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PROGRESS REPORTS TO

SASCAR

1981

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PREFACE

This volume contains the annual progress reports on research projects supported by the South African Scientific Committee for Antarctic Research (SASCAR). The reports cover the period July 1980 to June 1981. This volume has been distributed free to members of SASCAR and its sub-Committees and to participants in the South African Antarctic Research Programme for their information. The contents are not for publication or citing. The Programme is supported financially and logistically by the Department of Transport on the advice of SASCAR.

VOORWOORD

Hierdie publikasie bevat die jaarlikse vorderingsverslae wat handel oor navorsingsprojekte wat ondersteun word deur die Suid-Afrikaanse Wetenskaplike Komitee vir Antarktiese Navorsing (WKAN). Die verslae dek die periode vanaf Julie 1980 tot Junie 1981. Hierdie publikasie word gratis en slegs ter inligting aan die lede van WKAN en sy subkomitee, en aan deelnemers aan die Suid-Afrikaanse Nasionale Antarktiese Navorsingsprogram versprei. Die inligting hierin is nie vir publikasie of verwysing nie. Op aanbeveling van WKAN word hierdie program finansieel en logisties deur die Departement van Vervoer ondersteun.

1. SOUTH AFRICAN ANTARCTIC RESEARCH PROGRAMME 1980/81

1. SUID-AFRIKAANSE ANTARKTIESE NAVORSINGSPROGRAM 1980/81

SOUTH AFRICAN SCIENTIFIC COMMITTEE FOR ANTARCTIC RESEARCH (SASCAR), 1980-1981

The year under review saw the retirement of Dr F J Hewitt, Deputy President of the CSIR (1972 to 1980) and Chairman of SASCAR (1970 to 1979). Dr Hewitt contributed significantly in developing, the South African National Antarctic Programme into a scientific effort respected both nationally and internationally. Although his own personal interests had perhaps more in common with the SANCGASS/SASCAR Upper Atmosphere Sciences Programme, Dr Hewitt's term as Chairman of SASCAR saw the growth to maturity of the SASCAR Biological Sciences Programme, the development of the new SASCAR Earth Sciences Programme, the acquisition of the modern research/supply ship MV *SA Agulhas* and the building of the new Sanae base in Antarctica. As South Africa's permanent representative on the Scientific Committee for Antarctic Research (SCAR), from 1970 to 1979, he won many friends, both personally and for the South African Antarctic effort, amongst the international Antarctic community. We wish him well in his retirement.

Mr J P de Wit, a Vice-President of the CSIR, succeeded Dr Hewitt as Chairman of SASCAR and South Africa's permanent representative on SCAR. Prof R N Pienaar, Head of the Department of Botany, University of Natal, Pietermaritzburg, succeeds Mr De Wit as Chairman of the SASCAR sub-Committee for Biological Sciences from 1981. Dr G Heymann, also a Vice-President of the CSIR, succeeded Dr Hewitt as Chairman of SANCGASS (South African National Committee for Geomagnetics, Aeronomy and Space Sciences).

SCAR REPRESENTATIVES

South African representatives on SCAR Working Groups during the year were; Prof W R Siegfried (Biology), Mr E Fitschen (Geodesy and Cartography), Prof D R Hunter (Geology), Mr L G Wolmarans (Glaciology), Mr J G Nel (Logistics), Mr J van Heerden (Meteorology), Mr F P Anderson (Oceanography), Prof L O Nicolaysen (Solid Earth Geophysics) and Mr R W Vice (Upper Atmosphere Physics). No representative is on the SCAR Working Group for Human Biology and Medicine.

MEMBERS OF SASCAR COMMITTEES

Members of SASCAR and its sub-Committees during the year were as follows:

SASCAR - Mr J P de Wit (Chairman), Prof N D Clarence, Dr P R Condy, Mr L N J Engelbrecht, Mr E Fitschen, Dr G Heymann, Prof S P Jackson, Mr A Kriek, Mr B Mills, Dr D C Neethling, Mr G Stander, Dr J J Taljaard, Prof H P van der Schijff, Mr O A van der Westhuysen, Mr J van Heerden, Mr H H van Niekerk and Mr G A Visser.

SASCAR sub-Committee for Biological Sciences - Mr J P de Wit (Chairman), Dr P R Condy, Prof T Erasmus, Prof J R Grindley (project leader for marine biology), Mr B J Huntley, Mr J G Nel, Dr G Newman, Prof R N Pienaar (new Chairman), Prof W R Siegfried (project leader for ornithology), Prof J D Skinner (project leader for mammalogy), Prof D F Toerien (project leader for botany and palynology) and Mr O A van der Westhuysen.

SASCAR sub-Committee for Earth Sciences - Mr L N J Engelbrecht (Chairman), Dr P R Condy, Mr E Fitschen (project leader for geodesy and cartography), Prof D R Hunter (project leader for geology), Dr D C Neethling, Mr G Nel, Prof L O Nicolaysen (project leader for solid earth geophysics), Mr O A van der Westhuysen and Mr L G Wolmarans (project leader for glaciology).

SANCGASS - Dr G Heymann (Chairman), Prof N D Clarence, Mr P S du Toit, Prof J A Gledhill (project leader for airglow and ionospherics), Dr G J Kühn (project leader for geomagnetics and electronics), Prof P H Stoker (project leader for cosmic rays), Mr O A van der Westhuysen, Mr P J van der Westhuizen, Mr R W Vice and Prof A D M Walker (project leader for magnetospherics).

BIOLOGICAL SCIENCES

The Special Evaluating Group on the Cats of Marion Island, established in September 1979 and comprising Dr P R Condy (Convenor), Mr A Berruti, Prof P G Howell, Dr G Robinson, Dr P D Shaughnessy and Mr R J van Aarde, produced its report to SASCAR in August 1980. Most of its recommendations were accepted, and further research on the cats commenced in April 1981, with the object of providing data, on specific aspects, which are needed to improve the validity of the present population model. This model is intended to act as a guide for the management of the cat problem and the control of their numbers.

As in previous seasons, most work was carried out on Marion Island. Biologists also visited Prince Edward (September 1980, May 1981), Gough (October 1980), and Bouvet (January 1981) islands in connection with some of the projects listed below.

The proceedings of the 1978 Symposium on the Biology of Marion Island were published in mid-1981, as Volume 8 (1978) of the South African Journal of Antarctic Research.

In June 1980 participants in the biology programme, along with a number of other invited South African researchers, gathered for a workshop on the future direction of South Africa's biological research in the Antarctic and sub-Antarctic regions. The report from the workshop, entitled "South African Antarctic Biological Research Programme", is to be published in the South African National Scientific Programmes Report series, issued by CSP, CSIR, during 1981.

Projects funded during 1980/1981 financial the year were as follows (name of researchers and year of completion of project in brackets):

(a) Botany and palynology (Project leader - Prof D F Toerien; Home Base - Institute for Environmental Sciences, University of the Orange Free State, Bloemfontein)

- palynology and long distance dispersal at Southern islands (L Scott, 1983).
- Nitrogen cycling on Marion Island (M G Steyn, 1984).
- Plant ecology of Marion Island (V R Smith, 1982).

(b) Mammalogy (Project leader - Prof J D Skinner; Home Base - Mammal Research Institute, University of Pretoria)

- ecology of the house mouse Mus musculus at Marion Island (J A Gleeson, 1981).
- influence of southern elephant seals Mirounga leonina on the coastal ecology of Marion Island (K Panagis, 1983).
- ecological and genetical relationships between two species of fur seals A. tropicalis and A. gazella at Marion Island (G H Kerley, 1983).
- spatial and temporal distribution of pinnipeds in the Southern Ocean (M N Bester, 1983).

(c) Marine Biology (Project leader - Prof J R Grindley; Home Base - School of Environmental Studies, University of Cape Town)

- intertidal community structure of Marion Island (W Blankley, 1983).
- biology of Durvillaea antarctica and other algae at Marion Island (P Haxen, 1983).

(d) Ornithology (Project leader - Prof W R Siegfried; Home Base - Percy FitzPatrick Institute for African Ornithology, University of Cape Town)

- population dynamics and biology of selected species of seabirds on Marion Island, with particular reference to their energy and mineral contributions to the terrestrial ecosystem (A Berruti and M Schramm, 1983).
- relationships between the population dynamics of selected species of seabirds (chiefly penguins) and their prey (chiefly krill) at the Prince Edward and Gough islands (M Lynch, 1984).

EARTH SCIENCES

The first field expedition in the new Earth Sciences Programme took place in January 1981. Four geologists (Prof D R Hunter, Dr J M Barton, Mr J Krynauw and Mr L Wolmarans) visited a number of outcrops in the Ahlmannryggen, with the aid of air support for the first time. They also selected a site at Grunehogna for a new field base for the earth sciences programme, due to be constructed during the 1982/83 field season. Two surveyors (Mr R Wonnacott and Mr G Hudson) also participated in this expedition to initiate the new Geodesy and Cartography project. They established two geodetic stations along the coast near Sanae. Four members of this Earth Sciences expedition also briefly visited Bouvetøya in January 1981, on the return voyage from Sanae.

A geology expedition to Marion Island in April/May 1981 was undertaken to investigate recent volcanic activity there. Members of this expedition were Prof W J Verwoerd (Leader), Dr D H Cornell, Mr J Swart, Mr J A Conradie, Mr W S Seimons and Mr J M Moore. Their report is included elsewhere in this volume.

The report on the first SASCAR Earth Sciences Programme (1960 to 1975), and entitled "Geological Investigations in Western Dronning Maud Land, Antarctica - A Synthesis", by L G Wolmarans and L E Kent was completed in July 1981. Drafting of the three part geological map of the area covered by the report has also been completed. The report and map are to be published as a supplement to the South African Journal of Antarctic Research, in 1982.

The SASCAR sub-Committee for Earth Sciences established a Geology Working Party in April 1981. The object of the WP is to coordinate geological activities, both at the homebases (currently Pietermaritzburg, Johannesburg

and Stellenbosch) and in Antarctica. Members of the WP are Prof D R Hunter (Chairman), Mr J Krynauw (Coordinator), Prof H Allsopp, Dr J M Barton and Mr C Potgieter.

Projects funded during the 1980/81 financial year were as follows:

(a) Geology (Project leaders - Prof D R Hunter and Prof H Allsopp; Home Bases - Department of Geology, University of Natal, Pietermaritzburg and Bernard Price Institute for Geophysical Research, University of the Witwatersrand, Johannesburg, respectively)

- geochemistry and petrology of the Ahlmannryggen (D R Hunter and J Krynauw, 1985).
- geochronology and isotopic investigations on rock samples from the Ahlmannryggen (H Allsopp and J M Barton, 1984).

(b) Geodesy and Cartography (Project leader - Mr E Fitschen; Home Base - Office of the Director General of Surveys, Mowbray, Cape Town)

- Antarctic geodesy and cartography (R Wonnacott and G Hudson, continuing).

No projects in the Glaciology and Solid Earth Geophysics sections were undertaken, as resources are at present being focused on the establishment of activities in the Geology, Geodesy and Cartography sections of the programme.

UPPER ATMOSPHERE SCIENCES

Most work was conducted at Sanae, where the new base has enabled a considerable improvement in scope and facilities. This programme resides under the auspices of SANCGASS, though a re-organization in this regard is anticipated in 1981.

Projects funded by SASCAR during the 1980/81 financial year were as follows:

(a) Airglow and Ionosphere (Project leader - Prof J A Gledhill; Home Base - Department of Physics and Electronics, Rhodes University, Grahamstown)

- observation and understanding of the behaviour of the upper atmosphere at Sanae, over the South Atlantic Ocean and the South Atlantic Anomally (R Haggard and A W V Poole, continuing).

