergent in a full-scale purification installation supported the laboratory results.

The experiment was successful in so far as 85% of the 'soft' detergent was digested against 25% of the typical 'hard' detergents available commercially.

Sewage purification systems for small communities

Following on its work aimed at the development of an economic and efficient sanitation system for the smaller communities in South Africa, the C S I R is now testing a new sewage purification system at one of Pretoria's sewage works at the request of the South African Inventions Development Corporation.

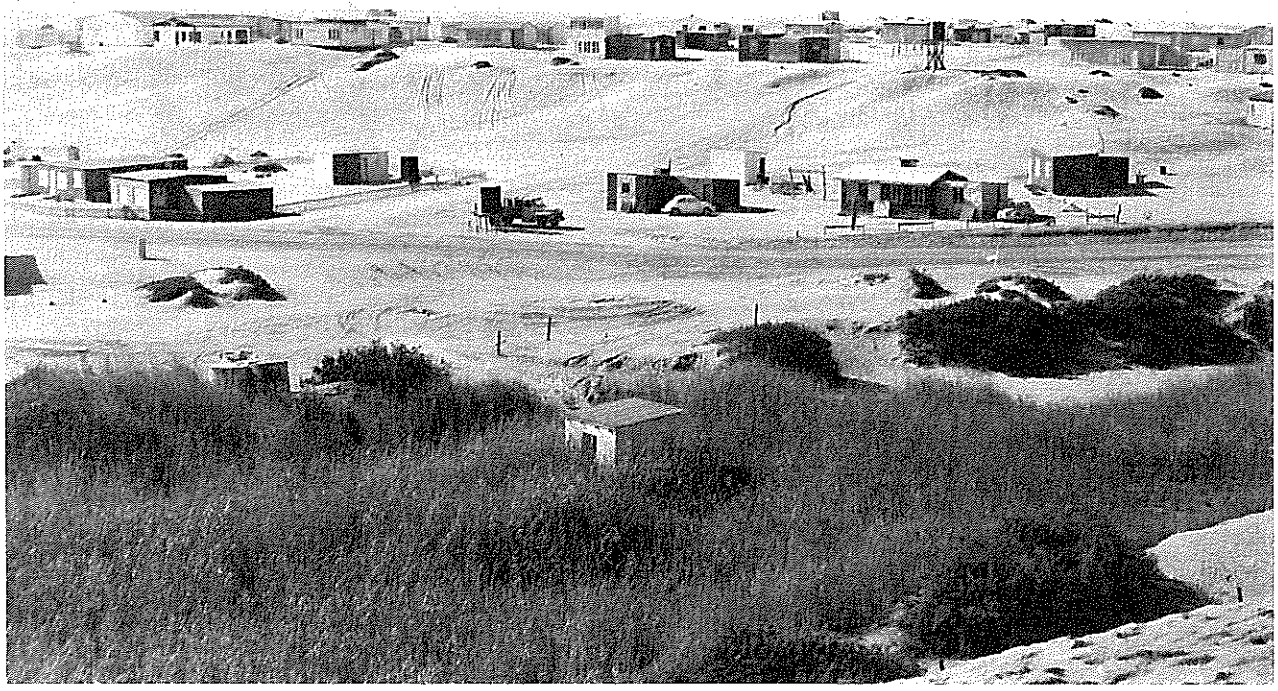
This new system is based on the generation of activated sludge in concentric channels interconnected in series. Continuous aeration is provided by discs rotating in the channels. Construction costs are relatively low, as the channels are of brick.

Encouraging results have been obtained to date and the investigation is proceeding.

— *National Institute for Water Research*

Water for dry areas

As a result of research work by the C S I R, an important source of underground water has been found for Henties Bay, a holiday resort on the west coast of South West Africa in the Namib Desert. The village



View of Henties Bay, showing pumphouse in foreground.

which up to now was dependent for its water on a single well can now proceed with expansion plans previously frustrated by the water shortage.

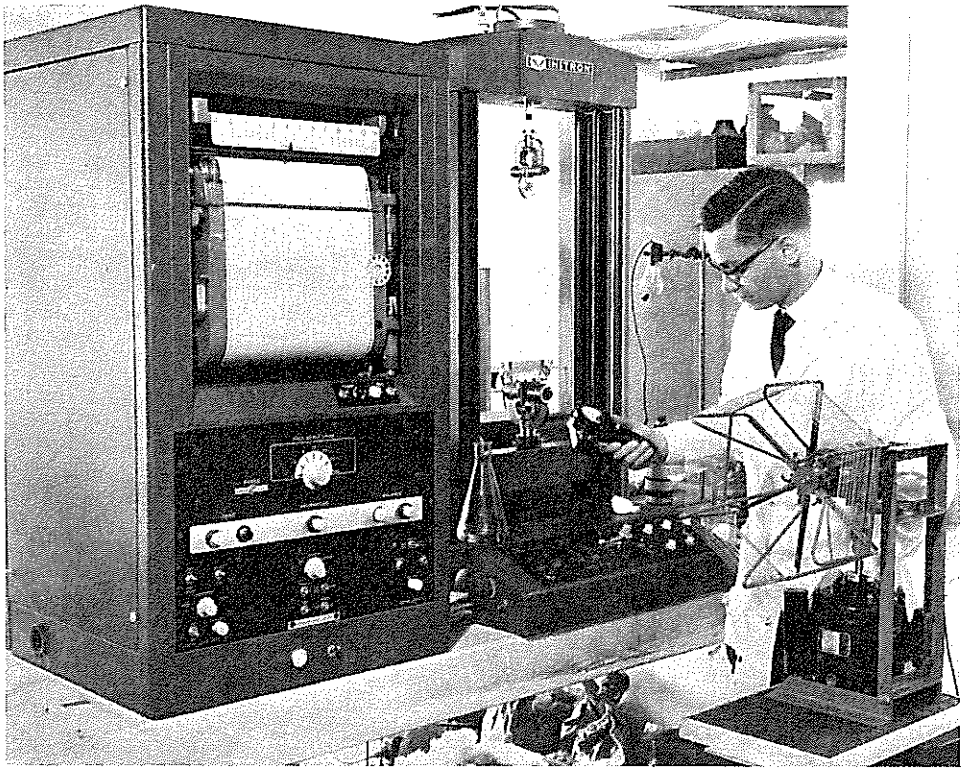
Water does occur in the sand bed of the Omaruru River which discharges into the sea 1½ miles north of Henties Bay, but the water in the mouth was regarded as unusable because of its poor quality. The C S I R was requested therefore to investigate the possibility of finding an alternative source for the town.

