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SOUTH AFRICAN  
COUNCIL FOR SCIENTIFIC  
AND INDUSTRIAL RESEARCH

SECOND ANNUAL REPORT

1946 - 1947

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AND INDUSTRIAL RESEARCH

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P.O. Box 395, Pretoria.  
1st November, 1947.

Sir,

I have the honour to present to you herewith the Second Annual Report of the Council for Scientific and Industrial Research for the year ending October 5th, 1947.

In accordance with the requirements of the Scientific Research Council Act, this report contains the report of the Council and a balance-sheet and Statement of Income and Expenditure certified by the Controller and Auditor-General for the financial year ending 31st March, 1947.

I have the honour to be,  
Sir,  
Your obedient Servant,

B. F. J. SCHONLAND.  
President: Council for Scientific and Industrial Research.

The Right Honourable J. C. Smuts, C.H., K.C., D.T.D.,  
Prime Minister of the Union of South Africa,  
Prime Minister's Office,  
Union Buildings,  
PRETORIA.

THE SOUTH AFRICAN COUNCIL FOR SCIENTIFIC AND  
INDUSTRIAL RESEARCH.

SECOND ANNUAL REPORT.

1. MEMBERSHIP AND MEETINGS OF THE COUNCIL.

The membership of the Council during the year under review has been:—

DR. B. F. J. SCHONLAND (President).  
DR. P. J. DU TOIT.  
DR. S. H. HAUGHTON.  
PROF. S. F. OOSTHUIZEN.  
DR. BERNARD PRICE.  
DR. J. SMEATH-THOMAS.  
MR. T. P. STRATTEN.  
DR. H. J. VAN ECK.  
DR. R. W. WILCOCKS.  
MR. J. E. WORSDALE.

The Executive Committee of the Council has consisted of Dr. B. F. J. Schonland (Chairman), Dr. P. J. du Toit and Dr. S. H. Haughton. Dr. Bernard Price and Mr. T. P. Stratten have served as alternates to Dr. du Toit and Dr. Haughton when they were absent.

The Council has held four meetings during the year, three of two days' duration and one of three days. The three-day meeting was held in Port Elizabeth, which gave the Council the opportunity of holding discussions with the Midland Chamber of Industries and other interested persons and of visiting the Leather Industries Research Institute at Rhodes University College, Grahamstown.

The Executive Committee has met five times during the year.

2. GENERAL FIELD OF ACTIVITIES.

During the past year the Council's activities, whose initiation was described in the First Annual Report, have been developed rapidly.

The progress of the Council's national laboratories and services is discussed in later sections of this report. In many respects this progress has exceeded expectations, in spite of unavoidable delays in securing equipment and facilities due to the circumstances of the time. It will

still take several years before all these laboratories are properly established because of the need for time and care in the selection and training of staff and in the equipping of laboratories, but also because the development of the long-range side of specialist research laboratories is of necessity somewhat slow.

The Council is glad to report that its plans for the fostering of industrial research associations have developed well. Four such associations, covering the Leather, Fish, Paint and Sugar-milling industries are now in being and a proposal for a fifth, to deal with the clay and ceramics industries and others interested in silicates, is in an advanced stage of discussion.

In terms of the Research Council Act, the Council is authorised to undertake research work for industrial and other sponsors. In the course of its first two years of operation, it has signed contracts for 20 such investigations to a total value of £13,968. Of these, seven have been completed and the remainder are proceeding satisfactorily. In all such cases the Council is careful to ensure that it is doing work which cannot be performed by private consultants in South Africa and that the contracts are in the national interest.

The arrangements made for the support of research in universities and similar institutions have operated satisfactorily during the year. The Council is convinced from the reports received from the recipients of grants and bursaries that its assistance to research workers will pay a rich dividend to South Africa in the future, not only through the actual results of scientific investigation supported by it, but also through the encouragement this financial assistance has given to those university students who are training themselves in research work. The industrial and general development of the Union is even now such as to make heavy demands on the scientific manpower of the country and this demand will increase in the future. It is probable that the Council will have to consider further ways in which assistance to the Universities in research can help to provide the large numbers of scientific men and women of high qualifications which the country will need before long.

During the year under review, the Council has provided effective support for research in the medical, dental and nutritional fields, details of which are given later.

In addition to the above activities, the Council, by direction of the Prime Minister, has been represented on the boards of a number of research laboratories receiving assistance from the State through channels other than the Council. These have included the Government Metallurgical Laboratory, the Fuel Research Institute and the preliminary committee of the Deep Level Mining Research Institute. Close co-

operation has also been maintained with the South African Standards Council and the Council for Social Research, on both of which the C.S.I.R. is represented by its president, and with government departments such as those of Health (Medical Research and Housing), Defence, Lands (Irrigation and Trigonometrical Survey), Mines (Geological Survey and Research), Agriculture and Commerce and Industries. The Council has also co-operated closely with the Federated Chamber of Industries, through the Chamber's research committee.

### 3. NATIONAL RESEARCH LABORATORIES AND SERVICES.

#### (A) LIBRARY AND INFORMATION DIVISION.

The work of this division has increased greatly during the year. A basic central library, for the use in the first instance of the staff of the national laboratories, is being built up in the field of physics, chemistry, building science, psychology and telecommunications. This library, together with the large stocks of pamphlets and reports, now numbering about 70,000, received from abroad on all branches of science and technology, is available to any enquirer in the Union and forms part of the inter-library loan service of the country.

Issues to industrialists have been mainly from the enormous number of reports on German industry received from the Combined Intelligence Objectives Sub-Committee, the British Intelligence Objectives Sub-Committee and the Field Information Agency, Technical.

The Library's monthly list of accessions, "C.S.I.R. Information", has a distribution of 651, covering Government departments and individual firms and technologists. It appears to fill a definite need. A leaflet entitled "Microfilm for the South African Scientist" has been prepared and distributed. This sets out a scheme whereby the division will obtain microfilm copies of articles in journals not in the Union and gives a directory of microfilm cameras and 'readers' in the country. Microfilms of various foreign journals have been obtained for enquirers during the year, and one microfilm of a South African thesis has been despatched overseas.

A "Draft Guide to Authors in the Preparation of Abstracts" has been prepared for the use of South African scientific journals whose abstracts will be distributed to overseas abstracting organisations. The head of the division has undertaken various other activities such as service on the South African Universal Decimal Classification Committee, arrangements for the collection and issue of the publications of the various international scientific unions to which the C.S.I.R. adheres on behalf of South Africa, advice to a number of other libraries on special technical matters and certain UNESCO library business.

The number of enquiries for information on special subjects continues to grow. It is of interest that the division has also dealt with a number of scientific and technical enquiries from Australia, Kenya, the United States and Great Britain.

(B) THE NATIONAL BUILDING RESEARCH INSTITUTE.

(1) *General.*

During the period under consideration, the functions of this institute have become more sharply defined. The separate characters of the three main divisions are now clearly emerging, and their work is conforming generally to the definition of their functions. These three divisions are as follows:—

- (a) *Architectural Division*—dealing with human and national needs in building.
- (b) *Functional Efficiency Division*—dealing with the functional requirements of building to fulfil these needs.
- (c) *Engineering Division*—dealing with the structural and material considerations necessary for expressing these requirements in practice.

An examination of the items under the programme of research will considerably clarify the broad definitions given above, but, as is to be expected, a great deal of overlapping exists among all three divisions. Within a single institute this overlapping of functions is probably an advantage, and it has been found that with mutual consultation very little actual duplication exists.

The Engineering Division is the largest of the three and has already shown signs of splitting into the following three separate sections:—

- (a) *Engineering*—dealing with the testing of materials and the structural aspects of buildings.
- (b) *Materials*—dealing mainly with the chemical and physical properties of materials.
- (c) *Soil Mechanics*—dealing with foundations and other problems related to the soil.

Since the institute has indicated that it is in a position to render service, public response has been very encouraging. This is particularly the case in the Soil Mechanics Division where contracts and Government work have been undertaken at an almost embarrassing rate. With a public demand of this type and the excusable desire to place the institute in the position to render a maximum of service, it is natural that the load of work should have rapidly overtaken the staff provision. This position will probably dictate the policy of the institute for the next few years and it will be necessary to examine very critically each proposed new project before any further commitments are made.

(2) *Staff.*

Mr. J. E. Jennings, Acting Director, was appointed by the Council as Director of the institute as from the 1st April, 1947.

Difficulty was experienced during the year in filling all the posts provided in the technical and professional officer grades, but it is anticipated that most of these will be filled by the beginning of 1948.

Two research officers have been sent overseas for special study, one to the Building Research Station of the Department of Scientific and Industrial Research in Great Britain to work on cements and concrete, and the other to the National Physical Laboratory, Teddington, to study wind tunnels in preparation for work on ventilators in this country.

(3) *Laboratory.*

During the period under review, two universal testing machines have arrived. These have capacities of 30 tons and 100 tons respectively, and will prove a notable addition to the equipment. An order has been placed for a further 300 ton compression and bedding machine, which is required principally for heavy testing work. A large amount of small equipment ordered during the previous financial year has also been received. Considerable laboratory work has been undertaken, but the laboratories are as yet by no means properly equipped for full requirements. Certain building alterations are being put in hand, the most notable being the provision of the temperature-humidity controlled rooms required for soil mechanics, paint and concrete work.

Work has been started on a field station and the construction of certain test rooms for the Functional Efficiency Division is well in hand. It is anticipated that the sites placed at the Council's disposal by the Pretoria Municipality for this purpose will prove extremely valuable.