(b) Cosmic Rays (Project leader - Prof P H Stoker; Home Base - Department of Physics, University of Potchefstroom)

- modulation of cosmic rays by the sun, magnetosphere and atmosphere and magnetospheric particle precipitation (H Moraal, continuing).

(c) Geomagnetics (Project leader - Dr P R Sutcliff; Home Base - Magnetic Observatory of the CSIR, Hermanus)

- monitoring and investigation of the geomagnetic field and aurora at Sanae and Marion Island (P R Sutcliffe, continuing).

(d) Magnetospherics (Project leader - Prof A D M Walker; Home Base - Department of Physics, University of Natal, Durban)

- magnetospheric physics (P Wakerley, continuing).

FINANCIAL AND STAFF MATTERS

Project proposals (NP10 forms) submitted in June/July 1979, for the 1980/81 financial year, requested in total an amount 15 per cent more than was in fact available for allocation. After allocation, funds for the 1980/81 financial year were divided as follows: Upper Atmosphere Sciences 50,6 per cent, Biological Sciences 29,7 per cent and Earth Sciences 19,7 per cent. Salaries, bonuses and allowances consumed 69,2 per cent, running expenses 16,3 per cent and capital expenses 14,5 per cent.

In the year under consideration, 18 "projects" were funded by SASCAR - Biological Sciences 10, Upper Atmosphere Sciences 5 and Earth Sciences 3. Many of these were umbrella-type activities, with more than one actual project being described and budgeted for on an NP10 form. This practice is being actively discouraged and the proposals received in 1980, for the current financial year, showed an improvement in this respect.

Research staff drawing salaries from the SASCAR budget in 1980/81 included 14 biologists, 23 physicists and two geologists. Ten expedition and/or home-based technical/field assistants were also employed, in most cases for less than the full 12-month period under consideration.

PUBLICATIONS

A quarterly newsletter, the "SASCAR Newsletter", was introduced in January 1981. It is an informal means to disseminate news about SASCAR and other national and international Antarctic activities, to participants in the South African National Antarctic Programme. It will be published about January, April, July and October each year, is produced by the Marine and Earth Science Programmes section of CSP, CSIR, and distributed to members of SASCAR Committees, research staff associated with SASCAR-funded projects and other interested persons in South Africa.

An attempt is being made to revive the South African Journal of Antarctic Research. Volume 8 (1978), comprising the proceedings of the 1978 Symposium on the Biology of Marion Island, was published in 1981. Volume 9 (1979) is due for publication later in 1981, and it is hoped to publish Volumes 10 (1980) and 11 (1981) in 1982. Contributions, mainly from the Biological Sciences Programme at present, are becoming more numerous and it is hoped that this trend will continue, and be supported by the Earth Sciences and Upper Atmosphere Sciences programmes.

A report on the visit to Bouvetøya in January 1981 is under preparation. It will be published later in 1981, and summarizes the observations made on the Nyrøysa platform (Westwind Beach as it was previously named) by the landing party. This party comprised a team from the Weather Bureau, two geologists, two suveyors, two ornithologists and two mammalogists.

Scientific papers, arising from SASCAR-funded research activities, are being published with increasing frequency in both local and overseas journals. In this volume of Progress Reports to SASCAR, a bibliography on the Biological Sciences Programme is included. The publications listed have in the main part orginated from SASCAR-funded research. In the 1982 and 1983 volumes of Progress Reports to SASCAR, we hope to include similar bibliographies on the Earth Sciences and Upper Atmosphere Sciences programmes respectively.

P R CONDY
Scientific Coordinator: Antarctic Programme
Marine and Earth Science Programmes
CSP, CSIR

2. ATMOSPHERIC SCIENCES

2. ATMOSFERIESE WETENSKAPPE

PROGRESS REPORT 1980/81

(a) Title of Project: SANAE ELECTRONICIST

Name of Project Leader: M B W ARLOW

Address of Project Leader: Magnetic Observatory
P O Box 32
HERMANUS
7200

(b) Objectives:

(i) To provide training for an electronic engineer to enable him to provide support in the maintenance of equipment used by the upper air physics and also the meteorological project at SANAE.

(ii) To establish a limited buffer store of electronic components at SANAE.

(c) Progress:

All objectives set out under (b) have been or are being met. As this project is based on providing technical support, no other provision in the guidelines for progress reports are of relevance.

Progress Report, 1980/81

Project Title: UPPER ATMOSPHERE PHYSICS

Project Leader: Prof J.A. Gledhill, Dept. of Physics and Electronics
Rhodes University, Grahamstown, 6140.

Project Researchers (1980/81)

1. Antarctic Research Officer: A.W.V. Poole, B.Sc. (Hons) (Rhodes)
2. Assistant Antarctic Research Officer : R. Haggard, B.Sc. (Rhodes), B.Sc. (Hons) (U N I S A
3. Assistant Antarctic Research Officer : J.C. Grujon, B.Sc. (U C T), B.Sc. (Hons)(Rhodes) (to 31/1/81)
   : I.S. Dore, B.Sc. (Hons) Rhodes (from 1/4/81)
4. Antarctic Electronics Research Officer : G.P. Evans, B.Sc. (Elec.Eng.) (Natal)
5. Trainee Expedition Ionosphericist : D. Gilson, B.Sc. (Rhodes)
6. S A N A E Ionosphericist : R. Key, B. Sc. (O.F.S.) (to 31/3/81)
   D. Gilson, B.Sc. (Rhodes) (from 14/7/80)
7. Returned Expedition Member: I.S. Dore, B.Sc. (Hons) (Rhodes) (to 31/3/81)
   R. Key, B.Sc. (O.F.S.) (left 31/3/81)
8. Part-time ionogram Scaler : J. Sprong

18th Annual Progress Report

Date

1 July 1980 to 30 June 1981

1. Objectives

The general objective of the project is to learn as much as possible about the physics and chemistry, i.e. the aeronomy, of the upper atmosphere over the Antarctic continent, the Southern Ocean, and the South Atlantic Anomaly. This comprises roughly the region bounded by latitudes 20^{o} S - 75^{o} S; 40^{o}E - 60^{o} W.

In particular, we study the diurnal, seasonal and long-term behaviour of the E and F regions, the movements of irregularities in them, the behaviour of the mid-latitude trough and its relation to the plasmapause, the transmission of auroral energy towards the equator and the effects of particle precipitation from the magnetosphere.

2. History of the Project

The area referred to above is unique, in that the earth's magnetic field strength reaches its minimum value anywhere on the surface of the planet

at about 25° S 45°W. As a result the charged particles in the magnetosphere penetrate lower into the atmosphere there than anywhere else, except in the auroral and polar cap regions where the magnetic field is almost vertical. Since the energy spectrum of these particles is different from that of the polar ones, their effects on the upper atmosphere will presumably be different also.

In 1961 Russian groups published experimental evidence of the presence of high-energy radiation belt particles at altitudes as low as 260 km over the South Atlantic and Southern Oceans, the so-called South Atlantic Anomaly. Since then a number of groups have published observations of the spectra and fluxes of these particles, both electrons and protons, but no measurements below 30 keV have been reported. The reasons for this are the swamping effects of the high-energy particles on the detectors and the variability, in both time and space, of the fluxes. (Gledhill, 1976)

Unfortunately, the effect of the high-energy particles is mainly to produce a small increase in the absorption of radio waves in the 60-90 km altitude range, a region which is difficult to investigate experimentally. The aeronomic effects which are observable with ionosondes, namely increased ionization in the region above 90 km, and with airglow photometers - excitation of atoms and molecules above 90 km, are produced by softer electron spectra with their main energy in the range 5eV-20 keV.

Alouette I

The efforts of our research group, with its expertise in ionospheric research since 1940, were therefore originally directed toward the identification of ionospheric peculiarities at Sanae and their correlation with the sparse satellite observations of particle fluxes at the higher energies. Gledhill and the Torrs (1966, 1967, 1968) showed in the period 1964-1969 that when the Canadian satellite Alouette I observed increased precipitation of electrons with energies above 40 keV (the lowest then available), the ionosphere at Sanae was always disturbed, though the disturbance was sometimes an increase and sometimes a decrease in ionization. They attempted to explain this by heating and consequent expansion of the neutral atmosphere as a result of the electron bombardment, with some success.

A quantitative relationship between the flux observed by Alouette I and the E-layer ionization density at Argentine Is, a British station in the Antarctic Peninsula, was reported by Haschick and Gledhill (1974).

Injun 5

During the period 1970-1976 Gledhill and Dares (1976) tried to estimate more accurately the energy input by electrons with energies below 40 keV, by examining carefully all the available data from the University of Iowa's satellite Injun 5, but they were finally unsuccessful. The high-energy background turned out to be more than 95% of the total particle count and the statistics were too poor to allow even approximate estimates of the low-energy electron fluxes.

Atmosphere Explorer-C

At the suggestion of Dr S.M. Radicella, the Antarctic and Southern Hemisphere Aeronomy Year (ASHAY) was held in 1976/77. Southern hemisphere countries combined with those in the northern hemisphere to make simultaneous aeronomic observations in five two-week periods. The co-chairmen were S.M. Radicella and J.A. Gledhill. By the good offices of Dr D.G. Torr special observations were made during two of these periods by the N A S A satellite Atmosphere Explorer-C (AE-C) when it passed over the South Atlantic Anomaly. During the first part of 1980 J.A. Gledhill was able to work on these data at Goddard Space Flight Center, with the aid of an Associateship from the U.S. National Research Council. He was able to remove the background by careful analysis of the data, not only for the ASHAY but for the whole period 1974-1977, and so to produce the first reasonably reliable estimates of the average electron spectra below 30 keV in the South Atlantic Anomaly.

Fig. 1 shows the minimum in the magnetic field in this region,
Fig 2 shows a typical electron energy spectrum and
Fig 3 gives a map of the rate of energy deposition in the upper atmosphere.
These are from a paper by Gledhill and R.A. Hoffman, in press (J. Geophys Res.

Theory of ionization and excitation

Meanwhile considerable effort has been devoted by the Rhodes group to the development of a method for calculating the effects of these precipitated electrons on the ionosphere and the intensity of the expected airglow emission. Current methods use extensive programs which take several hours to run on some of the world's fastest computers. We have concentrated on the derivation of simpler methods, with considerable success.

Wulff and Gledhill (1974) published a very rapid method of calculating the ionization rate as a function of height and energy, and Gagliardini, Karszenbaum (on an 8-month visit to Rhodes from Argentina) and Gledhill (1976) developed a rapid method for estimating airglow. The latter work is in progress toward publication.

Vertichirp Ionosonde

The normal observation programme during the period 1962 to date has provided ionograms at Sanae at quarter-hourly intervals with very little loss of data over the 19 years of operation. In 1975 the pulse ionosonde was replaced by a Barry Research Vertichirp ionosonde, a much more sophisticated instrument which allows the making of ionograms of much better quality with the very small power output of 3W. There was considerable international interest in the progress of our operation of such equipment, the first to be used in the remote, harsh environment of the Antarctic continent. Our success has influenced other organizations, e.g. the British Antarctic Survey, to instal more sophisticated equipment at their own Antarctic stations.

Routine data circulation

The steady flow of data from the Sanae ionosonde has enabled us to send to the World Data Centres - in the U S A, U S S R, U K and Japan, - monthly Bulletins of Ionospheric Characteristics at Sanae. These are also sent to about 35 interested organizations throughout the world. Analysis of the data has been severely hindered by lack of manpower, but Williams and Gledhill (1971, 1973) have published papers on the harmonic analysis of the data from Sanae and other Antarctic stations. Sanae data have also been used and acknowledged in several papers by other authors.