As the first stage in the hydrological study of the area near the Omaruru mouth, the true position and size of the river bed, which is entirely covered with alluvium, had to be established. It was ascertained by seismic refraction surveys that the Omaruru mouth forms a wide, shallow delta with an area of about 7 square miles. Near the sea the delta is about 2½ miles wide. Following the seismic findings, experimental boreholes were drilled throughout the delta and in every case water of good quality with an average T D S (total dissolved solids) of 400 parts per million was found.

The next step was to determine the rate of flow to the sea of the underground water as this would be the rate at which water could be pumped out. Surface water from the Omaruru River, as with all other rivers on the west coast, reaches the sea only after heavy rain in the interior. The sand beds — and in this case, the delta too — retains a considerable amount of water when the river is in flood. A conservative estimate of steady water supply from the delta could therefore be made only after a protracted drought. Controlled pump tests conducted in 1963 after a 12-year drought showed that the delta provides a steady supply in the region of 6 million gallons a day.

The success of this investigation again focuses attention on the potential of dry river-beds as sources of water in desert regions.

— National Physical Research Laboratory and National Institute for Water Research



Measuring kinetic yarn friction on the Instron tester equipped with specially designed accessories.

Facilitating the care of woollen articles

Investigations continue into the processing of woollen articles in order to facilitate their care and attention — a matter which is of great importance to the wool industry.

The tendency of woollen articles to shrink and felt during washing, is one of the aspects receiving the attention of the South African Wool Textile Research Institute. It has been established, for example, that closely woven woollen articles treated for shrinkage can be washed with a suitable detergent in neutral or slightly acid water at 50°C in an ordinary domestic washing machine without harmful affects. Loosely woven or knitted woollen material, however, still shrink considerably even when treated. Both the washing action and the temperature of the water are important factors.

Untreated woollen articles are subject to maximum shrinkage when the water temperature is between 40 and 65°C, the temperature usually recommended for the laundering of woollen garments by the manufacturers of detergents and soap powders. Woollen articles which have been treated for shrink-resistance undergo maximum shrinkage at a temperature between 30° and 40°C. For effective removal of dirt from garments a temperature of about 50°C is required.

An alkaline washing medium at a high temperature can damage the wool and strip the dyestuffs, whereas a neutral or slightly acid water normally does not affect the colour fastness of dyed woollen articles.

Another aspect of the care of woollen articles which is receiving attention is the durability of the so-called permanent creases artificially introduced into woollen clothing. The Institute has developed a new method for determining the "permanence" of these creases.

Improvement of knitting wool

The South African Wool Textile Research Institute has helped to clarify the phenomenon of wool yarn breaking without apparent reason in the process of knitting with the result that the final fabric is full of holes. About two years ago, it was established that the high degree of kinetic friction in certain wool yarns is responsible for this and that lubrication with paraffin wax reduces the friction resulting in smooth knitting. The source of the variations in friction in wool yarns, however, was only discovered recently when research workers at the Institute found that certain techniques for dyeing wool can increase the degree of friction of the wool yarn by as much as 100 per cent.

The difficulty can be overcome, however, by treating the dyed wool yarn with a softening agent to reduce kinetic friction. If the yarn is then lubricated with wax, the friction is reduced still further to the level of undyed yarn. This discovery is undoubtedly of great value because it means that relatively weak yarn can now also be used in knitting machines after treatment.

These findings on the knitting qualities of wool yarn have also focused attention on the unsatisfactory spinning qualities of top-dyed wool. The Institute has found that various methods of top-dyeing were responsible for differences in kinetic friction of the wool fibres.

— South African Wool Textile Research Institute

Medical research

Introduction

The C S I R has not established a national institute for medical research but supports research in the medical sciences in the following ways:

- by awarding *ad hoc* grants to individual scientists;
- by setting up units, groups and projects in collaboration with university medical schools and other institutes such as the S A Institute for Medical Research and the Veterinary Research Institute at Onderstepoort.

A unit is normally established under the direction of a scientist who has made an outstanding name for himself in a particular field, whereas a medical research group consists of individual researchers of more or less equal status working on a common problem.

For the financial year 1964/1965 the C S I R allocated some R430 000 for medical research; it also administered a further allocation of R283 000 provided by the Transvaal and Orange Free State Chamber of Mines and the State for pneumoconiosis research. In addition, grants from the U S Public Health Service for amoebiasis research, from the Transvaal Provincial Administration for bilharzia research, and from the Transvaal, Natal and Orange Free State Provincial Administrations for research on deaths associated with anaesthesia and surgery were administered through the C S I R.

A list of medical research units and groups supported by the C S I R follows, with a general survey of some of the research carried out during the year.

Amoebiasis Research Unit, Institute of Parasitology, Durban.
Anaesthetic Deaths Research Project, University of Pretoria.
Arthropod-borne Virus Diseases Research Unit, Poliomyelitis Research Foundation, Johannesburg.
Bilharzia Research Unit, subdivisions at Nelspruit, University of Potchefstroom, South African Institute for Medical Research, Johannesburg.
Cardio-Pulmonary Research Unit, University of the Witwatersrand.
Cardio-Vascular Pulmonary Research Group, University of Cape Town.
Clinical Nutrition Research Unit, University of Cape Town.
Degenerative Diseases Research Group, University of Stellenbosch.
Dental Research Unit, University of the Witwatersrand.
Endocrine Research Group, University of Cape Town.
Heart Research Group, University of Pretoria.
Human Biochemistry Research Unit, S A Institute for Medical Research, Johannesburg.
Nutritional and Dental Health Research Group, University of Pretoria.
Nutrition and Metabolism Research Group, University of the Witwatersrand.
Orthopaedic Development Unit, University of Cape Town.
Photobiology Research Group, University of Pretoria.
Pneumoconiosis Research Unit, Johannesburg.
Protein Research Unit, University of Cape Town.
Renal Metabolic Research Group, University of Cape Town.
Tuberculosis Research Project, Veterinary Research Institute, Onderstepoort.
Virus Research Unit, University of Cape Town.
Iron and Red Cell Metabolism Research Unit, University of the Witwatersrand.

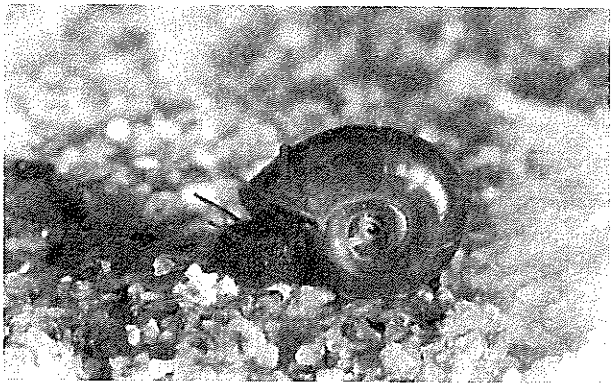
Bilharzia

Recent investigations show that bilharzia-carrying snails have appeared in the Vaal River Basin and also in the Orange River catchment area near Kuruman. This is of interest in view of impending developments in connection with the Orange River Development Scheme. With irrigation schemes and agricultural development in areas where vector snails occur, conditions are unwittingly created which tend to spread the disease amongst men and animals.