(4) *Publications.*

The following publications originated within the institute during the year:—

(a) *Formal Publications.*

- (i) "Building Research in South Africa"—paper to the Natal Institute of Engineers by J. E. Jennings.
- (ii) "Economics of Selection of Steel Windows in Buildings"—an article for "The South African Builder" by Director, National Building Research Institute.
- (iii) "Native Housing and its Architectural Aspects"—article for "The South African Architectural Record" by P. H. Connell.

(b) *Stencilled Reports.*

- (i) "Reinforced Brickwork" by D. J. Henkel.
- (ii) "Interim Report on Soil for Wall Construction" by N. Stutterheim and T. L. Webb.
- (iii) "A Brief Review of Available Information on Vermiculite Concrete" by N. Stutterheim.
- (iv) "Sub-Economic Housing Practice in South Africa" by P. H. Connell.

(5) *Enquiries.*

A large number of enquiries have been dealt with during the year. These cover a wide field and many of them have been embodied in the research programme of the institute.

(6) *Contracts.*

During the year the institute has undertaken two sponsored research projects with industrialists to develop a test for evaluating the resistance of concrete pipes to the abrasive action of solids carried by liquids flowing in the pipes and to study certain aspects of the manufacture of sand-lime bricks. It has also contracted to conduct foundation analyses through its soil mechanics section for certain works to be undertaken by the South African Railways and Harbours Administration.

(7) *Programme of Work.*

The following is a general statement of the work proceeding in the Institute, with an indication of the probable immediate developments of each project.

(a) *Engineering Division.*

*Project No. 1—The Physical Properties of the Various Elements of Buildings.*

Tables listing the various physical properties of different materials composing the elements of buildings are in an advanced stage of preparation. This project is considered to be the starting point for the assessment of all new materials of construction.

*Project No. 2—Costs of Buildings.*

A bursary has been established by the Council, to be held under the direction of the head of the Department of Quantity Surveying at the University of Pretoria, and the bursar has taken for the foundation of his work the detailed cost analysis of the type P. 100D dwelling of the South African Railways and Harbours. This dwelling approaches the sub-economic type normally in use by municipalities, and a great advantage accrues from the fact that cost records on buildings of this type extend over a considerable period both during and before the war. When work on this group is completed, it is intended that he should concentrate on sub-economic dwellings, of lower cost, such as those provided for Native housing.

The investigation into the cost of the elements has been completed. This student is devoting a great deal of detailed care to this investigation and as it ultimately involves the splitting down of the costs into labour, material and profit, it is most essential that the figures given are beyond question.

*Projects Nos. 4, 11, 26, 40 and 43—Servicing Codes of Practice Committees for South African Bureau of Standards.*

The South African Bureau of Standards has recently decided to extend the work of its Codes of Practice Committees to cover a much wider field than that originally envisaged, and following the example of the Building Research Station in England, it will be necessary for the institute to devote a considerable amount of time to these committees. Nine such committees are at present operating and the Building Research Institute is represented on each. It is now proposed to constitute a further twenty-four committees; consequently the research work necessary for a successful outcome of the deliberations of these committees will be considerably extended.

(b) *Soil Mechanics Division.*

*Project No. 5—Small House Foundation Design.*

Levelling work in connection with the observation of the movement of buildings has continued. Certain very remarkable upward movements of the structures have been observed, and it is suggested that the origin of these may be connected with changes in the natural plane of soil saturation artificially brought about by the erection of the building on the surface. Associating this conception with the general observation that most buildings tend to crack by an apparent downward movement of the corners, it may be possible that an upward doming of the surface of saturation under the building would lead to a similar dome-shaped rise of the building as a whole. This occurrence would give the appearance of the apparent downward movement of the corners; it must also be associated with soils which swell and shrink as moisture varies. Work has already been started on the checking of this hypothesis and in conjunction with the South African Railways and Harbours an elaborate system of bearing tests is being conducted in the Standerton area. It is unfortunately not yet possible to start on the laboratory examination of the soils, as the drilling equipment required for undisturbed sampling will be occupied on contract works for some time to come.

Certain "ad hoc" measures for overcoming cracking of buildings are also being investigated. In order that walls themselves should permit more severe distribution of foundation pressures, designs have been made, treating these as deep Verendeel beams and making use of conventional reinforced brick theory. Two buildings of this type will be erected by different authorities. In addition the South African Railways and

Harbours is arranging to erect a building on concrete beams and columns in an attempt to transfer the load to a region below the variable line of saturation in the soil.

*Project No. 6—Foundation Investigation for Brandvlei Dam.*

This project was requested by the Department of Irrigation and involves the examination of the foundation of an earth dam on a water-pervious sand foundation. The Department is engaged in raising the existing dam and requires information regarding the probable settlement which may result from the additional loads imposed.

Work of this type requires very careful sampling of the soil in the foundation and it is most essential to obtain samples as near to the natural condition as possible. For the project under consideration the sampling must be made to a depth of approximately 100 feet, and it is already established that this is the depth at which rock can be expected.

For sampling of this nature two different sampling core barrels, to give 6" diameter samples of cohesive and non-cohesive soils, have been designed and constructed in the workshops.

*Project No. 7—Foundations for Proposed Bridge—Bayshore Reclamation.*

This contract was proposed by the South African Railways and Harbours Administration and involves a structure to be erected in the Bayshore Reclamation area, Durban.

*Project No. 8—Foundation for Pre-Cooling Shed and Cargo Store, "T" Jetty, Durban Harbour.*

This contract is proposed by the South African Railways and Harbours Administration, and has many features similar to those of the preceding project. Work cannot, however, be started until the Bayshore project is well advanced.

*Project No. 9—Silt Pressures on Dam Walls.*

This work has been proposed by the Department of Irrigation as a knowledge of the pressure exerted by the entrapped silt is of considerable importance when any questions of alterations to an existing dam arise. The solution to the problem depends upon the successful development of the pressure cell described in the next project, and the information which may be obtained will be of vital interest to the general question of retaining wall pressures.

*Project No. 10—Soil Pressure Cell.*

The first prototype of this cell has been manufactured to a design made by the National Physical Laboratory. It appears that the cell satisfies the requirement that the maximum deflection shall not be greater than 1/10000th of the diameter. Preliminary tests of the first prototype have been made to ascertain whether temperature change has any serious

effect on calibration, and the results have indicated that no important change occurs. The design is at present being checked and an attempt is being made to simplify the production process. It is very necessary that the cell should hold calibration for at least ten years, and it should preferably remain accurate for forty years.

(c) *Materials Division.*

*Project No. 12—Soil-Cement Construction.*

Experimental work in connection with the effects of the initial moulding moisture, cement content and humidity changes of the atmosphere on the properties of soil-cement bricks, has been completed. Laboratory examination of a number of soils and correlation of this examination with their successful and unsuccessful use in buildings is being continued. As a result of this work certain tentative rules for the choice of soils for this class of work have been formulated, but will not be made public until the whole study is completed.

The following sections of the work are still being investigated:—

- (a) compressive strengths of the various mixtures employed;
- (b) weathering tests;
- (c) plastering;
- (d) water permeability.

It is anticipated that the final report will soon be available. Surveys of buildings constructed of soil-cement units, and physical tests of the soils used in their manufacture are continuing.

*Project No. 13—Pisé de Terre for Walling.*

This project has followed on the work on soil-cement and is of particular interest in view of some large-scale work being conducted in Rhodesia. Buildings of this type have been inspected in Salisbury where the costs of European housing have been reduced to approximately 8s. per square foot. While this reduction in cost cannot be attributed wholly to the walling material, a careful and critical study of this method of wall construction appears to be warranted, especially in view of its potential suitability for native housing. A number of pisé buildings have been inspected, and analyses of the soils used in their construction have been commenced on lines similar to those indicated in Project No. 12. The application of a new type of shuttering with possible improvements will be investigated, and the significant subject of protective wall coverings for pisé will be examined.

*Project No. 15—Concrete Waterproofing Agents.*

The permeameter for this investigation has now reached an advanced stage and a number of preliminary tests have been made on the mortar briquettes it is proposed to use. Certain requests from agents have been received for this test information and it is proposed to write contracts giving them results on their own products.

*Project No. 16—Bitumastic Materials for Building.*

A certain amount of literature has been studied and tentative proposals for tests have been made. This work will have a bearing on protective wall coverings for pisé de terre. No actual laboratory work has been started. It is proposed ultimately to undertake this work in conjunction with the National Chemical Research Laboratory as a joint research project.

*Project No. 17—Abrasion Test for Concrete Pipes.*

A number of pipes have been tested but it is not yet possible to state whether the test will be satisfactory for assessing the resistance to abrasion of concrete pipes. Certain unexplained results have been obtained, and it is possible that these may lead to unexpected developments and conclusions. The work is being undertaken as a contract and is proceeding.

*Project No. 18—Study of the Capacity for the Improvement of Portland Cement.*

The research officer to whom this study has been committed has recently left for overseas study. It is hoped that during his absence it may be possible to make a start on the routine examination of South African cements and this work will involve the practical considerations of strength, bleeding and workability.

*Project No. 19—Study of the Expansive Mortar Failures in Brickwork.*

This problem has arisen from a number of enquiries regarding the origin of plaster cracks which appeared to follow the regular patterning of the bonding of the brickwork of the walls. In some buildings the cracking has been observed to be a process which persists for a relatively long time and in some cases a very marked vertical growth of the walls has taken place.