Oblique ionograms

The chirp-type ionosonde is especially suitable for oblique sounding of the ionosphere between two separated stations. Since 1975 the availability of a Vertichirp ionosonde at both Grahamstown and Sanae has allowed us to make oblique soundings at quarter hourly intervals. Absolute propagation-time measurements are also made weekly. Excellent records are obtained, especially since the installation of a 100 W output amplifier at Sanae, but the interpretation of the oblique ionograms, which are more complex than those taken at vertical incidence, has suffered from lack of manpower and problems of calibration. A paper by J.P.S. Rash and J.A. Gledhill, describing the preliminary analysis of some of these records, is in the press (J. Atmos. Terr.Phys.)

Mid-latitude trough

Vertical incidence ionograms at Sanae often show the extra, diffuse trace known as "polar spur". This has been identified as due to reflections from the edge of the "mid-latitude trough", a relatively narrow region of depleted ionization, the position of which is closely associated with the outer edge of the plasmasphere,(the plasmapause). The current great inter-

national interest in the elucidation of the physics of the magnetosphere has prompted us to look more closely at this phenomenon. The interpretation of the ionograms would be much easier if the angle of arrival and the Doppler shift of the reflected signals could be determined.

Digitization

Since 1975 one of the chief thrusts of our research work has therefore been directed to realizing a suggestion by A.W.V. Poole that it should be possible, with some extensive development of the electronics, to record ionograms, the angles of arrival and the Doppler shifts in digital form, using the Vertichirp ionosonde as a basis. Progress has been good and the project is now nearing completion. A fast Fourier transform box has been built and tested by J.S. Fisher, which will enable the output of the receiver to be digitized in real time. G.P. Evans has developed the microcomputer control hardware and software to enable the ionosonde to be programmed to carry out any desired sequence of measurements, vertical incidence ionograms, oblique soundings, propagation time calibrations, angle of arrival measurements and Doppler measurements. A.W.V. Poole has examined the theoretical aspects of the system and has developed the hardware and software to distinguish the ordinary and extraordinary waves in the returned signal and to process the resulting data to the stage where the desired parameters are readily available in digital form for further processing on the University's main computer. He has published a paper on the use of pseudo-random codes of a special type in radar (Poole, 1979).

Voyages and Flights

On three occasions the S.A. Agulhas has sailed along a large part of the great circle between Sanae and Grahamstown and ionograms have been made with the portable ionosonde, "Minibal", developed and constructed by our group in the late 1960's. This has provided valuable information about conditions in the ionosphere near the reflection points of the 1, 2, 3, 4 and 5 - hop oblique signals observed simultaneously with the Vertichirps. This ionosonde has also been operated on normal relief voyages to Sanae, Gough and Marion Islands and also on a special winter cruise in the South Atlantic during 1979. The results are being evaluated by R. Haggard. Haggard and Gledhill (1976) have discovered that the critical frequency of the F2 layer at Gough Island was higher than would be expected from its geographical position, during October 1975. This may be an effect of the precipitating electrons, but it could be due to the effect of ionospheric winds and merits further study.

Minibal

The "Minibal" ionosonde has also been flown in aircraft of the the S.A. Air Force over otherwise unvisited areas of the oceans round South Africa. These flights have not provided very useful results however, mainly owing to the limited length of the antenna which can be mounted on C 130 aircraft. The minimum usable frequency is 2,9 MHz. The effects of the low-energy electrons would be most observable in the range 0,5 - 2 MHz.

Microbal

In order to meet this difficulty, A.W.V. Poole, B.B. Cretchley and C. Way-Jones designed a new type of pseudo-random code pulsed ionosonde. This "Microbal" will use modern digital correlation techniques to improve the signal/noise ratio and is expected to overcome the above low-frequency problem. Unfortunately, after the project had progressed to an advanced stage, funding for it was cut from the budget and progress has been sporadic since then.

Airglow

Both bombarding electrons, especially those with energies below 100 eV, and normal ionospheric processes raise oxygen atoms to excited states. They then emit radiation on falling back to the lower states, the two most important wavelengths being at 630 nm and 557,7 nm. Precipitated electrons can also excite N_2 molecules to an excited state of the ion N_2^+, which emits radiation at 391,4nm. The intensity of this is fairly simply related to the incoming energy flux. Thus the recording of airglow at these three wavelengths during the night gives valuable information about the total numbers of excited atoms and molecules present.

In 1975 our group took over the Sanae airglow programme and D.K. Taylor was appointed Assistant Research Officer. He constructed three tilting-filter airglow photometers between July and December. These have operated successfully during the dark winter months from then onwards. The records have shown many interesting events, but again owing to shortage of manpower only three have been investigated in any detail. Very good agreement was found between the parameters observed in this way and those from the ionograms, the riometer operated by the Potchefstroom University group, the records made by the University of Natal's image intensifier and the auroral records and magnetograms from the equipment operated by the C S I R's Magnetic Observatory. Only lack of time and manpower shortage prevent publication of these interesting results.

Because of the time-consuming and tedious nature of the scaling procedure for the airglow records, we decided two years ago to convert them to digital

form. Three new digital photometers were built by C. Grujon and these will replace the ones at Sanae, which will be returned to Rhodes for digitization in their turn.

Occasionally, curious nighttime E-layer traces are noticed on the vertical incidence ionograms at Grahamstown, which are almost certainly due to electron precipitation from the magnetosphere. To investigate this theory, a digital airglow photometer has been borrowed from the N I T R and will be operated at Grahamstown shortly.

Publications

Because of the recent heavy emphasis on digitization and the associated electronics and software, the number of publications has been small for the past few years. This is a phase common to most projects during intense development of instrumentation. It is now almost over and we expect to resume a normal publication rate.

The following are mentioned in the foregoing history;

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Wulff, A. and Gledhill, J.A. (1974) J. Atmos. Terr. Phys. 36, 79-91.
Gagliardini, D.A., Karszenbaum, H. and Gledhill, J.A. (1976) Paper read at SCOSTEP Conference, Boulder, Colo., U S A.
Gledhill, J.A. and Dares, G.E. (1976). Paper read at COSPAR Conference, Philadelphia, Pa., U S A.

The following students have obtained M.Sc. degrees under the programme.

1963 G. de Jager
1964 H.O. van Rooyen
1964 D.C. Baker
1966 M.R. Torr
1967 A. Nadasen
1972 J.G. Greener
1972 A.D. Haschick
1972 A. Wulff

1977 C.Y. Huang
1977 S. Lambert
1978 B.B. Cretchley
1979 J.S. Fisher
1979 E.J. de Kock

The following have obtained Ph.D. degrees under the programme:

1966 D.G. Torr
1968 M.R. Torr
1971 M.H. Williams
1978 J.P.S. Rash

Scientific Progress

Four magnetic tapes of observations by D M S P satellites of precipitating electron energy spectra in the range 200 eV to 20 keV have been obtained from the World Data Center in Boulder, Colo., U S A. Mr C. Hannah has been employed as computer assistant and has written programs to extract the data for the South Atlantic Anomaly from the tapes. First impressions are that the spectra are remarkably consistent with those observed by AE-C. A tape of similar observations from the Aerospace satellite S3-2 is also being processed at present. This work is leading towards confirmation and extension of the work done at Goddard Space Flight Center last year.

A remarkable event on 26 March 1976, during the first ASHAY period, has also been studied in great detail. The morphology of the mid-latitude trough is being worked out and observations of many parameters such as concentrations of O^+, NO^+, electron and Fe^+ ion density, ion drift velocities and electron temperatures have been collected from various experimenters on AE-C, together with a conjugate D M S P auroral photograph which fits the satellite observations extremely well.

A computer program is being written to simplify further the theoretical computation of airglow by the method of Gagliardini, Karszenbaum and Gledhill. It will be used to estimate the expected airglow intensities in the South Atlantic Anomaly.

Mr R. Haggard has continued his investigation of the ionosphere over the South Atlantic and Southern Oceans for his Ph.D. degree. He has shown that the critical frequency of the E-layer at Gough Island during a 24 day period in 1975 was very unusual. Normally, the critical frequency is a simple function of the cosine of the solar zenith angle and is symmetrical about noon, but at Gough Island the morning and afternoon behaviour is quite different. This could be due to particle effects or to winds. These possibilities are

being considered and compared with theory. The "Minibal" ionosonde was operated on the Sanae relief voyage, but with limited success owing to a maladjustment.

During the period under review the hardware for the microcomputer control of the chirpsounder has been completed by Mr G.P. Evans and at present the software is being written to give very flexible control over the programming of the operation of the instrument.

Mr A.W.V. Poole has completed a theoretical investigation of the instantaneous phase of a chirp signal returning from the ionosphere. A program for computer simulation was implemented and the effects of noise investigated. The results show that it should be possible to make simultaneous digital recordings of the Doppler velocity, virtual height, amplitude, angle of arrival and ordinary/extraordinary mode of the signal, while in effect recording a normal ionogram. The system should be ready for testing shortly.

The programs for computer archiving of ionospheric data and the automatic production of the monthly bulletins have been completed and shown to work satisfactorily (Mr Haggard). Unfortunately the line printer does not produce a good enough copy for photoreproduction and the production of Bulletins is held up temporarily. 18 Sanae and 15 Grahamstown Bulletins were issued during the year.

An analysis of Grahamstown and Sanae vertical ionograms to give the predicted maximum usable frequencies between the two was undertaken by Mr I.S. Dore. Comparison with the actually observed maximum frequencies on the oblique link showed very little correlation. This casts doubt on the value of the normal procedure for the prediction of communication frequencies from vertical incidence ionograms.

Mr G.E. Oberem has registered as a Ph.D. candidate, to work on the interpretation of oblique ionograms, with special reference to the deduction of the characteristics of the ionosphere at points on the tramsmission path from Sanae to Grahamstown. It is clear that the assumption of two equal "hops" on the path is not of much use and that a more detailed model will be necessary. His work so far has shown that unexpectedly large and erratic drifts occur between the oscillators at the two ends of the oblique path. This is receiving attention at present.

Mr C. Grujon designed and built fast pulse discriminators and amplifiers for the digitized airglow photometers and interfaced a SWT 6809 microcomputer with the photometers to control their filter movements, filter

compartment air temperature and shutter operation, and also to store the output on floppy discs. This will relieve the operator at Sanae from the necessity of changing the amplifier gain manually for up to 16 hours at a stretch, since the computer will now sense the output and adjust the gain automatically. The hardware is now complete and the software is in its last stages. The system will be taken to Sanae for operation in 1982. Mr I.S. Dore has now taken over responsibility for the airglow program after Mr Grujon's departure.

A digital three-filter airglow photometer was taken over from Sutherland, with the permission of the N I T R. Unfortunately there was very little documentation available, and this lack held up the commissioning of the photometer very considerably. This will be operated at Grahamstown in conjunction with the ionosonde during moonless periods to monitor for electron precipitation coincident with the appearance of "particle E" traces on the ionograms. This will be the first demonstration of the reality of the ionospheric effects of such precipitation at our latitude, if successful.

Acknowledgements

Publications

1. Rash, J.P.S. and Gledhill, J.A. (1981)" Electron density profiles from oblique incidence ionograms with applications to the ionosphere over the Southern Ocean", J. Atmos. Terr. Phys. (in press).