Mapping of these vectors is under way and, should funds be forthcoming, a Snail Biology Unit will be established at Potchefstroom University to carry out research into the properties of all snails that constitute an economic or health hazard in this country. The unit will collaborate with scientists already engaged in snail research at Onderstepoort, Stellenbosch University, Rhodes University, the South African Institute for Medical Research, the C S I R and elsewhere.

The clinical impact of bilharziasis on the health of communities living in areas where the disease is endemic is insufficiently understood, and an intensive programme of clinical research is called for if potential human suffering and stock losses are to be avoided.

Bilharzia experts have intimated that bilharziasis as manifested in the South African Bantu may differ from that found overseas or even in nearby Mocambique, in that the disease appears to be less lethal and less debilitating in South Africa than has hitherto been thought. Bilharzial infection in the Bantu is usually complicated by nutritional deficiency and parasitological infestation, factors which add greatly to the difficulties involved in establishing the real causes of morbidity. Unfortunately, accurate information is hard to come by and the need for renewed clinical research is becoming urgent.



Bulinus (Physopsis) africanus (left) and *Biomphalaria pfeifferi* (right)
the two most important intermediate hosts of Bilharzia in South Africa.

A recent unusual outbreak of bilharzia which caused many cattle deaths in Northern Natal has brought about renewed activity in bilharzial research on animals at Onderstepoort.

Dr. R. J. Pitchford, one of South Africa's leading workers on the prevention of bilharzia, has been temporarily seconded to a World Health Organization project in the Middle East. He is applying engineering methods of reducing bilharzia which were developed through research in the Eastern Transvaal. Dr Pitchford has been requested to spend three months annually in the Middle East for some time to come, to continue the work he is now directing.

Abdominal decompression during pregnancy

The results of decompression of the abdomen towards the end of pregnancy are still being studied. (Decompression increases the blood supply to the foetal brain at a time when inevitable pressure effects upon the foetus may tend to reduce this blood supply.) The early development of children born of mothers using this technique is being compared with development of those in a control group. It is still too early to draw reliable conclusions.

Porphyria

Research on porphyria continues to make progress. The congenital form of the disease is of exceptional interest in South Africa as several thousand Whites have inherited the syndrome from a Dutch immigrant who settled here about 180 years ago. Research by South African scientists has brought the disease into proper perspective in this country, has differentiated between the local forms, and by generally educating the medical profession both here and abroad about symptoms and treatment, has significantly reduced the hazards of this lethal and painful disease.

At an international congress on porphyria held in Cape Town in 1963, scientists from abroad expressed their appreciation of the quality of the researches carried out in this country.

Endocrine studies

Workers on diabetes have found that there are surprising differences in the manifestations of this disease among Whites, Bantu and Indians. Its incidence in a given race group varies with the standard of living or dietetic customs. The high incidence of diabetes and diabetic complications among relatively young Indians in Natal and the Transvaal necessitates a special research approach in the genetic sphere.

One diabetic research group is collaborating with centres in Britain on a "Pre-diabetes Trial Project". The object is to discover a method of treatment which prevents the disease from developing once a recognised predisposition has been discovered.

Orthopaedics

After years of study, an artificial leg for amputees has been invented by Prof. C. E. Lewer-Allen of the C S I R Orthopaedic Development Unit at Cape Town University. This is known as the UCT limb. It has been patented overseas and is in course of production. It promises to be an advance on all other artificial legs and was received with acclaim at the Copenhagen Orthopaedic Congress in 1963.

Cardio-vascular diseases

The tempo of research in this field is being maintained. Of special interest is the work under way at various centres on a mysterious form of heart disease, which was first clearly described by local research workers and occurs among Whites and Non-Whites in this country. The disease is the so-called "Cryptogenic Cardiomyopathy" for which, so far, neither cause nor cure is known. Partly as a result of the research done in South Africa the disease is awakening increasing interest overseas, especially in semi-tropical countries.

Dental research

Projects in this field cover improved methods for repairing cleft palates, and for correcting faulty development in the lower jaw causing disfigurement and psychological upset. Special investigations are being made into factors promoting bone repair after fracture or operation, and also into the effects of soil environment, water supply and feeding habits on dental development in a specially selected circumscribed community.

Virus research

In spite of the fact that the virus diseases of man, animals, plants and insects are recognized as the most devastating with which humanity has to contend, lack of money has prevented the Committee for Research in Medical Sciences of the Council for Scientific and Industrial Research from making more than a token contribution to the funds required for research on the many problems in this field.

Virus research in the Transvaal is supported in part by the Rockefeller Foundation, U S A, and carried out in collaboration with the Department of Health, the Department of Agricultural Technical Services, and Onderstepoort. Work is focused upon those virus diseases which are transmitted by arthropods. This large group of viruses, known to number more than 70, causes such important diseases as yellow fever, horse sickness, blue-tongue, equine and St Louis' encephalitis, Rift Valley fever, Wesselsbron and dengue fever.

Ten years ago a Unit was established with the broadly-based object of ascertaining which of these viruses occur in the Republic and neighbouring territories, the ways in which they spread and persist, the importance of the diseases they produce, and ways in which they can be accurately and rapidly identified. The ultimate aim was to develop effective methods of treatment or control.

Results of this research are of prime importance in the planning of large water conservation and irrigation projects which will favour the multiplication of these ready carriers of infection. A vast amount of work has already been carried out and the time has arrived to review the results critically so that future activities can be consolidated and considered in relation to available funds and to information emanating from similar studies in other parts of the world.

Virus researches which were started at the Cape in 1950 by the late Prof. van den Ende have expanded tremendously. Research workers in the Cape are concentrating largely on fundamental research into the nature of the virus particle complex, in order to assist their colleagues in the Transvaal who are responsible for studying the clinical aspects of infection, pathology, methods of spread, and methods of control (including the development and production of safe and effective vaccines).

In carrying out this basic research, full use is made of the opportunity to train locally recruited technical staff, as well as undergraduate and post-graduate personnel, in the complicated techniques in use or in the process of development.

Parasitology

Research on parasitology particularly in Natal is developing along new lines, with a strong bias towards biochemical and immunological concepts based on techniques of fairly recent development.

The load of bilharzia ova in the livers of infected children has been shown to be unexpectedly high, and the possibility of a relationship between tapeworm infestation and epilepsy, particularly among the Bantu, has been raised.

The problem of culturing *amoeba histolytica* in bulk continues to baffle experts.