In all cases observed a fair amount of magnesium has been found in the mortar and studies of the calcination and hydration of building limes are proceeding in the laboratory.

A crack gauge for recording movements in structures is being constructed.

In association with the Bureau of Standards it is proposed to conduct an extended survey of the properties of the various limes produced from different lime works, and it is hoped that at the same time as the theoretical investigations are proceeding a more or less empirical test indicative of the expansive characteristics of the lime may be developed. In view of the relative infrequency of this type of failure it will be necessary for the survey to cover a very large number of samples. Field examination of buildings exhibiting this phenomenon is proceeding.

*Project No. 20—Efflorescence of Brickwork.*

The survey of the occurrence and severity of efflorescence in brickwork in South Africa is well in hand and preliminary specification tests have been proposed for the Bureau of Standards. A large number of samples has been collected and prepared for analysis.

*Project No. 21—Standardisation of Wear Test for Flooring.*

This work is being undertaken in order to standardise the test previously developed at the University of the Witwatersrand for Building Control. Work to date has covered repetition tests for a range of abrasives and a large number of types of flooring materials, and its object has been to show the reproducibility of the results obtained. Considerable thought has also been given to the question of the local skin hardening which probably takes place with time in an actual floor, but no satisfactory modification of the test has yet been devised in order to take account of this phenomenon.

*Project No. 22—Termite-Proofing of Buildings.*

The work of a special Committee composed of representatives of the Divisions of Entomology and Chemistry, the Forest Products Institute, the Public Works Department, the South African Bureau of Standards and the National Building Research Institute, is now almost at an end and provisional specifications have been framed. The committee has been much helped by the research work undertaken by Mr. W. H. Coaton of the Division of Entomology and with the courtesy of the University of Cape Town it has been possible to use this information in advance of its publication. The work has also been greatly assisted by access to the records on timber preservation maintained by the Forest Products Institute.

Certain additional lines of research have been suggested and during the work of the committee quite a considerable amount of testing and other investigational work has been conducted. The report of the work of the Committee is at present being written and it is anticipated that this will cover a wide field, and, it is hoped, provide the basis of a useful code of practice.

*Project No. 25—Paints in the Building Industry.*

In conjunction with the South African Bureau of Standards, with whom a joint Paint Laboratory is to be operated, a limited amount of work has been conducted on this subject but the work has been held up owing to shortage of staff. Soon after the start had been made, this study was rapidly taken up by a number of local groups, the most notable of which are the Department of Public Works and the National Housing and Planning Commission. This paint research section has been established with a view to serving the consumer's interests and great possibilities exist for its development.

(d) *Functional Efficiency Division.*

*Project No. 27—Comfort Standards.*

The study of the literature on this subject is proceeding. A eupatheoscope, to the design of Dufton of the Building Research Station, which registers the combined effects of air temperature, air movement and radiation in terms of a single index on an equivalent temperature scale, has been constructed and it is hoped to initiate a series of pilot tests with this instrument in the near future to get some idea of the comfort equivalent temperature range for South African climatic conditions. Attention is further being devoted to the possibility of modifying this instrument to take into account the fourth physical factor which affects human comfort, namely, relative humidity. Knowledge of these four physical factors in their relation to the human factor, along with detailed information of exterior climatic conditions and of the appropriate physical properties of building materials, constitute the three corner-stones of this division.

*Project No. 28—Compilation of Climatological Data.*

A scheme has been evolved for casting climatological data with reference to temperature in a suitable form for use in calculation of heating and cooling loads in buildings. Work has not yet been started on the actual compilation and drawing of the climatic zone maps, but it is anticipated that this will be begun in the near future. Similar work will also be required on humidity, wind velocity and solar radiation.

*Project No. 29—Tests for the Thermal Properties of Building Materials.*

The construction of an apparatus for testing the thermal conductivity of thin slabs is at present in hand. The designs and drawings of test apparatus for thermal conductivity of wall sections and bricks have been completed. The design of a calorimeter for determining the specific heat of building materials has also been completed. Similar work for a test on emissivity is in hand. This work is being conducted in close collaboration with the National Physical Laboratory.

*Project No. 31—Open Fireplaces.*

A careful study of literature has been undertaken and, as a result of this, designs and drawings for three fireplaces have been made. It is proposed to incorporate these designs in a special ventilation test room to be erected on the field station. This test room will have a triple function for, besides being used for the fireplaces, it will also be used for natural ventilation tests and as a parallel test of heat transmission under normal conditions, in association with the heat transmission test room.

*Project No. 33—Solar Heat Transmission through various Elements of Buildings.*

A test room to determine directly the transmission of heat through the walls, roofs and other elements of a building is now completed.

The room has been orientated on the four cardinal points so that the effect of the aspect of the walls can be truly observed. A single pitch roof has been designed and provision has been made for varying its slope and aspect. It is anticipated that experimental observations will be commenced before the end of the year.

*Project No. 35—Roof Ventilators.*

The work of the South African Bureau of Standards' Codes of Practice Committee on Roof Ventilators caused a detailed investigation to be made into the operation of these units. This is largely dependent upon two factors, the temperature difference between the air inside and outside and the exterior wind velocity. The air exchange due to temperature difference can be relatively easily calculated, but little basis exists for assessing the effect of wind velocity. It is proposed, therefore, to erect a 10 ft. diameter low velocity wind tunnel which incorporates an open test section. Commercial ventilators will be tested in this wind tunnel and at the same time an attempt is being made to relate the factors involved theoretically. Preliminary designs for the wind tunnel have already been made. It is anticipated that considerable extensions of the knowledge on the operation of these units will result and that an organised research of this nature will lead to improvements in existing ventilators.

*Project No. 36—Ventilation of Buildings.*

A careful examination of the literature on this subject has been carried out and preliminary designs for a ventilation test room have been made. This test room will allow observations on the effects of air-bricks, flues, windows and doors upon the air change in the room. The test room will also serve as a prototype to the theoretical conditions applying in the heat transmission test room which is listed under Project No. 33, and will incorporate the test fireplaces listed under Project 31. Considerable need for information on normal ventilation exists, particularly in connection with the work of the Research Committee on Minimum Standards of Accommodation.

*Project No. 38—Studies of the Natural Lighting of Buildings.*

A detailed study of the literature has been made and designs are at present in hand for a test room which will measure daylight conditions in South Africa. It is necessary that this work should be very considerably extended during the next six months, in view of the demand that will be made by the Illumination Sub-committee of the Research Committee on Minimum Standards of Accommodation.

*Project No. 39—Warmth Test of Floors.*

While working with Building Control at the University of the Witwatersrand, Mr. N. Stutterheim developed a test which gives quantitative expression to the feeling of warmth experienced by the human foot on a floor. The test involves the transfer of heat from a body of warm mercury placed in contact with the floor, and an empirical formula provides a relative warmth factor. Theoretical analysis relating the specific heat, density and the thermal conductivity with this sensation of warmth has recently been completed in the institute, and calculations indicate that the different materials lie in the same order as observed by Mr. Stutterheim. There are, however, notable differences in quantitative results and certain revisions have been proposed in the test apparatus. Laboratory work, to check the theoretical analysis and to develop a modified test, will be undertaken in the near future.

*(e) Architectural Division.*

*Project No. 41—Study of Native Housing.*

A first report on the principles and practice of sub-economic housing in South Africa has been prepared and will shortly be issued. A start has been made on a second report dealing with a survey of the various experimental types of Native dwelling which have been built in the Union. There is no single document which summarises all these experiments, and much of the information will have to be obtained from relatively obscure sources. Many requests have been received for specific information of this type.

A watch is being kept on the general situation and contact maintained with all bodies attempting to reduce the cost of this type of housing. It is felt that this is probably one of the largest single problems facing the institute and study of the programme of research as a whole indicates that many of the research items will find direct application in this field.

*Project No. 42—Research Committee on Minimum Standards of Accommodation.*

This work arises from a request from the National Housing and Planning Commission that the institute should examine critically the tentative proposals suggested for minimum standards below which no dwellings should be erected. It was felt necessary to enlist outside aid and a strong and representative committee of interested bodies has been set up by the Council for Scientific and Industrial Research. Specific tasks have been given to nine working sub-committees each of which deals with one aspect of the study as a whole, e.g. heating and cooling, lighting, ventilation, noise, planning. The work of this committee is of very great importance, particularly in the field of Native housing, where the National Housing and Planning Commission has to make decisions on building programmes for housing schemes and for individual dwellings,

which must, at the least, remain useful during their whole economic life of forty years. It involves careful examination and estimation of the probable social trends of our community, and, at the same time, the factors relating to health, comfort and morality are receiving due attention. The work is of great magnitude and ranks with similar projects by the Ministry of Works in Great Britain, the Federal Housing Agency in America, and many other bodies concerned with similar problems. In view of the special needs of our mixed population, however, the study will have a marked South African character.

It is to be expected that most of the investigational work in connection with this committee will devolve upon the institute and the necessity of providing the National Housing and Planning Commission with at least an interim recommendation by June 1st, 1948, will mean that the first portion of this work must of necessity be confined to a study of available information. After June, 1948, the work will assume a fundamental character and information such as will be forthcoming from the solar heat transmission room, the ventilation test room and the natural lighting test room, will find direct application in the work of this committee. It is anticipated that work on the problem will last for at least five years.