2. Gledhill, J.A. and Hoffman, R.A. (1981)" Nighttime observations of 0.2-26 keV electrons in the South Atlantic Anomaly made by Atmosphere Explorer - C" J. Geophys. Res. (in press)

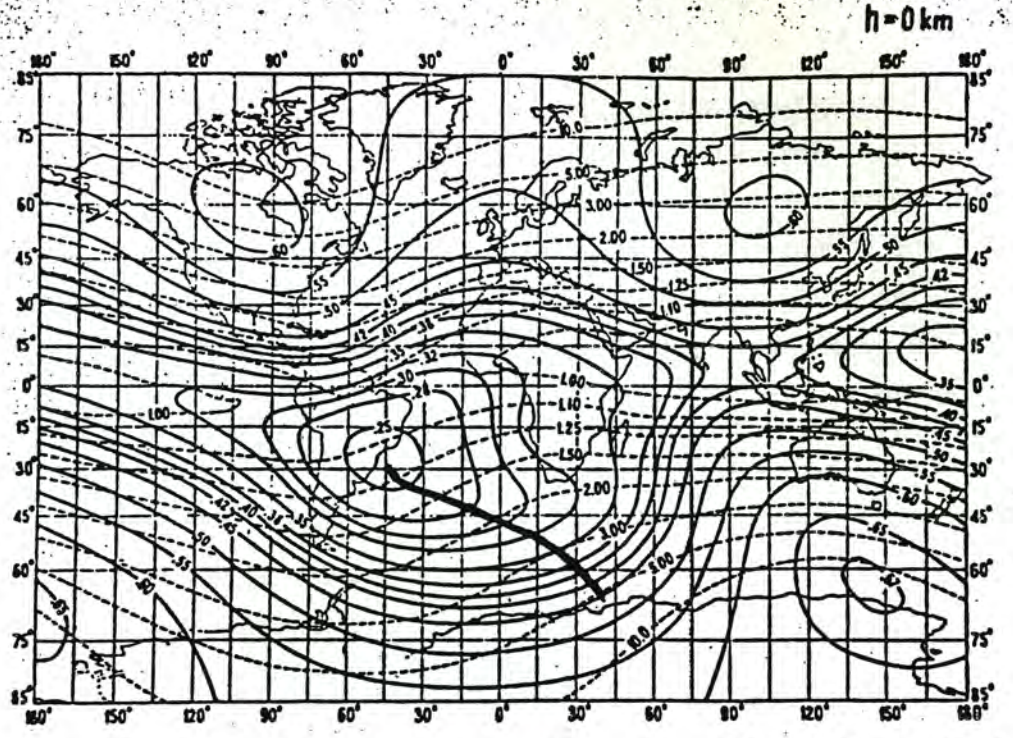


Fig. 1. The geomagnetic field. Continuous lines are contours of constant magnetic intensity B at ground level; dashed lines are contours of constant L at ground level; heavy line is locus of minimum values of B on each L shell [modified after *Vernov et al.*, 1967].

Fig. 1.

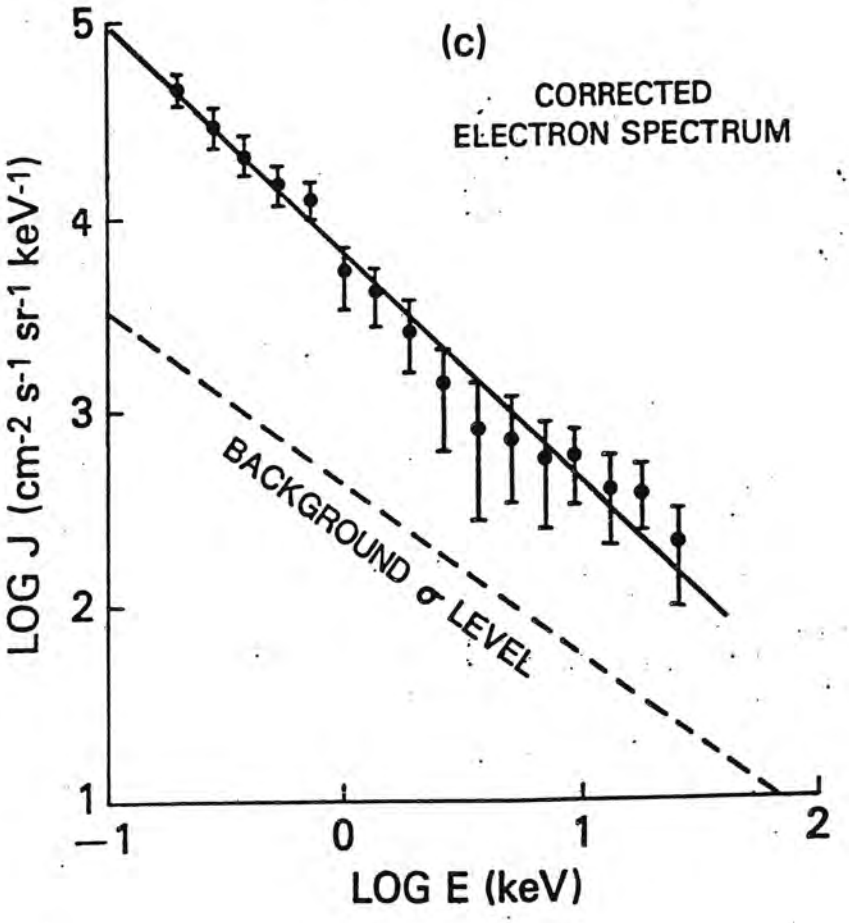


Fig. 2.

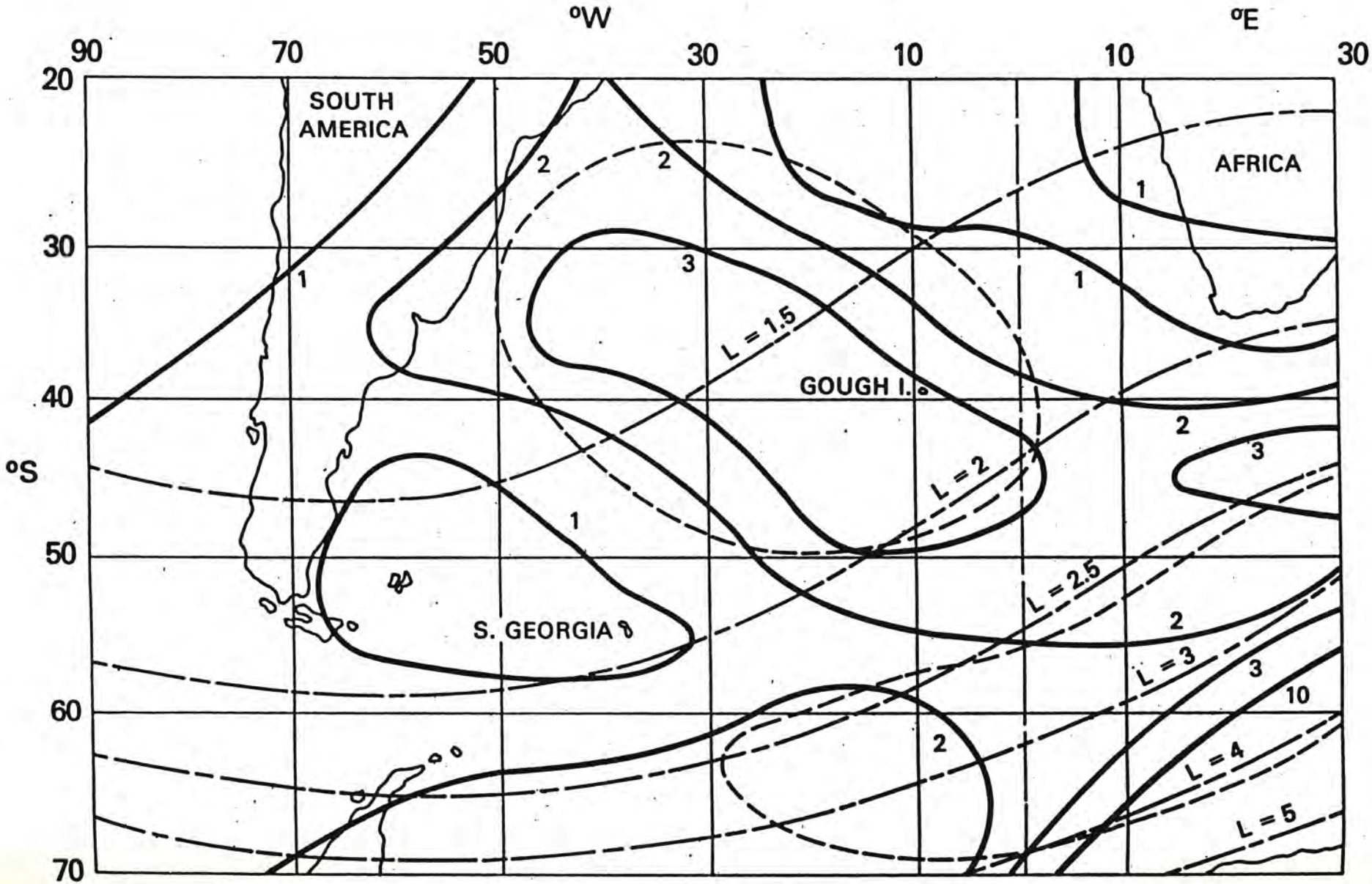


Fig. 3.

Contour units are 10^{-3} erg $cm^{-2} s^{-1}$ ($\mu W m^{-1}$).

SUID-AFRIKAANSE ANTARKTIESE NAVORSINGSPROGRAM

Bolugfisika - Kosmiese Strale

Programleier: Prof. P.H. Stoker
Dept. Fisika
PU vir CHO
POTCHEFSTROOM

VERSLAG VIR DIE TYDPERK VAN JULIE 1980 TOT JUNIE 1981

1. Doelstellings

1.1 Studie van die energie- en tydspektrum van energieke (> 1 GeV) sonprotone afkomstig van 'n sonfakkel.

1.2 Modulasie van kosmiese strale deur die makrostrukture van die interplanetêre magneetveld.

1.3 Atmosferiese modulasie van kosmiese strale.

1.4 Studie van die energiespektrum en gepaardgaande atmosferiese en geomagnetiese effekte van presipiterende elektrone (≥ 40 keV) deur waarnemings op ionosferiese absorpsies van kosmiese ruis.

1.5 Studie van simulasiemodelle van die geomagnetiese veld veral in die gebied van die Suid-Atlantiese Magnetiese Anomalie.

2. Geskiedkundig

Die projek het ontwikkel vanaf eerste waarnemings met 'n plaaslikvervaardigde neutronmonitor te Hermanus vanaf 1957 met die I.G.J. en breedtegraadwaarnemings met 'n neutronmonitor in 'n Shackletonbomwerper in 1962 om die effek van die Kaapstadse magnetiese anomalie op die verspreiding van kosmiese strale na te gaan. Die waarneming op kosmiese strale te Sanae vanaf 1964 en op die m.s. RSA tydens aflosreise was 'n noodwendige uitbreiding van hierdie eerste waarnemings. Waarnemings op kosmiese strale in die stratosfeer met balloninstrumente en op presipiterende elektrone en protone vanuit die magnetosfeer het gevolg. Tans word die eksperimentele resultate ingebed in simulasiestudies van die heliosfeer, magnetosfeer en atmosfeer om die waargenome effekte te verklaar.

3. Wetenskaplike vordering

3.1 Studie van energie- en tydspektrum van sonprotone

Met behulp van die resultate verkry uit die wêreldwye opname van kosmiese strale op seevlak in 1976 met 'n gewone neutronmonitor (NM64) en met 'n neutron-gemodereerde detektor (NMD), ook genoem 'n wastelbuis, op die m.s. SA Hugenoot van SA Marine en op die navorsingskip m.s. RSA van Departement van Vervoer, is 'n opbrengsfunksie vir albei instrumente afgelei. Deur hierdie opbrengsfunksies word die styfheidspektrum van kosmiese strale bo die atmosfeer in verband gebring met die relatiewe teltempo's van die twee soorte detektore op grondvlak te Sanae.

Die spektrum van sonprotone, wat te Sanae op 1 - 2 September 1971, 22 November 1977, 7 Mei 1978 en 23 September 1978 met die twee detektore waargeneem is, kon met behulp van die opbrengsfunksies afgelei word.