The effectiveness of new antiamoebic drugs (singly or in combination) is under continuous investigation, as is also the efficiency of anthelminthics in other parasitic diseases.

Co-operative industrial research

Introduction

The interests of manufacturing industry are served in various ways by the C S I R. In addition to broad programmes of research, such as those concerned with the health and housing of the industrial labour force which are of vital, if indirect, importance to industry, more direct services are rendered to private firms through research undertaken on their behalf in the C S I R's national research laboratories and institutes.

The companies concerned bear the full costs of these confidential research and development projects; in each case, the C S I R enters into a contract with the sponsoring company, reflecting mutual agreement on matters such as costs, publication, patents and exclusive rights to the results of the research. In some cases industrial research fellowships are granted, under which staff are assigned to work in specified fields for longer periods on behalf of individual firms or groups of firms. The firms contribute financially to these fellowships and the C S I R normally bears part of the costs. Groups or units are also formed within the laboratories to serve the technical needs of particular branches of industry.

Industrial Research Institutes

The Leather, Fishing, Sugar Milling and Paint Industries have been assisted in the development of their own autonomous research institutes through financial contributions from the C S I R equivalent in amount to the annual contributions of industrial subscribers. The operation of these industrial research institutes is reviewed annually by the Advisory Committee for the Development of Research for Industry; and the level of financial support for each institute is determined at five-yearly intervals on the basis of comprehensive reviews undertaken jointly by the C S I R and the Board of Control of the institute concerned.

In the financial year 1963/1964, the total contributions of private industry to these four industrial research institutes amounted to R332 000 and the C S I R's contribution was R326 000.

A few of the projects undertaken by these industrial research institutes are briefly described below.

Fishmeal for human consumption

The Fishing Industry Research Institute has developed a new product which has aroused the interest of overseas nutrition experts. It is a stabilized fishmeal which retains an attractive fish flavour after months of storage and which can be used, among other things, in the preparation of tasty fish-cakes, or in small quantities, to enrich cereal products.

South Africa continues to play a leading role in the manufacture of fish flour, an odourless product of neutral flavour which can be used in the enrichment of cereal foods.

Investigation is at present in progress into the nutritive value of the new fishmeal as compared with fish flour, its storage life and the size of its potential market. Satisfactory results have been obtained in all these investigations.

New method of determining biological value of proteins in food

The commercial value of fishmeal and similar products is usually determined in terms of protein content but it is becoming increasingly important to take into account the biological value of the proteins in those foodstuffs as well.

The usual method of determining this biological value — by means of experimental animals — is uneconomical and time-consuming, and therefore unsuitable for routine evaluations.

A relatively simple and inexpensive method has now been developed at the Fishing Industry Research Institute in conjunction with bodies in the United Kingdom and the United States of America. With this method the biological value of protein is estimated in terms of a mathematical formula based on digestion tests *in vitro*.

— Fishing Industry Research Institute

Instant leather

Although methods have been developed for speeding up the tanning process with solvents, these have not proved economic or practical. A recent discovery by the Leather Industries Research Institute has yielded a break-through likely to have wide applications.

This discovery is the climax of seven years of research on the application to leather manufacture of the so-called "freeze drying" method used for preserving biological material.

The new process, for which patents have been granted, involves a brief formaldehyde treatment of the unhaired hide followed by freezing. The frozen hide is squeezed to remove surplus moisture and passed through a mangle submerged in the tanning material. Instant tannage occurs as the sponge-like raw material compresses and expands, drawing in the liquid.

A series of mangles can be used to give special effects. For example, chrome tannage of waterproof sole leather can now be achieved almost instantaneously, followed by rapid impregnation with a wide range of waterproofing agents, wear-resistant materials and colours. The process can be used to develop new characteristics in leather, thus widening the horizon of its usefulness and helping it to compete more effectively against synthetics.

Wattle for oil drilling

At one time sulphited quebracho extract was the standard mud thinner in oil drilling. Quebracho extract is obtained from the tannin-containing wood of the quebracho, a South American tree, and is used for tanning. Recently it has been experiencing severe competition from rival materials based on ferrochrome ligno-sulphonates. In the United States alone a 37 000 ton per annum outlet for sulphited quebracho extract has been lost.

Work carried out at the Leather Industries Research Institute has shown that sulphited, spray-dried wattle extract can give results approximating those of other thinners. Research is continuing in order to effect further improvements. The project has special significance in view of the extensive oil drilling programme in South Africa. The Institute is able to study the exact needs of the oil driller and to correlate its findings with laboratory tests. It hopes to produce a modified wattle product for trial on a large scale.

This development, at a time when wattle growers are searching for additional outlets for their extract, is receiving strong support and co-operation from the Industry's Marketing Committee, especially as the rival material is more expensive than suitably modified wattle.

Moist heat setting of footwear

During the past two years, a revolution has occurred in footwear production methods following the discovery of the process known as moist heat setting. A high quality shoe used to remain on the wooden mould or last for four to seven days during manufacture to ensure that it would retain its shape after slipping from the last. It has now been found that this can be more effectively accomplished in about six minutes simply by exposing the upper leather to moist heat while on the last, followed by dry heat at the proper temperature.

For the first time in footwear history, good quality footwear can be turned out on the conveyor system in a relatively short time cycle and most factories are being re-designed and re-tooled to this end.

Scientists at the Leather Industries Research Institute have played a major rôle in this development. The Institute has assisted local factories by designing moist heat setting equipment and testing the reaction of a wide range of shoe-making materials to this process.

In the case of welted footwear, the slow rate of drying of the outer sole holds up the rapid turnover needed for conveyors. The Institute has developed a 20-minute dryer for this purpose which is being installed in factories supporting the Institute.

— Leather Industries Research Institute

Assessment of life of paint

No matter how attractive a paint surface may be, its final value largely depends on its life and on the protection which it affords. These are assessed on visual appearance after outdoor exposure or accelerated weathering. Exterior exposure of a good material, however, may have to be continued for several years before an assessment of quality can be made, while all accelerated methods have the disadvantage of failing to correlate, at least completely, with service experience.

One solution is to use exterior exposure and improve the sensitivity of evaluation, and this has been carried out at the South African Paint Research Institute by following the rate of loss of film thickness of the paint exposed out of doors. In spite of seasonal variation of climate, the results are astonishingly regular and repeatable. The effect of the amount of pigment in the paint and of the presence or absence of fillers is apparent, and after an initial period of settling down, the rate of loss of film thickness with time can be determined within a time comparable to that usual with accelerated weathering. Clear advantages are that the deterioration is natural, and that from the weight loss, and knowing the thickness of paint applied, a figure of expected service life can be calculated.