C. THE NATIONAL PHYSICAL LABORATORY.

(1) *General.*

The staff of the laboratory have devoted much of their time to fitting and equipping it for its specialised functions. The principal research officer in charge of general physics visited Great Britain, the United States and Canada to visit various laboratories and to study, in particular, questions of scientific standards of length and mass and the use of radio-isotopes for the new "tracer" techniques in chemistry, biology and medicine. Three research officers have spent part of the year overseas studying the needs of sections to deal with heat (at the N.P.L., Teddington and at the University of Oxford); light (at the N.P.L., Teddington and the Bureau of Standards, Washington), and X-ray diffraction, electron microscopy and mass spectrography (at various institutions in Britain and the United States). The results of this training should be visible in the development of the laboratory during the coming year.

In spite of continuing difficulty in obtaining apparatus and equipment, the laboratory has made considerable progress. The sub-section for electrical standardisation has been able to carry out a number of scientific standardisations for laboratories in the Union which carry sub-standard equipment.

The Spectrographic Section has made a satisfactory start, though not yet fully equipped, and has been able to give training to an officer of the Geological Survey of Southern Rhodesia.

The Acoustic and Electronics Sections have made considerable progress, while the General Physics Section's nuclear physics group has been actively engaged on special problems, including the local production of Geiger-Müller counters. It is also co-operating with the South African Bureau of Standards in the measurement of stray radiation from X-ray equipment in medical and industrial establishments.

(2) *Programme of Work.*

The activities of the Laboratory have not yet crystallised into a formal programme, but the following items can be reported upon:—

(a) *The design and construction of instruments for aptitude testing.*

Of two novel instruments designed at the request of the National Bureau for Personnel Research for the aptitude testing of cutters in the garment industry, one has proved very successful in practice. This is an electronic device to test the ability of a subject (garment cutter) to keep a pointer on a moving wavy line. An account of it has been published by E. C. Halliday, F. Anderson and E. O. Garnett in the journal "Electronics" for September, 1947.

(b) *A new method of measuring temperatures at a distance.*

A requirement from the Geological Survey and other sources for an instrument to indicate by remote signal the temperatures at various depths in a borehole is being worked on.

(c) *The measurements of soil pressures.*

As mentioned in the report of the National Building Research Institute an instrument has been designed and made for this purpose. Because of the ease with which soil will "pack" it was necessary that the movement of the diaphragm of the instrument should not be more than one ten-thousandth of its diameter. An apparatus has been designed in which the movement of the diaphragm changes the frequency of a stretched wire. This is "plucked" by an electrical circuit and its vibrations are transmitted electrically to the measuring equipment, in which the frequency change can be interpreted as a pressure change.

(d) *The use of supersonic waves as a bactericide.*

Equipment has been made and tested for use by the Onderstepoort Veterinary Research Laboratory in which the production of anti-toxin is improved by a method in which the bacteria, from which the anti-toxin is to be made, are torn asunder by supersonic waves from a magnetostriction oscillator.

(e) *General acoustics.*

The Acoustics section has undertaken a number of problems involving the use of sound waves, including the measurement of the elastic properties of wool fibres, the concentration of ores in the flotation process and the acoustic properties of materials for building and other purposes.

(f) *Measurement of Moisture Content.*

With a view to the measurement of moisture content in substances like grain, tobacco leaves and textiles, studies have been undertaken of the specific inductive capacity of such materials.

(g) *Spectrochemistry.*

The Spectrochemical section is working on the analysis of aluminium alloys for specifications to be drawn up by the Bureau of Standards. It is also making analyses of bonemeal samples to establish their flourine content. A search has also been made for "trace elements" in a town water-supply for medical research purposes.

(h) *Heat.*

The Heat section has been occupied with the setting up of standard temperature baths for thermometer calibration and is also concerned with the construction of a specific heat apparatus and a thermal conductivity apparatus suitable for measuring thermal conductivities in one foot square slabs. The work is being done in conjunction with the Building Research Institute.

(i) *Applied Geophysics Unit* (located at the Bernard Price Institute, University of the Witwatersrand).

This unit was established in June, 1947, by placing a research officer at the Bernard Price Institute to carry out applied geophysical research. Work is being done on the calibrating and adaptation of various geophysical instruments for the Geological Survey and for a firm under contract. The research officer has also taken part in a short investigation of the change of the earth's horizontal magnetic intensity with depth below the surface in the Blyvooruitzicht Mine. The investigation has yielded results of great theoretical importance.

The officer is preparing to carry out, under the direction of the Bernard Price Institute, a gravimetric survey of the Union, South-West Africa and adjacent territories, which is required by the Trigonometrical Survey. The pendulums and other equipment will be loaned by the Department of Geodesy and Geophysics of the University of Cambridge.

(3) *Other Activities.*

In addition to projects where actual experimental work is going on, the National Physical Laboratory has taken part in a consultative capacity on a number of committees on industrial and technical subjects.

The National Physical Laboratory is represented on the Electrolysis Committee of the Witwatersrand, which is studying the problems of electrolysis caused by the return currents of the electrification system of the Witwatersrand railway system. In this connection some measurements have been undertaken on asbestos cement pipes. It is also represented on the committees of the Bureau of Standards, which are

drawing up a code of practice for the medical and industrial use of X-rays, the standardisation of welders' goggles and the calibration of electricity meters. It was called in for consultation over a case of damage to a concrete water pipe-line which was damaged by lightning, although it was buried underground. The advice given has prevented the recurrence of similar damage.

In these and other ways the facilities of the South African National Physical Laboratory are being placed at the service of the public and the only limit at present to this work is the limited amount of apparatus which has so far been delivered.

#### D. TELECOMMUNICATIONS RESEARCH LABORATORY.

##### (1) *General.*

Work has been in progress in this laboratory in the following fields:—

- (a) Radio Communication and Navigational Aids.
- (b) Radio Aids to Meteorology.
- (c) Radio Aids to Aerial Survey.
- (d) Radio Aids to Geophysical Prospecting.
- (e) General Radio Research and Development.
- (f) Library and Information Service.

##### (2) *Radio Communication and Navigational Aids.*

###### (a) *The Ionosphere.*

The first project of the Laboratory was to measure and study the characteristics of the ionosphere and to provide predictions of future conditions.

Regular measurements of critical frequency, height of the various layers, etc., have been made in Johannesburg over the year, using the first recorder built in the Laboratory. The data from this recorder are published monthly in the C.S.I.R. Report Series ETJ and are sent overseas to interested organisations.

Since June, 1947, regular records have been received from the ex-Royal Navy recorder installed at Slangkop in the Cape Peninsula, and operated by the Post Office. Results from this recorder have not been altogether satisfactory and it is the intention to replace it as soon as possible with the latest T.R.L. designed equipment.

A single-band ionosphere recorder of new design has been completed and is now in operation in the Laboratory for the purpose of test under normal operating conditions. Results have indicated that this recorder represents a considerable improvement in technique.

Predictions of high frequency radio propagation conditions for Southern Africa are prepared monthly, based mainly on the ionospheric data obtained from the Johannesburg recorder. These predictions are published monthly for the month ahead, in the C.S.I.R. Report Series ETP. The predictions are given in the form of curves of optimum frequency against time of day for various transmission distances and for various latitudes. These predictions are distributed to interested organisations in South Africa, including the Civil Aviation Council, the South African Broadcasting Corporation, the South African Air Force, the South African Naval Forces, the South African Railways and Harbours and the Post Office.

Advice on particular problems is given on request; for instance, assistance was given to the South African Broadcasting Commission of Enquiry, in the calculation of the coverage to be expected from certain proposed new broadcasting stations.

The predictions prepared in the laboratory are predictions of normal conditions. As yet, no predictions of the occurrence of abnormal conditions are made but the subject is being studied and, on the occasion of the Royal Tour of South Africa, daily information was given to the South African Railways to ensure that communications were at the optimum. Solar and geomagnetic data are being accumulated by the laboratory with a view to the inauguration as soon as possible of a short-term prediction service.

The absorption of radio waves in the ionosphere is of importance in the calculation of the "Lowest Useful High Frequency" (L.U.H.F.). This, and the optimum frequency mentioned previously, define the frequency band in which communication over any particular link should be possible. No absorption measurements have yet been made by the laboratory and the information used for L.U.H.F. calculations in the past was based on figures produced by overseas organisations for which, in the absence of local measurements, no high degree of accuracy can be claimed.

###### (b) *Radio Noise Levels.*

Work on the measurement of radio noise levels will start in the near future. The information is of importance in the calculations of L.U.H.F.s, and similar remarks to those made under ionospheric absorption apply. A particular application of more immediate importance is the measurement of radio noise levels in the low frequency bands in the area between Johannesburg and Cairo. Any long-range radio navigational aid for Civil Aviation must operate in this frequency band if ionospheric effects are to be reduced to a minimum and the spacing of low frequency stations will depend on the coverage area and hence on the prevailing noise level. Work is due to start on this subject.

(c) *Underground Communications.*

A series of measurements was made during 1946 on the propagation of radio waves in the Witwatersrand gold mines on a contract with the Chamber of Mines. As the object of these measurements was the design of a light-weight radio set suitable for use by members of an underground rescue-team, two experimental sets using small frame aerials have been constructed for demonstration purposes. The frequency used must be the best compromise between the conflicting requirements of propagation through rock and the radiation efficiency of an aerial of limited size. Each set weighs about 10 lbs. and the frame aerial fits round the operator's body. The adoption is still under consideration by the Chamber of Mines.