Die opbrengsfunksies is egter nog nie noukeurig by styfhede om en by 1 GV en laer afgelei nie. Daarom dat 'n NMD ook op die SA Agulhas gemonteer is voor die reis na Sanae in Januarie 1981. Ongelukkig het die registreerder ingegee, maar goeie metings is in Februarie en Maart 1981 met die krilvaart van die SA Agulhas kon maak. Aandag aan verbetering van die opbrengsfunksies kan nou gegee word voordat die waarnemings op die sonprotongebeurtenisse en die spektrum van die sonprotone gepubliseer kan word.

3.2 Modulasie van kosmiese strale

Uit die verloop van drie-maandelikse lopende gemiddelde relatiewe teltempo's van die NM64 en die NMD op Sanae vanaf April 1971 tot hede blyk dit dat 'n variasie van minstens $\pm$ 1% op lang termyn voorkom. Hierdie variasie moet verband hou met 'n veranderlikheid in die langtermyn gemiddelde spektrum van galaktiese kosmiese strale van styfhede > 1 GV, soos gemeet by die Aarde. Hierdie veranderlikheid is bestudeer deur uit te gaan van 'n twee-parameter bolsimmetriese modulasieteorie. Voorlopige resultate dui daarop dat dit veral die modulasie van die laer deel van die styfheidspektrum, om 1 GV, is wat die relatiewe teltempo van die twee detektore bepaal. Die finalisering van hierdie werk hang dan ook af van 'n noukeurige bepaling van die opbrengsfunksies van die twee detektore in die styfheidsgebied om 1 GV.

Die langtermyn waarnemings op die relatiewe teltempo's van die twee detektore, NM64 en NMD, sluit aan by die studies van Dr. Moraal en mnr. M.S. Potgieter

oor die modulasie van kosmiese strale met behulp van 'n drie-dimensionale model van die interplanetêre magneetveld.

3.3 Atmosferiese modulasie van kosmiese strale

Die teltempo geregistreer deur 'n neutronmonitor moet vir variasies in atmosferiese druk gekorrigeer word. Die drukkoëffisiënt is bekend by verskillende magnetiese breedtegrade (of afsnystyfhede) en lugdrukke, vir die tydperk van maksimale intensiteit van kosmiese strale (of minimum son= aktiwiteit), en ook by bepaalde posisies gedurende die elfjarige sonsiklus. Die drukkoëffisiënt is egter nie voldoende bekend as funksie van afsny= styfheid (magnetiese breedtegraad) of lugdruk by modulasietydperke buite die tydperk van maksimale intensiteit van kosmiese strale nie.

Om die data van die NM64 en NMD op die SA Agulhas vir variasies wat deur lugdruk veroorsaak word, te kan korrigeer, is 'n drukkoëffisiëntfunksie ook gevind vir die ander jare as vir 1976 wanneer kosmiese strale 'n mak= simum intensiteit gehad het.

3.4 Ionosferiese absorpsie van kosmiese ruis

Gebeurtenisse van absorpsie van kosmiese ruis op 20, 30 en 50 MHz is vanaf 1976 tot 1979 bestudeer, soos waargeneem te Sanae. Absorpsiesterktes is vergelyk met variasies in die geomagnetiese veld.

'n Student is tans besig om die verloop van absorpsiegebeurtenisse in tyd uit die riometerdata te verkry. Sodra hierdie data in detail bekend is, sal verdere aandag aan die gebeurtenisse gegee word.

3.5 Simulasiemodelle van die geomagnetiese veld

Met die 1976 wêreldwye opname van kosmiese strale met die detektore op die SA Agulhas en die RSA het dit geblyk dat daar 'n verskil in breedtegraad= verlope van kosmiese strale in die gebiede van die Noord- en Suid-Atlantiese Oseane is. Ons het hierdie verskil toegeskryf aan sekulêre korreksie= koëffisiënte, wat nie meer korrek is om uit die 1965 Internasionale Geomag= netiese Referensieveld (IGRF) die 1976 geomagnetiese veld in die gebied van die Kaapstadse Geomagnetiese Anomalie te bereken nie. Die 1980 Internasionale Geomagnetiese Referensieveld sal na verwagting tydens die IAGA-konferensie in Augustus 1981 bekend gestel word. Uit hierdie nuwe veld sal die 1976-veld beter bereken kan word. Dan sal die verskil in die breedtegraadsverlope in die gebiede van die Noord- en Suid-Atlantiese Oseane waarskynlik opgeklaar kan word.

4. Publikasies

4.1 Vakwetenskaplike publikasies (gepubliseer)

1. König, P.J.: A Model for the anisotropic re-entry of albedo at Palestine. Journal of Geophysical Research 86, 515, 1981.

2. König, P.J. and P.H. Stoker: Displaced iso-rigidity contours in the North Atlantic for 1975. Journal of Geophysical Research 86, 219, 1981.

3. Raubenheimer, B.C., E.Flückiger, C.F.W. Mischke and M.S. Potgieter: Comparison between the experimental and theoretical responses of neutron monitors. South African Journal of Physics, 3, 29, 1980.

4. Stoker, P.H., A.J. van der Walt and M.S. Potgieter: Modulation of cosmic rays during solar minimum. Part I. Cosmic ray intensity survey at sea-level during 1976: Experimental details. S. Afr. J. Phys, 3, 77, 1980.

5. Potgieter, M.S., B.C. Raubenheimer, P.H. Stoker and A.J. van der Walt: Modulation of cosmic rays during solar minimum. Part II. Cosmic Ray latitude distribution at sea-level during 1976. S. Afr. J. Phys., 3, 77, 1980.

6. Potgieter, M.S., H. Moraal, B.C. Raubenheimer and P.H. Stoker: Modulation of cosmic rays during solar minimum. Part III. Comparison of the latitude distributions for the periods of solar minimum during 1954 1965 and 1976. S. Afr. J. Phys. 3, 90, 1980.

4.2 Konferensievoordagte vir publikasie aanvaar

1. Moraal, H. and M.S. Potgieter: Simultaneous interpretation of nucleon and electron modulations. Proc. 17th International Cosmic Ray Conference, Paper SH 5.1-9, 1981.

2. Raubenheimer, B.C., F. van Niekerk, M.S. Potgieter and H. Hatze: The calculation of differential response functions from latitude surveys. I. Theory. Proceedings 17th International Cosmic Ray Conference Paper SH 9.2-11, 1981.

3. Raubenheimer, B.C., F. van Niekerk: The calculation of differential response functions from latitude surveys. II. Results and discussion. Proceedings 17th International Cosmic Ray Conference, Paper SH 9.2-12, 1981.

4. Stoker, P.H.: Primary spectral variations of cosmic rays above 1 GV, Proc. 17th International Cosmic Ray Conference, Paper SH 4.1-6, 1981.

4.3 Interne verslae

1. Raubenheimer, B.C., I-M Karberg, F. van Niekerk, R. Strydom and P.J. van Rensburg: Autocorrelation analysis of atmospheric pressure, Workshop on time series analysis with geophysical applications, (Hermanus), Paper 10, p. 113-119. CSIR Report S238. 1980.

2. Cosmic ray neutron monitor data, Sanae, January - December 1980, Report no. S15, June 1981, Department of Physics, Potchefstroom Uni= versity for CHE.

POTCHEFSTROOM
30 Junie 1981

ANTARCTIC GEOMAGNETIC AND AURORA PROGRAMME

PROGRAMME LEADER — P R Sutcliffe

PROGRAMME RESEARCHERS — P R Sutcliffe (Leader of Pulsation Project)
D P Smits (Leader of Geomagnetic Project)
D Meyer (Leader of Aurora Project)

ADDRESS — Magnetic Observatory of the CSIR
P O Box 32
HERMANUS 7200

PROGRESS REPORT — Annual Progress Report for 1980/81

OBJECTIVES OF PROJECTS

(i) To monitor variations in the geomagnetic field in the South Atlantic-Indian Ocean and adjacent Antarctic regions.

(ii) To monitor geomagnetic pulsations in the vicinity of Sanae.

(iii) To monitor certain aspects of electron and proton aurora.

(iv) To improve our understanding of processes during magnetospheric substorms by making correlative studies of (i), (ii) and (iii).

(v) To provide geomagnetic absolute values and secular variation data for use in the compilation of regional and world magnetic charts (e.g. for MAGSAT programme).

(vi) To provide geomagnetic, pulsation and auroral data to other research groups.

HISTORY OF PROGRAMME

Variations in the geomagnetic field and aurora have been monitored at Sanae since 1960, while geomagnetic variations at Marion have been monitored since 1972. During 1979 a geomagnetic secular variation station was established on Gough Island; it will be surveyed once per year. The Magnetic Observatory has taken the Geomagnetic Pulsation Project over from the University of Natal, and will be responsible for recording pulsations at Sanae from 1982 onwards. The geomagnetic data are published annually and distributed to approximately 80 institutions throughout the world including the World Data Centres in Britain, Japan, U S A and USSR. Geomagnetic data for special intervals and aurora data are supplied upon request.

Previous research projects have been primarily concerned with the study of pulsation phenomena during magnetospheric substorms. Studies have also been made of the secular, solar diurnal and lunar daily variations at Sanae and of the 'island effect' and solar and lunar daily variations at Marion.

SCIENTIFIC PROGRESS

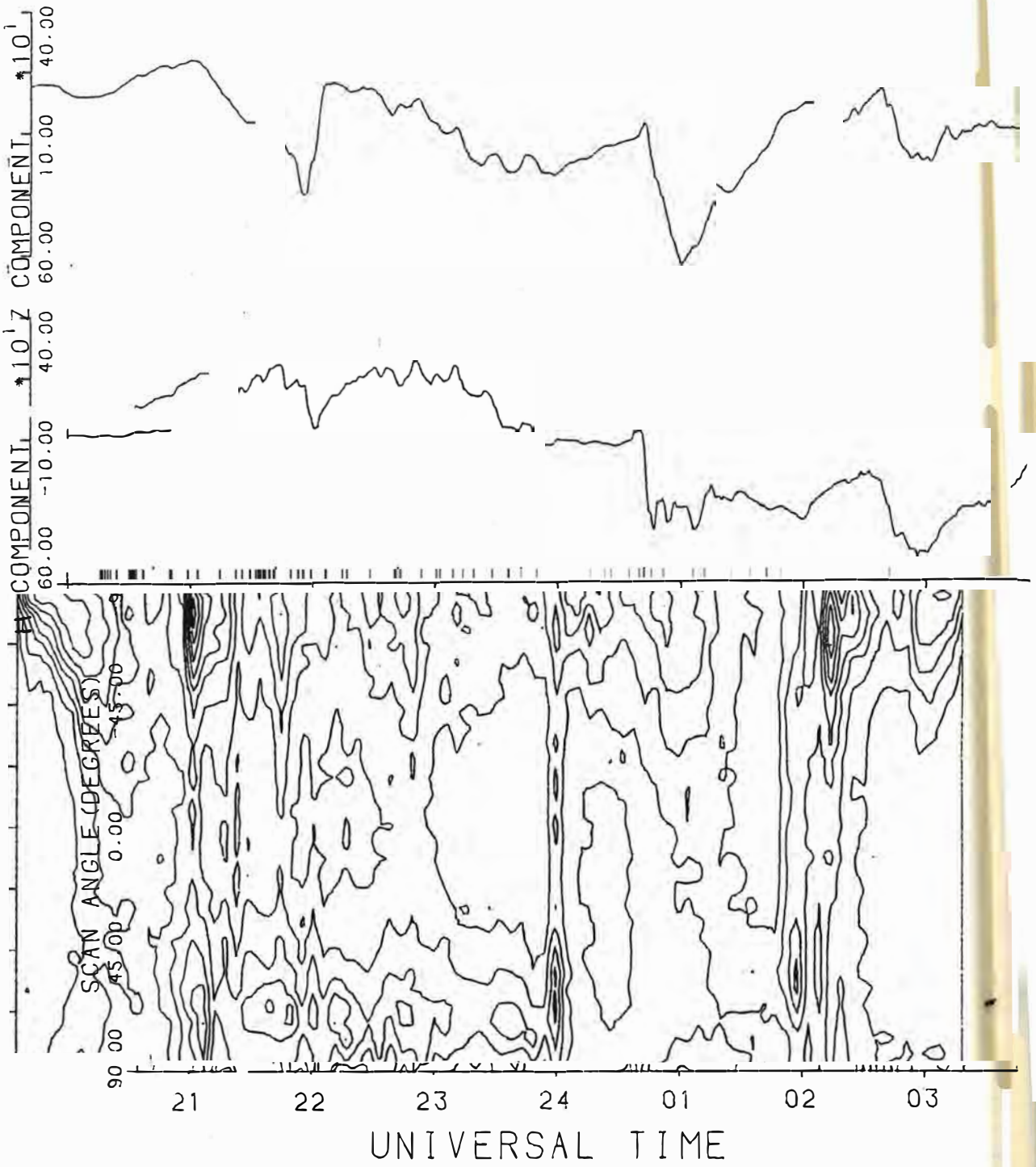
(i) Although research staff associated with the programme have spent the major part of their time doing research on geomagnetic pulsations, the research was based on pulsations recorded at low latitudes (see Annual Report of the Magnetic Observatory for a description of progress and list of publications). Nevertheless, the analysis methods developed and the knowledge gained will be invaluable once the pulsation project at Sanae has produced its first data.