Some causes of paint failure

Amongst the services which the South African Paint Research Institute renders is investigation of the causes of paint failures. The great majority of these are due to inadequate preparation before the application of paint.

Cases solved by S A P R I varied from failure due to using a greasy cloth for wiping down with solvent, and perspiration falling upon the carefully prepared surface of a motor car after phosphating, but before priming. Most of these cases involve investigation of mere traces of material, and frequently require the combined use of three or four techniques for their solution. Among those in regular use at S A P R I may be mentioned thin layer and gas chromatography, and the use of an infra-red spectrometer.

The instruments for use in the chromatography techniques were constructed at the Institute.

— South African Paint Research Institute

Filterability of raw sugar

As part of the work aimed at improving the quality of South African raw sugar, the Sugar Milling Research Institute continued its investigations into the unsatisfactory filterability of raw sugar.

Progress was made in the development of a method for the mechanical removal of starch from cold, raw cane juice by means of a centrifugal separator. Another method, viz. the enzymatic digestion of starch in mixed juice was also found to have interesting possibilities.

The method previously suggested by the Institute for improving the filterability of the raw sugar by remelting the lower purity products, has been increasingly applied by the industry with considerable success.

Sampling of cane for payment purposes

The possibility of evaluating individual consignments of cane on the basis of sucrose assessed by direct analysis, has long been considered. Investigations are being carried out to develop suitable methods of sampling, sub-sampling and analysis for this purpose.

It appears that sampling below the shredder allows for accurate cane analysis, and the performance of a mechanical sampler was studied at one of the factories. The method of sub-sampling and of analysing the sub-sample by cold extraction, was perfected.

These studies have shown that any simple direct sampling technique would be an improvement on the present Java Ratio system.

—Sugar Milling Research Institute

International conferences attended by CSIR staff during 1964

Dr S. M. Naudé, President of the C S I R, attended the *Annual Meeting of the Australian and New Zealand Association for the Advancement of Science* held in Canberra, Australia from 20 to 24 January.

The *Eighth Annual Meeting of the Scientific Committee on Antarctic Research (S C A R) of the International Council of Scientific Unions* held in Paris, France, from 24 to 28 August, was attended by Dr S. M. Naudé.

Prof. L. J. le Roux, Vice-President of the CSIR, attended the *Raketen und Raumfahrt Tagung* held in Darmstadt, Germany, from 26 to 28 June.

Mr C. G. Hide, of the South African Scientific Liaison Office, Cologne, attended the following:

Meeting of the Board of Management of the European Translations Centre (E T C) held in Scheveningen, The Hague from 4 to 6 March.

XVth General Assembly of the International Union of Biological Sciences (I U B S) held in Prague, Czechoslovakia from 17 to 22 July.

First International Biological Programme General Meeting (I B P) held in Paris, France, from 23 to 25 July.

30th Conference of the International Federation of Documentation (F I D) held in The Hague from 21 to 26 September.

Meeting of the Executive Committee of the International Union of Biological Sciences (I U B S) held in Stockholm from 2 to 3 November.

Mr J. A. King, of the South African Scientific Liaison Office, London, attended the following:

3rd Intergovernmental Oceanographic Commission held in Paris from 10 to 19 June (as an observer).

20th International Geographical Congress held in London during July.

Dr R. G. Shuttleworth, of the South African Scientific Liaison Office, Washington, attended the following:

IBM "share" Conference held in Philadelphia, U S A from 17 to 21 August.

International Conference on Radiation Preservation of Foods held in Boston, U S A from 27 to 30 September.

Miss N. M. Lodder of the Information and Research Services attended the *30th Conference of the International Federation for Documentation (F I D)* held in Scheveningen, The Hague from 21 to 26 September.

Miss N. M. Lodder of the Information and Research Services, attended the *38th Annual Conference of Aslib* held in Exeter, England from 28 September to 1 October.

Dr D. M. Calderwood of the National Building Research Institute attended two conferences in the United Kingdom, one on *The Planning of New Universities* held at Sussex University from 5 to 9 July and the other on *Organization of New Universities* at Keele University on 14 and 15 July.

The Steel Utilization Congress on Progress in Steel Construction Work organized by the High Authority of the European Coal and Steel Community and held in Luxembourg in October was attended by Mr J. K. Evenwel of the National Building Research Institute.

Dr J. P. van der Walt of the Microbiology Research Group attended the *International Symposium on Mycotoxins in Foodstuffs* held in Cambridge, Mass., U S A in March.

Mr C. G. Bruckmann of the National Chemical Research Laboratory attended the *14th ACHEMA Congress and Exhibition of the European Federation of Chemical Engineering* held in Frankfurt am Main, Germany from 19 to 27 June.

Mr N. H. Agnew of the National Chemical Research Laboratory attended the *International Symposium on Organic Reaction Mechanisms* in Cork, Ireland from 20 to 24 July.

The Second International Symposium on the Physiology of Digestion in the Ruminant held from 19 to 21 August at Iowa State University of Science and Technology, Ames, Iowa, U S A was attended by Mr A. Kistner of the National Chemical Research Laboratory. He read a paper on *Possible factors influencing the balance of different species of cellulolytic bacteria in the rumen.*

Dr H. M. Schwartz of the National Chemical Research Laboratory attended the *Second International Conference on Water Pollution Research* which took place in Tokyo, Japan from 24 to 28 August. Dr Schwartz read a paper entitled *The measurement of dehydrogenase activity of activated sludges.* (The authors of this paper were H. M. Schwartz, G. Lenhard and L. D. Nourse.).

Dr F. W. E. Strelow of the National Chemical Research Laboratory attended a *Symposium on Radiochemical Methods of Analysis* organized by the International Atomic Energy Agency and held from 19 to 23 October in Salzburg, Austria.

Mrs J. van Rooyen of the National Institute for Personnel Research attended the *Training Course in Methods-Time Measurement* held in Haarlem, Holland in January. Mrs van Rooyen also attended the *14th Annual Work Analysts Conference of N.V. Berenschot of Amsterdam* held in Utrecht, Holland in March.

The 43rd Annual Highway Research Board Meeting held in Washington from 13 to 17 January was attended by Mr S. H. Kuhn of the National Institute for Road Research. He read a paper on *The effects of the type of material on nuclear density measurements* and one entitled *An interpretation of vibration tests on roads by the impedance method.*

Dr P. J. Rigden, Director of the National Institute for Road Research, attended the *12th World Congress of the Permanent International Association of Road Congresses (P I A R C)* held in Rome, Italy from May 10 to 16.