(3) *Radio Aids to Meteorology.*

Microwave radar provides a means of tracking thunderstorms over considerable areas of territory with high accuracy. In areas where thunderstorms are frequent, it has, therefore, applications to practical forecasting, such as the measurement of upper winds by plotting the movement of storm centres and the provision of warning of dangerous cloud formations. Such a radar set was developed in the laboratory during 1946, and was installed at the Bernard Price Institute. Considerable interest has been shown in this set by the South African Meteorological Services and by the Meteorological Office of Southern Rhodesia. The design of a suitable set for use by the Meteorological Services for obtaining regular information is being undertaken on experience gained during the past year. The correlation between radar echoes and the actual meteorological conditions has not, however, as yet been fully investigated. The equipment is now fully automatic in so far as taking photographic records is concerned and gives information on thunderstorms at distances often exceeding 100 miles.

(4) *Radio Aids to Aerial Survey.*

The laboratory has engaged in certain preliminary work in this field.

(5) *Applications to Geophysical Prospecting.*

Consideration has been given to the possibility of detecting, by pulsed radio waves, discontinuities such as those produced from underground water. As in the case of underground communications, conflicting requirements are encountered. From an attenuation point of view, the frequency must be as low as possible while, on the other hand, the minimum range depends on the length of the transmitter pulse. Very careful receiver design is also necessary to reduce the minimum range and the project has led to the development of a very interesting type of receiver on a novel principle.

(6) *General Radio Research and Development.*

A Radio Frequency Standard and precision frequency measuring equipment are being set up in the laboratory. British Post Office crystals will be used as the fundamental oscillators.

(7) *Library and Information.*

The Library of the Telecommunications Research Laboratory receives up-to-date information on radio developments overseas. It is used chiefly by the laboratory staff, although its services are available to other organisations, through the medium of the main C.S.I.R. Library.

(8) *Publications.*

In addition to the ETJ and ETP series of ionosphere reports and predictions, the following publications have been made during the year:—

“Ionospheric studies in S.A.: T. R. L. Ionospheric Sounder” by T. L. Wadley; *Terrestrial Magnetism and Atmospheric Electricity*, March, 1947.

“A frequency prediction service for Southern Africa” by F. Hewitt, T. L. Wadley and (Miss) J. Hewitt; *Journal of the S.A. Institution of Electrical Engineers*, July, 1947, and the following stencilled reports have been issued:—“Automatic Ionosphere Sounding Equipment” by T. L. Wadley and J. A. Fejer (T.R.L. No. 2). “Underground communication by radio in gold mines on the Witwatersrand” by T. L. Wadley (T.R.L. No. 3). “Storm detection by radar” by P. Meerholz (ETI—1).

E. NATIONAL CHEMICAL RESEARCH LABORATORY.

(1) *General.*

The director of the National Chemical Research Laboratory, with the principal research officer in charge of Physical Chemistry, visited Great Britain and the United States during the greater part of the year. Other members of the staff have been sent overseas for the study of corrosion chemistry (University of Cambridge), acetylene chemistry (Imperial College of Science), micro-analysis (Universities of Belfast and Aberdeen) and modern analytical techniques.

In the meantime fittings and accommodation for the first stage of this laboratory have been completed in the headquarters buildings of the Council in Pretoria, and it is expected that it will begin work there early in 1948. This laboratory is still in its formation stage and lacks certain essential equipment. For this reason the Council has not hastened the provision of the necessary staff but has concentrated upon specialist training and certain special sections.

The decentralised units on nutritional chemistry and oils, fats and waxes mentioned in the last annual report have continued to do good work. The Council has arranged for the establishment of a third such unit to deal with problems of water pollution. It has appointed Mr. H. Wilson, who was until recently Chief Biochemist to the City of Johannesburg, to head this unit which will, for the time being, be housed in the Klipspruit Laboratories of the Johannesburg City Council and in accommodation kindly placed at its disposal by the University of the Witwatersrand. The water pollution research section will begin operations early in 1948.

(2) *Programme of Work.*

(a) *Microbiological Section.*

This section, through the kindness of the Director of the Onderstepoort Veterinary Research Laboratory, has been able to carry out work during the year at the Onderstepoort laboratories.

It has begun the establishment of a representative national culture collection of bacteria, yeasts and microfungi which must form the basis of the section's activities. Some 300 strains have already been obtained for this collection.

An investigation of new yeast-like organisms from the rumen ingesta of sheep is being undertaken at the suggestion of the officer-in-charge of the physiological section at Onderstepoort with a view to determining what role these organisms play in the digestion of lucerne by the sheep.

Arising out of discussions with the Leather Research Institute, Grahamstown, work is proceeding on a comparative investigation to determine the degradation products arising from the action of microfungi (moulds) on wattle tannin extract. These products may be of interest in relation to the composition of wattle tannin.

Arrangements have been made with the Leather Research Institute for similar co-operation in the testing of proofed grain bags for resistance to rotting by microbiological attack.

Amongst lines of investigation shortly to be started are those concerned with citric acid production by mould fermentation, the microbiological breakdown of pectin as a by-product of the citrus industry and a number of general investigations of possible economic importance.

(b) *Fats, waxes and proteins unit (University of Cape Town).*

This section has been concerned with the investigation of a variety of marine products: (i) *Pilchards*: Variations in the yields and the compositions of oil from South African pilchards have been studied, with a view to aiding their successful exploitation. In addition, bodying and other experiments on these oils are planned in order to promote

their use in the paint industry. (ii) *Soupsin Sharks*: A study of the various factors influencing the yield of vitamin A in the liver oil of the Soupsin Shark is being combined with a study of the general biology of this species, whose numbers are in danger of serious depletion as a result of present fishing operations. (iii) *Marine Fats*: A number of studies of the unsaponifiable and saponifiable fractions of marine fats have been in progress. It is hoped to extend these studies in the immediate future to include the fat-protein complexes of fish tissues. Such studies may be significant for an understanding of the processes involved in the storage of fish. (iv) *Whales*: A study of the occurrence and estimation of vitamin A and of kitol in whale livers is in progress.

(c) *Nutrition unit* (located at the S.A. Institute for Medical Research, Johannesburg).

The nutrition unit operates in close liaison with the Nutrition Council and has been concerned with metabolic studies of nutritional interest. Interest has been focussed primarily on studies of calcium, phosphorus and phytic acid metabolism of the Bantu in relation to European subjects. These primary investigations are giving rise to a number of others of comparable interest and importance, and are widening in scope.

(3) *Publications.*

The following reports have been published during the year:—

- (a) "The effect of recent changes of food habits on bowel motility" by A. R. P. Walker, S.A. Med. J., 1947, 21, 590.
- (b) "Drinking water as a source of calcium and phosphorus" by A. R. P. Walker, J.S.A. Chem. Inst., 1947, 24, 20.
- (c) "The effect of different methods of baking on the phytate phosphorus content of South African Standard war bread and sifted meal bread" by A. R. P. Walker, J.S.A. Chem. Inst., 1947, 24, 9.
- (d) "Slip Flow in Granular Beds" by P. C. Carman, Nature, 1947, 160, 301.

#### F. THE NATIONAL BUREAU FOR PERSONNEL RESEARCH.

(1) *General.*

This bureau exists to provide a national centre for research in the fields of aptitude testing and applied and industrial psychology. It carries out fundamental research in these fields, undertakes sponsored research under contract, and gives help and advice to other organisations doing research or routine work in personnel matters.

The sponsored research undertaken under contract by the bureau is restricted to projects of a novel nature, in that the tests and equipment for carrying out aptitude and other studies have not been devised elsewhere or need modification for the purpose in view.

In such cases, for example, in undertaking the aptitude testing of industrial operatives, the bureau proceeds as follows: the nature of the work and the circumstances under which it takes place are carefully analysed (operational and job analysis) and a provisional set of tests is devised and applied to a group of experienced operatives whose performance is already known by the employer. Statistical analysis of the results of this trial enables the bureau to select and to allot suitable weights to the original tests so as to provide a suitable trial "battery" of tests which should be satisfactory. This trial battery is then applied to a group of new entrants to the trade concerned and their subsequent performance is checked against the scores obtained in the tests taken on entry. This provides a final check on the validity of the test battery as a decree for personnel selection classification. After final standardisation, the tests are handed over to the industry concerned for routine application. The bureau itself is not directly concerned in the routine application but can act, if required, as a consultant in the following-up of the application of the tests. Advice will also be given on the general operational conditions required to obtain the greatest benefit from the introduction of a personnel selection and classification procedure.

The experience gained by many members of the staff while serving during the war in the aptitude test section of the South African Air Force has enabled the bureau to proceed rapidly in the peace-time application of techniques which were considerably developed during the war. As a result it has had a very heavy programme of work and has had to postpone a number of contracts proposed by industry until part of its present programme has been completed.

## (2) *Main Programme of Work.*

Three major sponsored projects have been undertaken during the year, on behalf of the Clothing Industry, the Chamber of Mines and the Union Defence Force. Work has also been done for the Post Office and for the Demobilisation Directorate.

### (a) *Selection and classification tests for operatives in the clothing industry.*

This investigation has been undertaken on behalf of the National Co-ordinating Council for the Clothing Industry of South Africa. Progress has been satisfactory and a sufficient number of trained operatives has been tested to make the construction of a final test-battery possible. The application of the test-battery to new entrants is about to take place. Both European and non-European operatives have been included, and a study is also being made of differences in ability between these two groups. A study of the factors determining fatigue and output among operatives in an underwear factory, with special reference to the influence of morale and good industrial relations, is also under way.