(ii) Work on the aurora project has mainly been aimed at developing techniques for converting proton aurora data into a format suitable for interpretation. The intensity of the hydrogen Balmer β (Hβ) line is measured at Sanae by a tilting-filter photometer

which scans the sky in the magnetic meridian; the data is recorded in analog form on chart rolls. Techniques and computer programs were developed to digitise and filter the raw data, to remove the background intensity in order to determine the uncontaminated Hβ intensity, and to correct this intensity for various atmospheric effects. The corrected intensities are plotted in a diagram of zenith angle (or latitude) versus time. A program to determine the doppler shift of the Hβ line, and hopefully also some measure of the energy of the precipitating protons, is being developed at present.

(iii) Data was prepared for the Antarctic Workshop to be held at the University of Port Elizabeth on 6 July 1981. At this workshop, each of the groups involved in Upper Atmospheric Research at Sanae will provide data recorded on two nights at Sanae, viz 26/27 July 1979 and 15/16 September 1979. On the first of these nights a magnetic storm occurred and on the second a sub-storm occurred. The figure shows a contour plot of the proton aurora intensity (Hβ line) and the variations in the H and Z components of the geomagnetic field on the night of 26/27 July 1979 during the time when visible aurora was present.

It is hoped that the coming together of the various upper atmospheric research groups and the detailed study of these events will lead to a better understanding of the processes during magnetospheric sub-storms.



PUBLICATIONS

Lambert, S., Corrections for geometric and atmospheric effects of photometric observations of aurora, Magnetic Observatory Scientific Report R MAG 5/23, December 1980.

Lambert, S. and P.R. Sutcliffe (in press). Photometric observations of proton aurora at Sanae, J. atmos. terr. Phys.

PROGRESS REPORTS TO SASCAR

PROJECT TITLE: Solar Terrestrial Physics, University of Natal Group, Durban.

PROJECT LEADER(S): Professor A.D.M. Walker. Professor M.W.J. Scourfield.

ADDRESS: Dept. of Physics, University of Natal, King George V Avenue, Durban, 4001, RSA.

PROJECT RESEARCHERS: Barker M.D. Hansen H.J. Hughes A.R.W. McChesney J.M. Palmer G.A. Rash J. St. Quintin A.M.C. Wakerley P.A.

DATE: 23rd Annual Progress Report April 1980 to March 1981. Submitted April 1981.

1. (a) Objectives

(a) Investigation of the micro and macro-structure of the plasmasphere and plasma-sheet regions of the magnetosphere, together with their inter-relationships, over a range of geomagnetic conditions. Collaboration is at the national and international level.

(b) Investigation of the global variations in the lower ionosphere potential and global thunderstorm activity to elucidate the extent of solar control of the earth's weather system.

2. History of Project

The Durban Group began ground-based observations of whistlers and geomagnetic pulsations at SANAE in 1970. The programme has been subsequently extended to include Low Light Level TV observations of aurora (1975), retrieval of satellite whistlers (1976) and direction-finding equipment to record the bearings of whistler duct exit points (1977). During 1978 recordings of fair weather electric fields and the integrated ELF noise level was started. The group has grown from 3 to 14 members.

Programme growth has been planned so that the different areas of investigation complement each other and all members of the group participate in a number of these areas.

Scientific Progress (23)

A ground based whistler system is operated at SANAE where data is collected by means of continuous and synoptic recording programmes. Recording schedules are also carried out in co-operation with other groups in Antarctica (U.S.A. & U.K.).

New VLF pre-amps have been made and tests carried out on the 1980 Gough Island cruise where some slight whistler activity was reported.

The Satellite Tracker was taken from SANAE and has been installed in Durban and a regular recording programme is followed with satellites

ISIS I and ISIS II.

An investigation of the dispersion characteristics of whistlers recorded from ISIS II has been started and a computer programme developed for this. The latitude dependence of whistler dispersion will be determined from the satellite passes.

Low latitude VLF studies have been made of whistler dispersions as a function of magnetic latitude using data from ISIS II recorded in Quito Equador. This is data used in conjunction with the data being recorded in Durban from ISIS I and II and will enable the latitude range over which VLF phenomena is being observed to be extended.

Measurements of lower hybrid resonance frequencies are being used to study ion densities at about 1500 km and comparing these with electron densities on the same field lines at the equator by using ground based measurements of whistler dispersion.

The quality of the data processing for the auroral programme is being upgraded and the ¾" video format is being used in place of ½", with the additional capability of being able to record for periods of up to 1 hour. There are two video systems at SANAE.

Simultaneous measurements of ionospheric electric fields are being investigated and T.V. imaging of pulsating auroral forms have shown that the latter undergo $\vec{E} \times \vec{B}$ drift. A display of pulsating aurora may be considered as the projection on the ionosphere of an assembly of ducts of enhanced plasma density convecting with the background plasma.

Computer programmes have been written to determine the frequencies of pulsating aurora observed at SANAE which have been recorded on video tape. A video analyser linked to a TV monitor is used to select and analyse the video signals; the analyser has eight signal channels which can be used simultaneously and, these signals are subsequently stored on disc in the H.P. Computer.

Power spectra of these signals are obtained by an FFT programme and displayed on the computer graphics display. Hard copy of the power spectra is available from the line printer.

A programme is currently being developed to determine whether there is any systematic movement of electron precipitation above the region of pulsating auroras.

Analogue recordings of the H component of geomagnetic pulsations were continued during 1980.

A vertical field mill is running continuously at SANAE and the data recorded, brief comparisons have been made between periods of magnetic activity and the activity of the local electric field.

The initial study is now terminated which revealed atmospheric electric field variations recorded under fair-weather conditions on the South Polar ice-shelf in summer show the site to be globally representative and therefore of possible use in monitoring variations in the electrosphere potential. Evidence is also produced which suggests that the contribution to global thunderstorm activity by oceanic thunderstorms should be regarded as itself having a diurnal variation of some 18% in amplitude.

Use of ELF data to monitor the global incidence of thunderstorms has been suspended temporarily. Initial results obtained at SANAE have revealed that the equipment requires significant modification. The staff member who initiated this project is no longer with the group.

Magnetohydrodynamic resonance theory is being used to model the structure of the Magnetospheric and Ionospheric electric and magnetic fields associated with Pc5 geomagnetic pulsations.

Quick look image-time intensity data from the STARE radar are used to study the diurnal behaviour of hydromagnetic oscillations in the Ionosphere These are known to be associated with Pc5 geomagnetic activity seen on the ground.

Theoretical investigations have also been made into the effect of Kelvin-Helmholtz instability in the low latitude magnetopause boundary layer and a linear theory has been developed which takes into account the

finite thickness of the boundary layer. The predicted results are consistent with satellite observations of the magnetopause and ground observations of pulsations.

The group in co-operation with Hermanus, Potchefstroom and Rhodes will be presenting a workshop and data of common interest will be presented and discussed.

Three staff members of the group are attending a 1 semester course in remote sensing by the Landsat/Nimbus satellites.

The course is given by the Dept. of Survey, future developments will depend upon identification of valid physics-related problems, availability of staff, time and funds.

PAPERS DELIVERED AT CONFERENCES

Duthie D D and Scourfield M W J. Auroral pulsation TV images and VLF hiss correlation. Paper read at the 25th Annual Conference of the South African Institute of Physics, Johannesburg, 1980.

Hughes A R W. Satellite measurements of whistler dispersion at low latitudes. Paper read at the Committee on Space Research Conference, Budapest Hungary, May, 1980.

Hughes A R W. The characteristics of spherics observed on satellites at low latitudes. Paper read at the Meeting of Royal Meteorological Society, Sheffield United Kingdom, March 1980.

Levin D M. A transformerless receiving system for VLF signals at SANAE Antarctica. Paper read at the 25th Annual Conference of the South African Institute of Physics, Johannesburg, 1980. S.A.I.P., 1980, E5 P33.

Scourfield M W J. The evening (Harang) and morning discontinuities. Paper read at the Arbeitsgemeinschaft Extraterrestriche Fisika, Mainz West Germany, 1980.

Scourfield M W J, Keys J G[+] and Nielsen E[++]. Evidence for the $\vec{E} \times \vec{B}$ drift of pulsating auroral forms. Paper read at the 4th International Magnetospheric Study Workshop, Paris France, 1980.

Scourfield M W J. Evidence for the $\vec{E} \times \vec{B}$ drift of pulsating auroral forms. Paper read at the A.G.U. Spring Meeting, Toronto, May 1980.

Scourfield M W J. Evening (Harang) and morning discontinuities in ionospheric electron drifts and their dependence upon the interplanetary magnetic field. Paper read at the A.G.U. Spring Meeting, Toronto, May 1980.

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M W J Scourfield 4/5/80

3. BIOLOGICAL SCIENCES

3. BIOLOGIESE WETENSKAPPE

PROGRESS REPORT

PROJECT TITLE: SPATIAL AND TEMPORAL DISTRIBUTION OF PINNIPEDS

PROJECT LEADER: J D Skinner, Mammal Research Institute,
University of Pretoria, Pretoria 0002

PROJECT RESEARCHER: M N Bester, M.R.I., University of Pretoria,
Pretoria 0002

PROGRESS REPORT: First progress report, July 1980 to June 1981, incorporating fourth progress report on the project formerly entitled "Population dynamics and reproductive physiology of the Amsterdam Island fur seal Arctocephalus tropicalis at Gough Island", and the third progress report on the project formerly entitled "Population ecology of the southern elephant seal Mirounga leonina at Kerguelen Island".

PROJECT OBJECTIVES

(1) Population sizes and trends of the three species of pinnipeds (A. tropicalis, A. gazella, M. leonina) at Gough, New Amsterdam, Prince Edward and Kerguelen Islands).

(2) Factors responsible for the observed trends.

(3) How do the different populations respond to their particular environments in e.g. local distribution and habitat preference.

(4) What is the social structure, age structures, natality schedule and mortality patterns of the populations, and how are these influenced by changes in population size.

(5) Immigration, emigration, and dispersal and dispersion.

(6) Population identification and extent of intermingling.