Mr M. C. Hodson of the National Institute for Telecommunications Research attended the *World Conference on Radio Meteorology* held in Boulder, Colorado, U S A from September 14 to 18. He presented two papers, the first entitled *The frequency of occurrence of precipitation echoes in the Transvaal* and the second (by M. C. Hodson and T. V. Peter) *Observations of the ellipticity of raindrops, using a polarized radar system.*

Dr B. J. Cholnoky of the National Institute for Water Research attended, by invitation, the *Meeting of the W H O Scientific Group on the Biological Estimation of Water Pollution Levels* held in Geneva from 1 to 6 June.

Dr G. J. Stander, Director of the National Institute for Water Research, who is a member of the World Health Organization Expert Advisory Panel on Environmental Health,

attended, by invitation, the *Meeting of the W H O Scientific Group on Research into Environmental Pollution* in Geneva, Switzerland from 20 to 25 July.

The Second International Conference on Water Pollution Research held in Tokyo, Japan from 24 to 28 August was attended by Dr G. J. Stander, Director of the National Institute for Water Research, who is a member of the Permanent Steering Committee of the Conference. Dr Stander was elected Vice-President for the Third Conference to be held in Munich in September 1966.

Mr C. J. Loedolff of the National Institute for Water Research attended the *Second International Conference on Water Pollution Research* in Tokyo, Japan from 24 to 28 August. He read a paper entitled *The function of Cladocera in oxidation ponds* and was a discusser of a paper *A biotic index of polluted streams and its relationship to fisheries* by Dr T. W. Beak of Canada.

Mr E. Hoek of the National Mechanical Engineering Research Institute attended the *4th International Conference on Strata Control and Rock Mechanics* held at the Henry Krumb School of Mines, Columbia University, New York, U S A from May 4 to 8.

The Ninth Conference on Coastal Engineering held at the Laboratorio Nacional de Engenharia Civil, Lisbon, Portugal from June 21 to 29 was attended by Mr H. B. Sauermann of the National Mechanical Engineering Research Institute.

Dr H. M. B. Ballschmieter of the National Nutrition Research Institute attended the *First International Symposium on Oilseed Protein Foods* which was held in Tokyo, Japan from 11 to 15 May.

Mr L. R. P. Butler of the National Physical Research Laboratory attended the *Pittsburgh Conference on Spectroscopy* held in Pittsburgh, U S A from 2 to 6 March. He read a paper on *Multiple element atomic absorption spectroscopy.*

Dr G. Gafner of the National Physical Research Laboratory attended the *International Conference on the Physics and Chemistry of Solid Surfaces* held at Brown University, Providence, U S A from 21 to 26 June and delivered a paper on *Calculations on the wavelength dependence of back reflected electrons from nickel.*

Dr G. Heymann of the National Physical Research Laboratory attended the *Conference on Nuclear Spectroscopy with Direct Interactions* held in Chicago, U S A from 9 to 11 March. He also attended the *Gordon Research Conference on Nuclear Structure Physics* at New London, U S A from 31 August to 4 September.

Dr E. C. Halliday of the National Physical Research Laboratory attended the *General Conference of the Metric Convention* held in Paris, France from 5 to 13 October.

Dr A. E. Carte of the National Physical Research Laboratory attended the *Third Symposium on Remote Sensing of Environments* held at the University of Michigan, Ann Arbor, U S A from 14 to 16 October.

Mr M. van der Spuy of the National Research Institute for Mathematical Sciences attended the *International Conference on Large Electric Systems* held in Paris, France, from 1 to 10 June.

Dr G. J. Rudolph, Mr A. P. L. Kotzé and Mr J. W. Grobbelaar of the National Research Institute for Mathematical Sciences attended the *International Symposium on Mathematical Programming* held in London, England from 6 to 10 July.

Mr M. van der Spuy of the National Research Institute for Mathematical Sciences attended the *World Power Conference* held in Lausanne from 12 to 17 September.

The Operational Research Society's Conference held in Cambridge, England, from 14 to 18 September was attended by Mr. A. P. L. Kotzé, Mr. J. W. Grobbelaar and Dr G. J. Rudolph of the National Research Institute for Mathematical Sciences.

Mr J. D. N. van Wyk of the National Research Institute for Mathematical Sciences attended the *Joint International I F A C/ I F I P Conference* held in Stockholm from 21 to 23 September.

Dr D. F. Louw of the South African Wool Textile Research Institute attended the *Research and Development Committee Meeting of the International Wool Secretariat* held in Melbourne, Australia from 4 to 5 May (as alternate to the Director). He also attended the *Technical Wool Conference* held by the Western Utilization Research and Development Division of the United States Department of Agriculture in California from 13 to 15 May.

Dr D. P. Veldsman, Director of the S A Wool Textile Research Institute, attended the *Research and Development Committee Meeting of the International Wool Secretariat* held in Melbourne, Australia from 19 to 20 October.

The Twelfth General Assembly of the International Astronomical Union held in Hamburg from 25 August to 3 September was attended by Mr. J. Hers of the Republic Observatory.

Industrial research institutes

At the invitation of the National Academy of Sciences, Dr G. M. Dreosti, Director of the Fishing Industry Research Institute, attended a meeting of the *Research Advisory Committee of the Bureau of Commercial Fisheries* in Washington in March. He also attended the *Fifth Annual Conference of the International Association of Fish Meal Manufacturers* held in Vienna, Austria from 29 September to 2 October.

Mr D. Williams-Wynn of the Leather Industries Research Institute attended the *International Congress of the Hide and Allied Trades Improvement Society* in Copenhagen, Denmark, where he delivered a paper entitled *Hide and skin improvement in South Africa.* He also attended the *Congress of the International Union of Leather Chemists Societies* at The Hague, Netherlands, where he delivered a paper on *Theoretical aspects of the retannage of chrome leather with vegetable tannins.*

Dr K. Douwes Dekker, Director of the Sugar Milling Research Institute, attended the *Annual Meeting of Sugar Industry Technicians Inc.* held in New York during May and delivered a paper on *Filterability of raw sugar.* He also attended the *Symposium on Sugar Cane Diffusion* held in Braunschweig, West Germany in October.

Medical and university research units

Dr L. Krut of the Clinical Nutrition Research Unit attended the *International Biochemical Congress* held in New York in July.

Dr L. H. Opie of the Degenerative Diseases Research Group attended the *Conference on Muscle Metabolism* held at Toronto, Canada during February.

Prof. A. J. Brink, Director of the Degenerative Diseases Research Group, attended the *Conference on Pediatric Cardiology* organized by the Johns Hopkins Hospital, Baltimore from 10 to 13 May.

Dr W. P. U. Jackson, Director of the Endocrine Research Group, attended the *5th Congress of the International Diabetes Federation* held in Toronto, Canada from 20 to 24 July. Dr Jackson also attended the *Second International Congress of Endocrinology* held in London from 17 to 22 August.

Dr G. H. Findlay, Director of the Photobiology Research Group, attended the *International Symposium on Sunlight and Skin Cancer* held in Princeton, New Jersey, U S A from 17 to 21 March.