### (b) *Classification tests for native miners and boss-boys.*

Operational and job analysis is practically complete. In the meantime the section concerned has pushed ahead with the analysis of the testability of native mine labourers. The problem here is a difficult one, as natives speaking a wide variety of languages and dialects, and, for the most part illiterate, have to be dealt with in large numbers simultaneously. This calls for the development of a new group testing technique, which dispenses with the use of pencil and paper, the devising of test situations not too foreign to the cultural background of tribal natives, and capable of being administered virtually without the use of language instructions. A wide variety of tests has been applied to some hundreds of natives of all tribes, including tropical natives.

From these data it has been possible to select a number of tests which may prove suitable for group administration and this provisional test-battery is being applied, in the first instance to groups of not more than 10 men.

Arrangements have been made with the management of one mine for the follow-up of all those tested, both in the "new boys school" and on the actual job. As soon as evidence is forthcoming that the tests are capable of grading the men according to efficiency, they will be further modified to make them suitable for mass administration in standard form. Included in the battery is a series of physical fitness tests. Different jobs require different degrees of stamina, as well as different requirements in respect of strength of arm, leg or trunk muscles. Aptitude tests which ignored this factor could be only partly effective.

This investigation is proving a major undertaking which is unlikely to be complete until the end of 1948.

### (c) *Personnel Research for the Union Defence Force.*

All prospective candidates for employment in the Permanent Force are given a screening test once a month at the Permanent Force Training Centre. This test has been constructed on the basis of knowledge derived from War Office experience and the selection of other ranks for the S.A.A.F. Sufficient information was available to warrant the immediate elimination of all those who fail to reach a particular standard. This standard will be further verified by follow-up data and the testing of personnel already in Army Units. Thus the entire 11th Armoured Brigade, including officers of the rank of Captain and downwards, was given the test.

A further detailed follow-up study is being made of the artisan selection tests, constructed during the war for the selection of artisans for the S.A.A.F. Re-standardisation is necessary in view of the different population now entering the service. More stable training conditions

will also make it possible to remove imperfections in validation which are inevitable under wartime conditions. The battery is being extended to cover additional Army trades.

Re-standardisation of aircrew selection tests is equally necessary, but too few candidates offered themselves this year to enable more than a beginning to be made.

The selection of officer cadets has also been undertaken, with the adaptation for South African conditions of the War Office Selection Board test techniques.

A steady trickle of soldiers maladjusted to service conditions has been dealt with for diagnosis and reclassification. This material too is very useful for the purpose of validation as it indicates what qualities or test performances are prognostic of failure in a variety of military situations. The Defence research project is a long-term one, most useful in that it provides a steady flow of material for experimental purposes.

(d) *The development of screening and aptitude tests for the engineering branch of the G.P.O.* continued during this year, but shortage of staff prevented the application of the whole test battery to all recruits in the various training centres in the Union. A screening test, designed to be administered by district engineers, was applied to this year's intake of apprentices. The standardisation of this test will take some years, as it will have to be applied to apprentices at technical colleges as well as to subsequent post office intakes in order to obtain a large enough population and sufficient follow-up data.

(e) *The survey of ex-volunteers in sheltered employment* and the study of the Wechsler-Bellevue test, a new project on which work was started in July, could be maintained as it did not require a large testing team. Chief object of the survey is to measure the intelligence of sheltered employees, to assess their potentialities for work in the open labour market, and to determine what makes for effective work within the sheltered employment situation. The Wechsler-Bellevue test is being studied as it is claimed to be a useful test of adult intelligence, capable of giving a measure of age deterioration. It is also intended to determine to what extent intelligence test performances can be influenced by extraneous factors, such as the temporary or permanent effects of affective disorder, sedation or shock therapy, alcoholism and other personality deviations. Mental test scores have in the past been interpreted as if performance could not be materially affected by such factors, a presumption which is unlikely to be correct, though no one knows the nature and limit of the errors which may be introduced this way, nor how severe any disturbing condition must be, before it can produce measurable effects.

### (3) *Minor Projects.*

(a) Some experimental work has been done on the development of techniques for the selection of higher grade administrative and executive officers and technical personnel. An adaptation of the Civil Service Selection Board and War Office Selection Board techniques is used for this purpose. The procedure has not yet been standardised as a number of different approaches are being tried out whenever a suitable opportunity presents itself. The N.B.P.R. has so far been asked to assist in the selection of an organising secretary, public relations officers, administrative officers, a personnel manager, technical assistants for a personnel department and a manager for a rehabilitation farm for ex-soldiers. The technique holds out much promise for the future and is likely to prove the only one capable of diagnosing the subtler personality qualities which enter into higher level administrative ability.

(b) A series of aptitude tests is being applied to ex-soldier patients from Tara Neuropsychiatric Hospital, in order to advise on occupational readjustment. This can be looked upon as a preliminary exploration for a larger project contemplated for next year. As it stands, the project provides important data on extraneous factors influencing test performance.

(c) The standardisation, apart from that reported upon for the field projects above, of tests in general use requires special attention. Tests of mental alertness, reasoning ability, mechanical comprehension and arithmetic are used in most of the bureau's projects and by many other organisations. It is desirable to establish for each of these tests a wide range of occupational norms. For this purpose tests have been supplied to the Physical Training Corps, the Union Department of Education, the Durban Technical College, the Leather Industries Research Institute, the Mining and Industrial Department of the Transvaal Branch of the S.A. Red Cross, to individual teachers in the Transvaal Education Department, to a research student at the Johannesburg Technical College and to the Vocational Guidance Bureau of the Ort-Oze. Strict conditions for the safeguarding and control of test material have been laid down. Data are beginning to come in, with examination scores for validation purposes.

On one test, the elementary form of the mental alertness test, a start has been made with item analysis and reliability studies.

(e) *Performance tests of the block-type.* A number of tests of this type are in common use, e.g. Ferguson Form Boards, Carl Hollow Square, Wiggly Blocks, Koh's Blocks and Cube Construction Test. These tests either involve fitting blocks of different sizes into a given space, arranging cubes to conform to a pattern, or building them into solids with

given attributes. These tests are being investigated to determine their factor composition, their diagnostic capacity for certain types of trade training, and their suitability for temperament assessment. The battery has been applied so far to two groups of military artisan trainees.

#### (4) *Miscellaneous Activities.*

(a) The director serves on the following bodies to advise on applied psychological matters:—

- (i) Permanent Force Officers Cadet Selection Board.
- (ii) Industrial Hygiene Committee, S.A. Bureau of Standards.
- (iii) Interdepartmental Committee on Vocational Guidance and Placement.
- (iv) Mining and Industrial Committee, S.A. Red Cross.
- (v) Sub-committee of the Faculty of Medicine on Professional Training of Psychologists, University of the Witwatersrand.
- (vi) Decimal Coinage Committee, Anti-Waste Organisation.
- (vii) Air Personnel Research Committee.

(b) Repeated requests are received for vocational guidance of children about to leave school. These requests are refused unless special circumstances obtain. A fee is always charged in such special cases.

(c) Design of apparatus—The N.B.P.R. departmental workshop has designed and made a number of pieces of equipment for use by field research teams (e.g. for Wechsler-Bellevue test, Mines Research team, Clothing Industry team). A set of mechanical models, to be used in an intensive laboratory study of mechanical aptitude, is also being constructed.

(d) Enquiries for technical information—Enquiries are frequently received for information on specific personnel problems. Two abstractors are engaged in building up a reference system relating to all problems in applied psychology, with special reference to industrial and clinical psychology. This is done in two ways: routine perusal of current and past journals; review of all available literature relevant to research projects undertaken by N.B.P.R. If information is wanted on any topic on which the reference data are incomplete, a special study is made of this topic by the abstractors. Up to date, the reference cards number 2,800. On 18 subjects, a complete reference file is available.

A military registry, dealing with personnel research in British and American Armed Services is kept up-to-date. Particularly in respect of aviation medicine in Great Britain, this registry is able to provide a virtually complete series of research reports.

#### G. THE CENTRAL WORKSHOP.

The Council has established a central machine and instrument shop with a staff of skilled artisans and special craftsmen to serve all its laboratories in the most efficient and economical manner. This workshop has been placed under the control of the director of the National Physical Laboratory, who is chairman of a consultative committee including the heads of other laboratories. It has produced a great deal of valuable equipment during the year, most of it of original design and of a nature which could not satisfactorily be made outside.

#### H. LIAISON DIVISION AND OVERSEAS SCIENTIFIC LIAISON OFFICES.

##### (1) *General.*

This division was formed during the year to provide liaison between the Council's laboratories and industry, including in its functions the handling of technical enquiries, visits to industrial firms and the organisation of co-operative research in industry. In addition it has the responsibility for handling contracts for sponsored research and applications for the certification of research expenditure for the remission of income tax. It assists the President and sub-committees of the Council in dealing with research grants and bursaries and in general with the external relations of the Council, including the overseas scientific missions, whose activities are closely linked with it.

##### (2) *Enquiries.*

Fifty-six enquiries have been received by the Headquarters branch division during the year. These have been dealt with by reference to the C.S.I.R. laboratories, Library and Information Division, Overseas Missions, the Department of Commerce and Industries and other Government or outside laboratories. As a matter of special interest it is recorded that an enquiry about bichromate production in Germany was answered by arranging for one of the staff of the enquiring firm to visit German plants under the auspices of the B.I.O.S. organisation. He was accompanied by a member of the staff of the C.S.I.R. in London and a B.I.O.S. report of their investigation is being published.