Objectives 4-6 are dependent on a tagging programme to be continued and extended, with a concerted effort to systematically mount annual searches for tagged animals a priority.

HISTORY OF PROJECT

This project was proposed during 1980, and the first phase commences during the summer of 1981/82 at Amsterdam Island. This project,

yield for 1980 have been determined. No change in population size and pup yield have occurred since previous surveys, and although pre-weaning pup mortality (8,6%) was similar to previous years (average of 4,1%), pup mortality up to mid-November increased to 14,3%. It has also been established that, similar to Kerguelen, Gough elephant seal pups show a post-weaning dispersal phase at least by the first few days in November, rendering pup (underyearling) counts at this time incorrect. Eighty percent of live pups present were tagged, and four previously tagged seals (2x1977; 2x1978 pups) were resighted at the onset of the moulting season, all except one in the vicinity of their birth place. Key questions of research realized, and partly realized are the same as for the Kerguelen M. leonina population. However, no intrinsic population factors seem to regulate the population, as it is a small and struggling one, having apparently reached its asymptote in size.

A. tropicalis research was primarily home-based, except for the above-mentioned visit to Gough Island, during which time morphometric data from weaned underyearlings were obtained. This completed data available on body growth patterns. A small number was tagged and a few resightings recorded of seals between 3-5 years of age outside the breeding season (Bester 1981).

All biological material has now been processed as follows, and only final data interpretation and presentation remains:

(a) Canine teeth (n = 226) were sectioned for age determination based on incremental lines in the dentine/cementum.

(b) Gross morphometrics of male reproductive systems have been completed, and testes, epididymes and prostate glands of males (n = 119) have been prepared for histological examination, as were adrenal glands.

(c) The female reproductive system (uterus, ovaries) have been similarly prepared.

(d) Hormone assays of blood samples collected on a monthly basis from both sexes (n = 120) have been completed (in Prof R P Millar's lab, Chemical Pathology, University of Cape Town).

(e) Food items from stomach contents have been identified (Prof J Grindley, School of Environmental Studies, U.C.T.) as well as all internal parasites (Natural History Museum, London; Queensland Institute for Medical Research, Australia) .

Bester, M.N. 1980a. S.A. Agulhas Vaart 16 - 1980 Gougheiland Aflosreis. Internal report 4 pp.

Bester, M.N. 1980b. Use of NRIO Zodiac inflatable dinghy at Gough Island. S.A. Agulhas Voyage 16. Report to CSP, CSIR. 3pp.

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Bester, M.N. 1981b. Population ecology of the southern elephant seal Mirounga leonina at Kerguelen Island. Progress report : July - December 1980. Internal report. 3 pp.

Bester, M.N. & Lenglart, P-Y. 1981. Pinnipeds at Iles Kerguelen, with emphasis on the southern elephant seal Mirounga leonina. Report on the co-operative mammal research programme between TAAF (France) and SASCAR (South Africa), September 1979 - January 1980. pp. Mimeograph.

Skinner, J.D. & van Aarde, R.J. 1981. Observations on the trend of the breeding population of southern elephant seals Mirounga leonina at Marion Island. Internal report 13 pp.

Project Title	:	INTERTIDAL COMMUNITY STRUCTURE ON MARION ISLAND
Project Leader	:	Professor J.R. Grindley School of Environmental Studies, University of Cape Town.
Project Researcher	:	Mr. W.O. Blankley School of Environmental Studies, University of Cape Town.
Date	:	Third annual progress report July 1980 to June 1981.

1. OBJECTIVES

To describe and quantify community structure of the Marion Island littoral fauna. Aims of the study are to :

1. Provide detailed analyses of the diets of major predators;
2. Determine the abundance, habitats and species associations of dominant community members;
3. Map the structure of the inshore food web.

2. HISTORY OF PROJECT

Intertidal studies on Marion Island were commenced by Mr. N. Fuller during the first expedition (1965-66) and a series of 13 taxonomic report were published in the Marion Island Monograph (1971) on the basis of his collections. More detailed studies of littoral ecology were complet by Mr. A.F. de Villiers and published in 1978. Studies of zooplankton around the islands were published by Grindley & Lane (1979 and 1981). No quantitative intertidal work had been carried out until the commenceme of the present study which was initiated in May 1979 and continued until May 1980. Major work completed was outlined in the previous progress report of June 1980. Since May 1980 efforts have been directed at

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synthesizing analyses of field data and collected samples into manuscripts which are presently being prepared for publication.

3. SCIENTIFIC PROGRESS

The research project is comprised of six research topics. Manuscripts have been completed on the first three (A-C) and the remaining three are in preliminary stages but should be complete by the end of 1981. The interrelationship of the research topics make it important that the papers are finally prepared and submitted simultaneously to prevent overlap and ensure adequate coverage of all areas investigated.

A. Feeding ecology of Anasterias rupicola.

Anasterias is an abundant (14,2 m^{-2}) carnivorous starfish which actively seeks prey in the intertidal and subtidal zones. 404 cases of predation were analysed involving 29 different prey species. Anasterias feeds mainly on the limpet Nacella (Patinigera) delesserti, the polychaete Platynereis australis and isopod Dynamenella huttoni. Other important prey were amphipods, bivalves and chitons. Feeding rates were estimated from observations of the incidence of feeding in the littoral population and from controlled caging experiments. Results indicate that about 13% of the Anasterias population are feeding at any one time and a mean Anasterias can consume 10^{+} 7,8 mean Nacella per year.

Size-limited predation by Anasterias is clear. Small starfish feed on small prey such as amphipods, bivalves and chitons while larger individuals prey more on large prey such as limpets, polychaetes and isopods. Smaller and larger Nacella are successfully attacked by smaller and larger Anasterias respectively. The situation is complicated, however, by the phenomenon of cluster feeding where up to 13 starfish may be found clustered around and feeding on a single prey item. Cluster feeding is common with larger prey and allows smaller starfish to derive nourishment from prey normally beyond their size limits for capture. This is an unusual record of co-operation between echinoderms for mutual trophic benefit.

B. Comparative feeding ecology of the three fish species.
The feeding habits of Notothenia coriiceps, N. macrocephala and Harpagifer bispinis were examined and compared. Standard lengths, stomach contents and habitats of 258 fish captured on the east coast of Marion Island were recorded. Notothenia coriiceps and N. macrocephala are omnivorous whilst H. bispinis is predominantly carnivorous. Correspondence analysis of the three diets showed the existence of three clearly defined feeding niches despite the occurence of common prey species. Inter and intraspecific similarities and differences in the diets of small and large size classes of each species were also displayed by correspondence analysis. Diets of small and large N. coriiceps showed the largest intraspecific divergence and those of both small N. coriiceps and N. macrocephala showed the closest correspondence. Size limited predation of the limpet Nacella by N. coriiceps is described. Seaweeds, isopods, polychaetes, amphipods, limpets and bivalves are the most important types of prey consumed by the fish. Overlap in diets are ascribed to the generalised nature of a youthful system rather than to a lack of definition in the feeding niches occupied by the fish.

C. The marine food of gulls, sheathbills and cormorants.
Kelp gulls Larus dominicanus feed extensively on intertidal Nacella and the bivalve Gaimardia trapesina from the upper fronds of the offshore kelp Macrocystis pyrifera. Six monthly collections of Nacella shells deposited on Boulder Beach by feeding gulls showed that a mean of 441 $\pm$ 236 shells accumulate there per month. Nacella from the 40,0 -55,0mm size class are most heavily preyed on whilst smaller Nacella are swallowed whole and the shells regurgitated later. Regurgitations of crushed Gaimardia shells were analysed and found to contain 16,5 $\pm$ 4,2 Gaimardia from the 20-30mm size class. Gulls also feed on Anasterias rupicola, Notothenia macrocephala and Harpagifer bispinis to some extent.

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The lesser sheathbill Chionis minor feeds on intertidal seaweed and fauna and also invertebrates from amongst kelp jetsam but is less dependent on marine food sources than the gulls and cormorants. Analysis of Chionis faeces and observations of feeding activities provided data for a description of their major marine prey. The sheathbill feeds mainly on the intertidal algae Porphyra but also consume many Hyale amphipods, Ectemnorrhinus beetles, limpets (Kerguelenella lateralis and Nacella) and littoral insect larvae. They also peck the soft parts from intertidal Anasterias, feed on the polychaete Platynereis australis and remove small Nacella (35mm) from rocks at low tide. Nacella shells at gull feeding sites are scoured for flesh remains.

King cormorants Phalacrocorax albiventer dive for demersal prey in the shallow subtidal but probably more in the deeper Macrocystis holdfast zone and beyond. Two regurgitations and the stomach contents of a dead chick were the only samples obtained (M. Schramm P.F.I.A.O.) from the poorly established island population. Fish, H. bispinis and N. macrocephala, crustaceans Nauticavis marionis, unidentified squid and polychaetes formed the bulk of the samples. These three resident avian species, exploiting the rich littoual food sources at the primary, secondary and tertiary levels provide a strong trophic link between the terrestrial and local marine systems.

D. General ecology and growth of Nacella (Patinigera) delesserti.
Nacella are important prey of Anasterias rupicola, Notothenia coriiceps and Larus dominicanus. Analysis of scraped quadrats and underwater photo-transects are nearly complete and will provide data on habitats and limpet densities. Tagged, free ranging Nacella and caged experimental animals were used to estimate growth and feeding rates. Projected completion date for this study is July, 1981.

E. Biomass and species associations.
Scraped quadrats, underwater photo transects and samples of subtidal debris are being used to provide data on biomass and species associations of intertidal and subtidal fauna. Projected completion

date is November, 1981.

F. Food web summary.

Data on trophic pathways, feeding rates, prey sizes and energy content will be selected from the above five studies and combined into a comprehensive account of the structure and dynamics of the littoral food web. Computer generated maps should form the body of data. Projected completion date is December, 1981.

ADDENDUM

Many possibilities exist for further studies on the large amount of samples collected during the years research work on the island. The above studies essentially deal only with biomass and trophic relationships. Material for the study of reproduction in fish and other species has been prepared and awaits attention whilst many unusual specimens (e.g. lugworms, large nudibranchs, crabs, undescribed polychaetes and isopods) need documentation. Parasites of fish and starfish were also studied and collected.

5. PUBLICATIONS

Three manuscripts have been prepared and initially approved by Professor J.R. Grindley and Professor G.M. Branch. When the remaining three are complete (December 1981) all six will be submitted for publicatio

PROGRESS REPORT

PROJECT TITLE: The ecology of the house mouse (Mus musculus) on Marion Island.

PROJECT LEADER: Professor J.D. Skinner, Mammal Research Institute, Univerity of Pretoria, Pretoria, 0002.

PROJECT RESEARCHER: J.P. Gleeson, Mammal Research Institute, University of Pretoria, Pretoria, 0002.

PROGRESS REPORT: Fifth progress report, December 1980 - June 1981.

Objectives: To investigate the interrelationship between the mice and the island's invertebrate and in some cases vertebrate fauna as well as their effect on the flora, with emphasis on the autecological parameters of the house mouse propulation. The aims of the project are to:

1. Determine the distribution and density of the house mouse population.
2. Determine the magnitude of seasonal population changes.
3. Study the reproductive trends in the population.
4. Determine primary food (Prey) items.
5. Determine the energetic equipment of individual mice.

Fieldwork commenced in April 1979, and was completed in May 1980, with additional fieldwork done in September 1980.

Progress:

1. Fieldwork. All fieldwork has been completed.

2. Laboratory analyses, All laboratory analyses on ageing of skulls, stomach content analyses and on the invertebrate investigation have been completed, and the data resulting have been analysed. While mice are primarily insecitvorous in their diet, they do appear to utilize vegetative food sources during the summer months. Invertebrate biomass appears to change seasonally, with the highest biomass being found in the summer months.