Dr L. J. A. Loewenthal of the Photobiology Research Group attended the *International Congress of Tropical Dermatology* held in Naples, Italy from 8 to 13 June.

Dr I. Webster of the Pneumoconiosis Research Unit attended the *Conference on Biological Effects of Asbestos* organized by the Biological and Medical Sciences Section of the New York Academy of Sciences, held in New York from 19 to 21 October. Dr Webster also attended the *Conference on Asbestos Exposure and Neoplasia* organized by the Geographic Pathology Section of the International Union against Cancer, held in New York from 22 to 24 October.

Prof. J. H. N. Loubser and Dr. P. T. Wedepohl of the Solid State Physics Research Unit attended the *Annual Conference on Solid State Physics* held in Bristol, England in January.

Dr H. H. Schlössin of the Solid State Physics Research Unit attended the following:

Annual Conference on Solid State Physics held in Bristol, England, in January.

L'Etude des defauts cristallins par l'emploi des rayons X, des electrons et des neutrons (studies of crystal defects by x-rays, electrons and neutrons) held in Nancy, France from 19 to 21 March.

Journées Internationales des Applications du Cobalt (International Conference on the Application of Cobalt) held in Brussels, Belgium, from 9 to 11 June.

International Conference on Powder Metallurgy held in Paris, France, from 15 to 18 June.

Prof. F. R. N. Nabarro, Director of the Solid State Physics Research Unit, attended the *Faraday Society Discussion on Dislocations in Solids* in Göttingen, Germany, from 15 to 17 September.

Dr J. W. Matthews of the Solid State Physics Research Unit attended the *American Vacuum Society Symposium* held in Chicago from 29 September to 2 October.

Financial Statement and Appendix

Balance Sheet as at 31st March, 1964

STATEMENT No. 1

Liabilities				Assets			
31.3.63			31.3.64	31.3.63			31.3.64
R		R	R	R		R	R
	CAPITAL				FIXED ASSETS		
	Capital Fund—see Statement No. 2.			5,893,467	Land and Buildings (at cost)—See Statement No. 2..		6,487,128.25
6,334,886	Building and Reserve Capital Fund.....		6,772,895.89	5,147,987	General Capital Account		
	Expenditure as at 31st March 1964.....	6,487,128.25			Assets (at cost)—see Statement No. 2		6,037,705.37
	Balance unexpended.....	285,767.64(a)					
5,692,761	General Capital Fund.....		R6,540,334.18				
	Expenditure as at 31st March 1964.....	6,037,705.37					
	Balance unexpended.....	502,628.81(b)					
R12,027,647			R13,313,230.07	R11,041,454			R12,524,833.62
	CURRENT LIABILITIES				CURRENT ASSETS		
189,872	Advances received for—			161,121	Investigations and Tests in Progress.....		—
	Investigations, tests and services.....		410,011.45	606,505	Sundry Debtors.....		1,179,939.55
453,259	Sundry Creditors—			26,565	Unsatisfactory deliveries.....		—
	Department of Commerce and Industries.....	13,552.06		136	Disallowances.....		956.51
	Other.....	976,267.80	989,819.86	201,160	Research grants paid in advance.....		185,483.09
				1,175,945	Investments with Public Debt Commissioners.....		1,486,989.91
428,835	Provision for firm commitments on Running Expenses Account as at 31st March, 1964.....		368,239.00	70,311	Cash—		
					(1) S.A. Reserve Bank—Current Account.....	18,958.40	
183,584	Appropriation Account.....		363,428.66		(2) On Imprest Accounts.....	3,684.79	
					(3) On Deposit.....	43,883.17	66,526.36
R1,255,550			R2,131,498.97	R2,241,743			R2,919,895.42
R13,283,197			R15,444,729.04	R13,283,197			R15,444,729.04

(*a*) Commitments in respect of building contracts amounted to R372,488 at 31st March 1964.
(*b*) There are firm commitments of R405,873 in respect of orders placed.

PRETORIA, 28th September, 1964.

S. M. NAUDÉ
President

J. H. VISAGIE
Secretary/Treasurer.

The above Balance Sheet has been audited in accordance with the provisions of Section 56 of the Exchequer and Audit Act, No. 23 of 1956, read with section 14(1) of the Scientific Research Council Act, No. 32 of 1962, and I certify that it is a true reflection of the accounts of the Council for Scientific and Industrial Research.

PRETORIA, 18th December, 1964.

I. T. MEYER
Controller and Auditor-General

STATEMENT No. 2

Capital Fund:
Statement of Transactions for the year ended 31st March, 1964

Details	Accepted Estimates	Totals as at 1 April 1963	1963–64 (Net) Expenditure	Totals as at 31 March 1964
	R	R	R	R
(A) *Building and Reserve Capital Account*				
Land and Buildings	400,000	5,893,467.19	593,661.06	6,487,128.25(a)
Balance Unexpended	—	441,418.79	155,651.15(—)	285,767.64
TOTALS	R400,000	R6,334,885 98	R438,009 91	R6,772,895.89
(B) *General Capital Account*—				
Furniture, Fittings and Office Equipment	24,350	383,102.62	60,206.27	443,308.89(d)
Laboratory and Workshop Equipment	1,111,111	3,967,847.84	783,216.06	4,751,063.90(d)
Stores on Hand	—	204,622.38	6,964.94	211,587.32
Vehicles and Cycles	—	161,536.77	9,817.41(—)	151,719.36
Subsidized Cars (at cost less repayments)	—	1,940.65	122.14(—)	1,818.51
Books and Journals	39,090	318,418.75	49,270.81	367,689.56
Prefabricated Structures	—	10,517.83	—	10,517.83
Shares	—	100,000.00	—	100,000.00(c)
Cost of Assets	1,174,551	5,147,986.84	889,718.53	6,037,705.37
Balance Unexpended	—	544,773.69	42,144.88(—)	502,628.81
TOTALS	R1,174,551	R5,692,760 53	R847,573 65	R6,540,334.18
TOTALS OF (A) AND (B)	R1,574,551	R12,027,646 51	R1,285,583.56	R13,313,230 07