##### (3) *Liaison Visits.*

The chief objects of visits to industrial firms are to find out what their problems are and to bring to their notice the results of the researches and other work of the C.S.I.R. While some of the C.S.I.R. laboratories are still in the formation stage, the main purpose will be to explore the directions in which their research programmes might be modified, or added to, to meet the requirements of industry. As far as possible, these visits are being organised according to a scientific rather than an industrial grouping, though, in many cases, the grouping will be the same.

The visits concluded so far covered the following fields:—  
 "Cross-section" of industry in the Port Elizabeth area;  
 Sugar and fermentation industries in Natal, (accompanied by  
 the Officer-in-Charge of the microbiological section,  
 N.C.R.L.);  
 Electroplating industry in the Transvaal.

(4) *Research Associations.*

The division has assisted in the administrative work involved in the incorporation of the Leather, Fish and Paint Industries Research Associations and in the organisation of new research associations in the Clay and Ceramic and the Sugar-milling industries.

5. *Other Activities.*

The division has dealt with various matters involving overseas liaison such as the Union's co-operation with the International Scientific Unions and the British Commonwealth Scientific Conference and with the publicity and publications side of the Council's activities.

6. *Overseas Scientific Offices.*

The Scientific Liaison Offices of the Council in London and Washington have continued to prove very valuable. They handle scientific and technical enquiries both from South Africa and from outside countries to South Africa, many of which are matters of interest to Government and university departments and special laboratories which in the Union are not the direct concern of the Council. They have assisted in the procuring of equipment, the provision of large numbers of reports for our own and other libraries and they provide a useful means of securing Union attendance at Commonwealth, international and other conferences at which we would not otherwise be suitably represented, if at all.

#### 4. RESEARCH BURSARIES AND GRANTS.

On the advice of the research committees of the Universities, followed by that of its own screening committees, the Council awards bursaries, skilled and unskilled assistantships and grants to research workers. Its activities in this field are divided into those covering general science and engineering, and those covering medical and dental research.

A. *GENERAL SCIENCE.*

The Council awarded seven senior bursaries or fellowships to enable South Africans of outstanding ability and experience to carry out at least a full year of research without having to perform other duties. The names and fields of work of these senior bursars are given below.

University or College	Name	Subject
Cape Town	Dr. A. Poldevaart	Petrology and petrogenesis of granitisation and metamorphic phenomena in the Orange River Basin below Upington.
	Mrs. M. R. Levyns	Cytotaxonomy of genera of Cyperaceae, Ficinia, Tetrasia and allied genera of Rhyncosporoidea.
Natal	Dr. J. Henkel	Indigenous grasses.
Pretoria	Dr. G. Mes	Influence of climatic conditions on plant growth (working in U.S.A.).
Rhodes	Dr. J. L. B. Smith	The fishes of South Africa.
Stellenbosch	Prof. C. A. du Toit	Skedel morfologie van lewende en uitgestorwe visse en amphibia.
Witwatersrand	Dr. L. H. Ahrens	Geochemical studies of rocks and minerals (working in U.S.A. and Britain).

The Council has awarded, during the year, 12 bursaries of £200 p.a. to post-graduate students training as research workers and 18 of £100 p.a. to students doing research as part of their honours or masters' degree.

It is part of the Council's scheme for assistance in university research to provide assistance to experienced workers in cases where special technical skills are called for or where much routine work is involved. Under this heading support for 1 skilled assistant and 2 general routine assistants has been provided during the year.

The Council does not provide moneys for the purchase of minor equipment, which provision it regards as the responsibility of the university concerned. It has, however, provided £1,696 to five separate applicants for the purchase of major equipment which is not normally part of a university laboratory and which remains the property of the Council. A sum of £2,884 was also granted during the year for general running expenses of university research, including grants towards the publication of the results of research in scientific journals and monographs.

## B. MEDICAL AND DENTAL RESEARCH.

The Council is advised on medical and dental research by a special and representative committee. During the year it has awarded three senior bursaries for research in the medical field. The names of these senior bursars and their fields of work are given below.

<i>University</i>	<i>Name</i>	<i>Subject</i>
Cape Town	Dr. G. M. Bull	Benign proteinureas; renal disturbances accompanying cardiac failure (working in London).
	Dr. O. E. Budtz-Olsen	Blood-clotting (working in Oxford).
Witwatersrand	Dr. J. F. P. Erasmus	Surgery in the treatment of psychic disorders; study of the problem of intractable pain.

From reports on the work of these bursars and of those in the general science field, the Council is satisfied that provision of funds under this head is of great value to the country.

For medical and dental research, the Council has awarded 5 bursaries to post-graduate students training as research workers, 8 skilled assistantships and 6 general routine assistants. It has also provided £3,419 for major equipment and £4,893 for general expenses of research, including the costs of publication.

The bursaries and grants given by the Council for both general science and medical research include provision for research in the field of nutrition. To assist it in this matter, the Council has had before it the recommendations of the research committee of the National Council for Nutrition, which screens all such applications for financial support.

On the advice of its Medical and Dental Research Committee, the Council approached the Minister of Health and the Board of Management of the South African Institute of Medical Research with a view to representation of the Council on the Board of this institute. An agreement has been drawn up between the Government, the Witwatersrand Native Labour Association, the University of the Witwatersrand and the C.S.I.R., which provides for two representatives of the C.S.I.R. on the Board of Management of the S.A.I.M.R.

The Council has been nominated by the Government as the official agency to secure from the Atomic Energy Commission of the United States the various radio isotopes now being made available by that body

for medical treatment and research. The Council has already made provision for the necessary trained staff and equipment to ensure that these valuable new agents are properly used.

## 5. INDUSTRIAL RESEARCH ASSOCIATIONS.

### A. THE LEATHER INDUSTRIES RESEARCH INSTITUTE, RHODES UNIVERSITY COLLEGE, GRAHAMSTOWN.

The Council, as the body which grants a state subsidy for this and other research associations, has to report that the institute has had a very successful year and that its researches and other services to the leather industries have been of a high order.

### B. THE FISHING INDUSTRIES RESEARCH INSTITUTE, CAPE TOWN.

This research association began work during May of this year in temporary accommodation in Cape Town. The Board of Control has appointed Dr. G. M. Dreosti as director. A small staff has already been engaged and is at work on the preliminary programme of research. The Department of Agriculture has rendered great assistance to the institute in its early stages.

### C. THE PAINT INDUSTRIES RESEARCH INSTITUTE, NATAL UNIVERSITY COLLEGE, DURBAN.

An action committee of the paint industries decided during the year to form a research association and the Council has assisted in various ways, including the selection of the director, Dr. J. O. Cutter, who has had considerable experience in this field in Great Britain. It is expected that this institute will begin work early in 1948 in accommodation provided by Natal University College.

The Council's staff, in consultation with the Boards of Control, has drawn up memoranda and articles of association for the incorporation of these Institutes as non-profit organisations under the Companies Act.

### D. SUGAR MILLING RESEARCH INSTITUTE.

As a result of discussions between the Council and the Natal Sugar-Millers Association, this Association has decided to set up a research institute to handle problems of the industry other than those involved in the growing and productivity of cane. These will include technical problems of milling and sugar extraction, utilisation of waste materials and labour-saving methods.

### E. SILICATE INDUSTRIES RESEARCH BUREAU.

Discussions are in hand with industries concerned with clay, ceramics and refractories, for the formation of a small research institute with the above title.

## 6. GENERAL.

At the request of the Fuel Research Board, who shared in the cost, the Council arranged, during the year, for an eminent coal petrographer, Dr. J. M. Schopf of the United States Bureau of Mines, to spend six months examining the possibility of applying special petrographic techniques, which have proved of economic use in the United States, to the assessment of South African coals. Dr. Schopf's report and recommendations will be published in 1948.

## 7. ACKNOWLEDGEMENTS.

A number of committees have advised the Council during the year on present and future policy. The Council wishes to thank the members of these committees, in particular the Medical and Dental Research Advisory Committee, the Building Research Advisory Committee and the Telecommunications Advisory Committee for their valuable assistance.

The Council acknowledges a continuation of the grant of £1,000 p.a. from the South African Broadcasting Corporation for applied research in the wireless field, a grant of £1,000 from the Administration of South-West Africa and a grant of £750 per annum for two years from Messrs. African Explosives and Industries towards research in the field of lightning protection and warning.

Donations to the library have been received from the American Library Association, Dr. Cole-Rous, Danmarks Institut for International Udveksling af Videnskabelige Publikationer, Enamelist Publishing Company, Dr. A. J. Hesse, Mr. W. F. Higgins of the N.P.L. in England, Industriens Utredningsinstitut, Stockholm, the Italian Representative in the Union, Schweizerische Landesbibliothek, Transvaal Museum, United Kingdom Information Office, United States Information Library, Dr. M. Wilman, Dr. B. F. J. Schonland, Mr. J. E. Jennings, Dr. W. S. Rapson and Dr. S. M. Naudé.

The Council wishes to express its gratitude for these donations and grants.