Details	Accepted Estimates	Totals as at 1 April 1963	1963–64 (Net) Income	Totals as at 31 March 1964
	R	R	R	R
(A) *Building and Reserve Capital Fund*—				
(1) Parliamentary Grants	400,000	5,553,300.00	400,000 00	5,953,300.00
(2) Donations	—	67,619 23	1,020 00	68,639.23
(3) Interest on Investments	—	557,629 94	36,989.91	594,619.85
(4) Transfer from Appropriation Account	—	156,336.81	—	156,336 81
TOTALS	R400,000	R6,334,885 98	R438,009 91	R6,772,895 89
(B) *General Capital Fund*—				
(1) Parliamentary Grants: Statutory Objects	584,350	4,761,557.00	584,350.00	5,345,907.00
Research Projects for Government Departments	200,000(b)	16,175.44	198,341.61(b)	214,517.05
(2) Donations	—	53,874.64	15,299.37	69,174.01
(3) Revenue	390,201	237,060.37	49,582.67	286,643.04
(4) Transfers from Appropriation Account	—	624,093.08	—	624,093.08
TOTALS	R1,174,551	R5,692,760.53	R847,573.65	R6,540,334.18
TOTALS OF (A) AND (B)	R1,574,551	R12,027,646.51	R1,285,583.56	R13,313,230.07

NOTES:—
(*a*) R6,487,128.25 for land and buildings does not include value of site donated by Pretoria University which was valued at R41,800 for transfer purposes.
(*b*) Parliamentary Grant (R312,000) reduced by transfer of R112,000 to Running Expenses Account (Refer Statement No. 3.—Note (a)). Balance of Grant (R1,658.39) surrendered on 25th June, 1964.
(*c*) Shares of S.A. Inventions Development Corporation acquired in terms of section 10(3) of Act No. 31 of 1962.
(*d*) Includes Furniture and Equipment under construction to the value of R2,688.63 and R388,163.03 respectively.

ALLOCATION OF UNEXPENDED FUNDS

(i) Firm commitments against Equipment Capital Fund (estimated)	270,740.00
(ii) Held by Universities for purchases of capital equipment	45,133.49
(iii) Reserved for Capitalisation of equipment manufactured within the CSIR	90,000.00
(iv) Not committed at 31st March, 1964, but earmarked pending receipt of quotations or further investigations regarding suitability of equipment	96,755.32
	R502,628.81

PRETORIA, 28th September, 1964.

S. M. NAUDÉ
President

J. H. VISAGIE
Secretary/Treasurer.

STATEMENT No. 3

Running Expenses and Appropriation Accounts for the year ended 31st March, 1964

1962–63	Details	Accepted Estimates	1963–64	1962–63	Details	Accepted Estimates	1963–64
R		R	R	R		R	R
3,546,030	Salaries, Wages and Allowances	4,543,034	4,217,996.34		Parliamentary Grant—		
1,323,974	Consumable Stores and Services	1,373,467	1,779,875.86	3,894,000	Statutory Objects	4,623,500	4,623,500.00
249,269	Subsistence and Transport	305,030	288,810.67	424,475	Research Projects for Government Departments	697,850(a)	685,956.33(a)
731,543	General Expenses	950,425	972,081.19	1,307,670	Investigations, Tests and Services	1,676,272	1,719,204.42
401,160	Research Grants	710,894	465,016.15		Contributions towards:—		
254,370	Subsidies—			17,960	Research Activities	—	50,642.20
	Industrial Research Institutes	356,200	325,940.95	62,982	Royalties	—	—
				6,343	Publications	3,377	6,503.08
6,506,346		8,239,050	8,049,721.16	9,258	Sundry Revenue	2,000	18,139.75
756,322	Less: Charges for Internal Services and Running Expenses Capitalised in Equipment manufactured.	763,633	927,687.35	90,579	Reimbursement of Cost of Capital Facilities	—	99,194.12(b)
				552,179	Allocated from Appropriation Account in terms of section 15(4) of Act No. 32 of 1962	612,418	612,418.86
5,750,024		7,475,417	7,122,033.81				
3,003(+)	Less: Adjustment of previous years expenditure	—	38,142.71				
5,753,027		7,475,417	7,083,891.10				
612,419	Balance carried forward to Appropriation Account	140,000	731,667.66				
R6,365,446		R7,615,417	R7,815,558.76	R6,365,446		R7,615,417	R7,815,558.76
552,179	Allocation by Council to—			260,637	Balance as at 1st April 1963		183,584.36
	(1) Running Expenses Account (1963–64)		612,418.86	291,542	Provision for firm commitments as at 31st March, 1963.		428,834.50
			612,418.86	552,179			612,418.86
52,680	(2) Building and Reserve Capital Account		36,989.91	612,419	Balance brought forward from Running Expenses Account		731,667.66
428,834	(3) Provision for firm commitments at 31st March, 1964		368,239.00	52,679	Interest on Investments for allocation to Building and Reserve Capital Account		36,989.91
1,033,693							
183,584	Balance for allocation by Council in terms of section 15(4) of Act No. 32 of 1962		363,428.66				
R1,217,277			R1,381,076.43	R1,217,277			R1,381,076.43

NOTES. (*a*) Parliamentary Grant (R585,850) increased by transfer of R112,000 from Capital Fund (Refer Statement No. 2—Note (b)) Balance of grant R11,893-67 surrendered on 25th June 1964.

(*b*) Cost of Capital Facilities (i.e. buildings, roads, etc) at Hartebeesthoek which is by agreement fully recoverable from the N.A.S.A. (U.S.A.)

PRETORIA, 28th September, 1964.

S. M. NAUDÉ
President

J. H. VISAGIE
Secretary/Treasurer

STATEMENT No. 4

CSIR Budget 1964-65

A. Running Expenditure

Activities	EXPENDITURE								FUNDS		
	Salaries	Supplies and Services	Subsistence and Transport	Scientific Services	Grants and Subsidies	General Expenses	LESS: Internal Recoveries	Total	Parliamentary Grant	Recoverable Expenditure	Carried forward from 1963/64
	R	R	R	R	R	R	R	R	R	R	R
CSIR Laboratories and Departments..	5,374,882	1,534,704	302,411	327.822	399,914	804,206	1,039,347	7,704,592	4,416,813	3,247,779	40,000
Grants to Universities etc	171,644	16,475	15,250	—	255,868	217,109	—	676,346	642,479	33,867	—
Subsidies to Industrial Research Institutes	—	—	—	—	171,208	6,000	—	177,208	177,208	—	—
TOTALS..... R	5,546,526	1,551,179	317,661	327,822	826,990	1,027,315	1,039,347	8,558,146	5,236,500	3,281,646	40,000

B. Capital Expenditure

Activities	EXPENDITURE										
	Books/ Journals	Technical Equipment	Furniture/Office Equipment	Vehicles			Buildings	Total			
CSIR Laboratories and Departments.....	43,833	1,643,288	30,000	36,000	—	—	300,000	2,053,121	990,470	1,062,651	—
Grants to Universities, etc.....	—	88,530	—	—	—	—	—	88,530	88,530	—	—
TOTALS..... R	43,833	1,731,818	30,000	36,000	—	—	300,000	2,141,651	1,079,000	1,062,651	—
						GRAND TOTALS R		10,699,797	6,315,500	4,344,297	40,000

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