## LIABILITIES.

	£	s.	d.	£	s.	d.
Capital Account—Building and Reserve Fund .....	225,600	0	0			
Appropriated during 1946/47 .....						
Capital Account—Current Capital Expenditure .....	85,705	5	0			
Appropriated to 31/3/46 .....	10,605	5	0			
Appropriated during 1946/47 .....	75,100	0	0			
Sundry Creditors .....	1,262	10	1			
Provision for Outstanding Liabilities P.W.D. for rent of buildings .....	13,042	0	0			
Fishing Industry Research Institute .....	10,130	0	0			
	2,912	0	0			
	<u>£325,609 15 1</u>					

Audited under my directions and, subject to the remarks contained in the report, certified correct.

C. J. K. LOVEDAY,  
Acting Controller and Auditor-General.

PRETORIA, 16th July, 1947.

## ASSETS.

	£	s.	d.	£	s.	d.
Cash						
1. S.A. Reserve Bank .....				62,115	6	8
For Running Expenditure .....				603	3	8
For Capital Expenditure .....				61,512	3	0
2. Held by Universities for purchase of major equipment .....				4,146	18	6
3. On Imprest Accounts .....				296	17	0
(a) Pretoria for petty expenses .....				46	0	0
(b) Washington for petty expenses .....				2	8	1
(c) Washington for office rent and maintenance .....				248	8	11
Cash Invested .....	228,125	0	10			
Public Debt Commission Deposit .....				225,600	0	0
Interest accrued to 31/3/47 .....				2,525	0	10
Sundry Debtors .....	3,001	11	11			
Payments in Advance .....	7,079	7	8			
Research Awards for 1947 .....				7,020	18	0
Telephone rentals .....				58	9	8
Furniture and Fittings .....	3,181	17	3			
Office Equipment .....	1,704	2	6			
Laboratory and Workshop Equipment .....	13,130	10	4			
Vehicles and Cycles .....	631	1	9			
Books and Journals .....	1,398	11	8			
Excess of expenditure over revenue .....	798	9	0			
	<u>£325,609 15 1</u>					

(Sgd.) B. J. SCHONLAND, *President.*

(Sgd.) J. R. SORRIE, *Secretary/Treasurer.*

PRETORIA, 29th May, 1947.

### SOUTH AFRICAN COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH. REVENUE AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31ST MARCH, 1947.

## EXPENDITURE.

	£	s.	d.	£	s.	d.
To Transfer to Capital Account—Building and Reserve Fund .....	225,600	0	0			
” Transfer to Capital Account—Current Capital Expenditure .....	75,100	0	0			
” Running Expenses .....	100,688	17	8			
H.Q. and Administration .....	12,483	4	0			
Library and Information Division .....	2,410	17	0			
Overseas Missions (London) .....	3,884	18	3			
Overseas Missions (Washington) .....	2,391	19	1			
Research Awards .....	8,263	0	0			
National Building Research Institute .....	13,425	2	5			
National Physical Laboratory .....	16,327	4	6			
Telecommunications Research Laboratory .....	6,042	9	10			
National Chemical Research Laboratory .....	3,744	16	10			
National Bureau for Personnel Research .....	8,308	12	5			
Industrial Research Associations .....	10,115	18	1			
Rent and Cleaning .....	8,081	17	0			
Alterations to Buildings .....	5,208	18	3			
H.Q. and Administration .....	15	10	4			
N.B.R.I. .....	2,030	2	3			
N.P.L. .....	902	4	1			
N.C.R.L. .....	2,261	1	7			
	<u>£401,388 17 8</u>					

Audited under my directions and, subject to the remarks contained in the report, certified correct.

C. J. K. LOVEDAY,  
Acting Controller and Auditor-General.

PRETORIA, 16th July, 1947.

## REVENUE.

	£	s.	d.	£	s.	d.
By Balance brought forward from 1945/46 .....	17,516	2	8			
” Parliamentary Grant .....	375,600	0	0			
For Building and Reserve Fund .....	225,600	0	0			
For Current Capital Expenditure .....	24,400	0	0			
For Current Running Expenditure .....	125,600	0	0			
Donations .....	1,000	0	0			
” Fees earned for investigations and tests .....	3,880	18	6			
” Interest on investment .....	2,525	0	10			
” Sundry Revenue .....	68	6	8			
” Balance, being excess of expenditure over revenue .....	798	9	0			
	<u>£401,388 17 8</u>					

(Sgd.) B. J. SCHONLAND, *President.*

(Sgd.) J. R. SORRIE, *Secretary/Treasurer.*

PRETORIA, 29th May, 1947.

SUID-AFRIKAANSE WETENSKAPLIKE EN NIWERHEIDNAVORSINGSRAAD.  
BALANSTAAT PER 31 MAART 1947.

LASTE.

	£	s. d.	£	s. d.	£	s. d.
Kapitaalrekening — Bou- en Reservefonds ..	225,600	0 0			62,115	6 8
Toegedeel gedurende 1946/47 ..						
Kapitaalrekening — Lopende en Kapitaaluitgawe ..	85,705	5 0			603	3 8
Toegedeel tot 31/3/46 ..	10,605	5 0			61,512	3 0
Toegedeel gedurende 1946/47 ..	75,100	0 0				
Diverse Krediteure ..	1,262	10 1				
Voorstiening vir Uitstaande Verpligtinge ..	13,042	0 0			46	0 0
Dept. van Publieke Werke vir huur van geboue ..	10,130	0 0			2	8 1
Navorsingsinstituut vir die Visnywerheid ..	2,912	0 0			248	8 11

Kontant Belê .. 228,125 0 10  
 Deposito by Staatskuld-kommissie .. 225,600 0 0  
 Rente opgehoop tot 31/3/47 .. 2,525 0 10

Diverse Debiteure .. 3,001 11 11  
 Vooruitbetalings .. 7,079 7 8  
 Navorsingstoekennings vir 1947 .. 7,020 18 0  
 Telefoonhuur .. 58 9 8  
 Meubels en Toebehore .. 3,181 17 3  
 Kantoortoerusting .. 1,704 2 6  
 Laboratorium en Werkwinkeltoerusting .. 13,130 10 4  
 Rytuie en Fietse .. 631 1 9  
 Boeke en Tydskrifte .. 1,398 11 8  
 Bedrag waarmee Uitgawe Inkomste te bowe gaan .. 798 9 0

£325,609 15 1

£325,609 15 1

Ooreenkomstig my opdragte geouditeer en onderhewig aan die opmerkings in die verslag vervat as korrek gesertifiseer.

C. J. K. LOVEDAY,  
 Waarnemende Kontrolleur en Ouditur-Generaal.

PRETORIA, 16 Julie 1947.

(Get.) B. J. SCHONLAND, President.  
 (Get.) J. R. SORRIE, Sekretaris/Tesourier.

PRETORIA, 29 MEI 1947.

SUID-AFRIKAANSE WETENSKAPLIKE EN NIWERHEIDNAVORSINGSRAAD.  
 INKOMSTE- EN UITGAWEREKENING VIR JAAR GEËINDIG 31 MAART 1947.

UITGAWE.

	£	s. d.	£	s. d.
Aan Oordrag na Kapitaalrekening — Bou- en Reservefonds ..	2,410	17 0	225,600	0 0
Oordrag na Kapitaalrekening — Lopende Kapitaaluitgawe ..	3,884	18 3	75,100	0 0
Bedryfskoste ..	2,391	19 1	100,688	17 8
Hoofkwartier en Administrasie ..	12,483	4 0		
Biblioteek en Inligtingsafdeling ..	2,410	17 0		
Oorsese sendings (Londen) ..	3,884	18 3		
Oorsese sendings (Washington) ..	2,391	19 1		
Navorsingstoekennings ..	8,263	0 0		
Nasionale Bounavorsingsinstituut ..	13,425	2 5		
Nasionale Fisiese Laboratorium ..	16,327	4 6		
Telekommunikasienavorsingslaboratorium ..	6,042	9 10		
Nasionale Chemiese Navorsingslaboratorium ..	3,774	16 10		
Nasionale Buro vir Personeelnavorsing ..	8,308	12 5		
Nywerheidsnavorsingsverenigings ..	10,115	18 1		
Huur en Skoonmaak ..	8,081	17 0		
Veranderinge aan Geboue ..	5,208	18 3		

Hoofkwartier en Administrasie .. 15 10 4  
 N.B.N.I. .. 2,030 2 3  
 N.F.L. .. 902 4 1  
 N.C.N.L. .. 2,261 1 7

£401,388 17 8

Ooreenkomstig my opdragte geouditeer en onderhewig aan die opmerkings in die verslag vervat, as korrek gesertifiseer.

C. J. K. LOVEDAY,  
 Waarnemende Kontrolleur en Ouditur-Generaal.

PRETORIA, 16 Julie 1947.

INKOMSTE.

	£	s. d.	£	s. d.
Per Saldo oorgebring van 1945/46 ..	17,516	2 8		
Parlementêre Toekenning ..	375,600	0 0		
Vir Bou- en Reservefonds ..	225,600	0 0		
Vir Lopende Kapitaaluitgawe ..	24,400	0 0		
Vir Lopende Bedryfskoste ..	125,600	0 0		
Bydraes (Donasies) ..	1,000	0 0		
Gelde vir ondersoek en toetse verdien ..	3,880	18 6		
Rente op Belegging ..	2,525	0 10		
Diverse Inkomste ..	68	6 8		
Saldo synde bedrag waarmee Uitgawe Inkomste te bowe gaan ..	798	9 0		

£401,388 17 8

(Get.) B. J. SCHONLAND, President.

(Get.) J. R. SORRIE, Sekretaris/Tesourier.

PRETORIA, 29 MEI 1947.