3. Computer analyses: Computer analyses of population age trends from skulls, body morphometric parameter trends and live trapping grid utilization trends have been completed. Population age trends indicate the season of recruitment into the population, as well as changes in

age structure of the population. Changes in various morphometric parameters, brown fat, abdominal fat and testis index may be attributed to seasonal influences on the mice. Intensity of utilization of four grid areas was determined from grid utilization trends.

4. Additional data on mouse distribution and density, seasonal population changes and reproductive trends have been analysed and completed. Mouse populations display seasonal fluctuations, with the highest densities in the late summer months. Reproduction takes pla during 8 months of the year in females, with a peak in reproductive activity during mid-summer. Densities of mice vary in the various habitats examined, with highest densities occurring near the coast, while mice are found in all habitats below 450 m above sea level.

5. Final report: All the above data are being written up as an M.Sc. thesis, which will be submitted as a final report on the project. This report is in the final stages of completion.

6. Analyses of the individual energetics requirements of mice still need to be finally analysed.

7. Publications: Progress report June to December 1980.
No further publications to date.

Project Title	:	BIOLOGY OF DURVILLAEA ANTARCTICA
Project Leader	:	Professor J.R. Grindley School of Environmental Studies, University of Cape Town.
Project Researcher	:	P.G. Haxen School of Environmental Studies, University of Cape Town.
Date	:	3rd Annual progress report, July 1980 to June 1981, submitted in June 1981.

1. OBJECTIVES

The central objective in this study is to research the biomass and productivity of Durvillaea antarctica on Marion Island. It will contribute towards an understanding of this giant plant's role as a primary producer in the inter-tidal and near shore waters of the island. Plant chemical composition is intimately related to this study so there is a need for work to be initiated on the plant's chemical composition in the new programme. Not only will this knowledge be of considerable value in itself but it will also provide information on energy (in kJm^{-2} yr^{1}) availability to organisms in higher trophic levels which includes particularly the grazing limpet (Nacella delesserti) but also amphipods, isopods, bacteria and to a lesser extent the pelecypod filter feeders Kidderia bicolor and K.oblonga.

In order to achieve this objective the study has been divided into sections that are listed below. These sections are for purposes of management only and all are intimately related.

1. Biomass per unit length of shore.
2. Seasonal productivity.
3. Population dynamics and mortality data.
4. Analysis of chemical composition (In new programme)

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5. Analysis of physical data, particularly swell and light availability.
6. Seawater analysis, particularly nitrogen available to the algae as nitrate, nitrite and ammonia.

2. HISTORY

Fuller's work led to thirteen taxonomic reports which appeared in the Marion and Prince Edward Island Monograph and deal primarily with marine fauna. Further work published by A.F. de Villiers (1978) in the South African Journal of Antarctic Research entitled "Littoral Ecology of Marion and Prince Edward Islands" dealt primarily with the distribution and relative abundance of major zone forming organisms. Studies by Grindley and Lane (1979 and 1981) deal with plankton in the waters surrounding the Prince Edward Island group. No quantitative seaweed work had been undertaken on Marion until the inception of the present programme -

The present programme was initiated in April 1979 when P.G. Haxen commenced an investigation into the Biology of Durvillaea antarctica. He left for Marion Island in May 1979 and returned in September 1980. The prolonged stay on the island allowed field work to be repeated and the development of suitable techniques for the measurement of productivity. This work on the island was described in progress report for June 1979 to June 1980 (in progress reports to SASCAR 1980).

3. SCIENTIFIC PROGRESS

Three months of the year under consideration were spent on Marion Island with activities similar to those described in the June 1979 to June 1980 progress reports.

1. Biomass

To estimate biomass per metre of shore several approaches have been followed. Shore topography and aspect exert considerable modifying influence on exposure to swell and wave action. The study site on

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Transvaal Cove was divided into three categories with respect to exposure to swell and two or three two-metre wide transects per category were established.
All plants in each area were harvested and measured for eight different physical parameters (e.g. frond and stipe fresh weight). Data from these surveys provide significant information on the influence that wave action has on each category of plant morphology and also gives data on biomass distribution. Extrapolation of these data to aerial photographs recently obtained (May 1981) will make it possible to provide reliable biomass estimates for longer stretches of Marion Island's shores. Work was done on immature and juvenile kelp stands. Final interpretation of these data in in progress but as yet incomplete.

2. Productivity

A new method to measure growth involving the positioning of very small and light plastic markers along frond lengths was developed in this study. Intervals between markers were periodically re-measured. Each plant was marked in duplicate (two fronds or "thongs" per plant) and between five and twenty plants were periodically sampled by measuring the intervals between markers. Storm losses necessitated frequent remarking of plants. Holes were used in place of markers for immature plants. Data from calorific analyses will provide estimates of energy production on a seasonal basis. Information from the chemical analyses will be invaluable for a complete description of Durvillaea.

3. Mortality

Losses of marked plants selected along the shore were recorded. Additionally studies on entire boulder populations were undertaken, with intervals, and number and diameter of stipe recorded. Lost marked plants were frequently washed up on the beach, especially after storms. Observations on these plants led to the realization that further studies on the role of bacteria and amphipods in the mortality

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and subsequent breakdown of kelp will be essential. The decaying masses of kelp and the detritus derived therefrom through the action of bacteria and wave erosion play a vital role in the overall ecology of Marion Island.

4. Biometric Data

This section is a key part of the programme and provides essential information to be integrated with other sections of the programme. Not only have samples been taken from fresh plants on a regular monthly basis and dried providing information on seasonal moisture variation, but many additional studies have been undertaken in relation to the breakdown processes of plants cast ashore. Particularly important amongst these are samples taken at regular intervals from material cast up on the beaches. Large amounts of material are involved here and this forms a very important part of the inshore ecosystem. Bacteria and amphipods are intimately associated with the breakdown of the beach cast. Both these aspects need to be studied in some detail with the emphasis on the bacteria.

Almost 900 samples have been crushed and milled in preparation for chemical analysis. Although some pooling of samples may be necessary this is to be avoided as much as possible as a considerable amount of care has gone into experimental planning and sample preparation.

Some initial samples have been sent for calorific analysis and in the new programme this aspect needs to be expanded. Some charges will be incurred here. Total nitrogen analysis will prove either expensive or time consuming. Assistance would be valuable here.

Sodium alginate has been extracted from Durvillaea and used in the preparation of standard curves to which alginate contents from other samples will be related in the new programme. It should be stressed that alginate is an extremely limited and valuable natural resource. Chemical analyses are routine, time consuming and assistance with this aspect of the work will be required in the new programme.

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5. Analysis of Physical Data

Meteorological data is awaited from Pretoria although some swell data has already been obtained. Light data is particularly important to productivity study.

6. Seawater Analysis

Seasonal data on nitrate-nitrogen and ammonia is complete in tabular form.

7. Additional Preliminary Studies

(a) Bacteria

A preliminary study of bacterial degradation has been undertaken and the results indicate that such studies should become a major part of the new programme.

(b) Holdfasts

Some preliminary information was obtained on Marion Island. Studies undertaken indicate tha holdfasts act as nurseries for certain juvenile isopods. The grazing and burrowing action of the juveniles is certainly associated with kelp mortality. This may be seasonal as juveniles grow and increase their graying pressure. This is an important subject which needs intensive investigation.

(c) Map

A computer map of Transvaal cove has been generated for site location purposes.

CONCLUSION

Despite the fact that this is a huge programme for one person to manage and operate it is progressing well. Much tedious routine work has been completed, notably preparation of samples for analysis. Initial bacterial and holdfast work indicates the need for further study.

PROJECT TITLE: The genetic and ecological relationship between two species of fur seals, Arctocephalus tropicalis and A. gazella on Marion Island.

PROJECT LEADER: J.D. Skinner, Mammal Research Institute, University of Pretoria.

PROJECT RESEARCHER: G.I.H. Kerley, Mammal Research Institute, University of Pretoria.

PROGRESS REPORT: Second Progress Report, June 1980 - May 1981.

Objectives:

1. Monitoring the population trends of the fur seals on Marion Island.
2. Investigating the seasonal occurrence of the fur seals on Marion Isla
3. Determine the degree of ecological separation during the terrestrial phase of the fur seals (species, sex and age classes).
4. To determine the morphological, genetic and biochemical characteristics of the two species.

History of Project:

Pinniped research on Marion Island has covered the ecology of Mirounga leonina (completed 1977) and the distribution, abundance and annual cycle of the two Arctocephalus species (completed 1977). The present project was initiated in March 1980. During the May 1980 Relief Cruise of the S.A. Agulhas to Marion Island, the working conditions were assessed. Fieldwork commenced in September 1980 and the first phase was completed in May 1981. The objectives of this study fall within those set out for autoecological and monitoring studies of the National South African Antarctic Programme.

Progress:

Population trends.

Population sizefor both species was determined by direct census methods The population estimate appears to agree well with the proposed 10,5% rate of increase for A.tropicalis, however, the population trend for A. gazella still needs to be analyzed. It would however appear that the latter species is occurring in lower numbers than previously observed. The colonization of this island by this species may however still be in the establishing phase and the observed increase in the A. tropicalis may account for the lowered numbers of A. gazella .

Seasonal Cycle.

The seasonal occurrence of both species was determined by weekly counts from September to April, for comparative purposes. There appears to be no temporal separation between the species as they have coincident haulout peaks during December and February.

Vocalizations.

A complete range of vocalizations has been recorded for both species. These vocalizations are to be compared with the aid of sonograms to quanitfy the differences between these two species. Field observations do indicate that differences do occur and the recorded sounds are typical for each species.

Habitat Selection.

Data have been collected in two aspects of habitat selection (1) The parameters of the major breeding colonies of both species were measured (2) The parameters of individual habitat choice have been determined for territorial bulls of both species. These data are to be processed using principal component and discriminant function analayses.

Both species do breed throughout the entire coastline of both Marion and prince Edward Island, and intermingling does occur. A. gazella were observed to produce pups within the bounds of A. tropicalis harems but direct observations could not confirm interspecific copulation.

Field observations suggest that A. gazella predominantly breed on the vegetated areas behind the breeding beaches of A. tropicalis. These areas are also intensively utilized by sub-adult and idle A. tropicalis.

Morphological and biochemical data.

Standard morphological measurements as well as skulls and skins have been collected for fifteen adult A. tropicalis bulls, three adult A. gazella bulls and five adult suspected hybrid bulls.

Field observations of pelage differences will be supplemented by colour coded comparisons of the collected skins. Preliminary comparisons suggests that there is a difference between the apparent hybrid skulls as well as the two species. This will be investigated by discriminant function and principal component analysis.

Blood samples have been collected from 42 A. tropicalis pups and th
is to be analysed electrophoretically to characterise the blood biochem
of this species. These samples will be analysed for Albumin, transferr
slow Alpha-2-globulins and general serum proteins as well as iso-electr
focussing.

Publications: Progress report March 1980 - June 1980.

HELICOPTER TIME APPLICATION.

Helicopter time will be necessary for the successful completion of the project on "The genetical and ecological relationships between two species of fur seals Arctocephalus tropicalis and A. gazella on Marion Island". The flying time will be utilized to ferry equipment and personnel to the otherwise inaccessible seal colonies.

Flying time requested is:

May 1982 Approximately two hours to fly to the west coast of Marion Island, as well as a trip to Prince Edward Island.

October 1982/November 1982 Approximately three hours to visit the seal colonies to collect biochemical samples.

PROGRESS REPORT TO SASCAR

Project Title

RELATIONSHIPS BETWEEN THE POPULATION DYNAMICS OF SELECTED SPECIES OF SEABIRDS (CHIEFLY PENGUINS) AND THEIR PREY (CHIEFLY KRILL) AT THE PRINCE EDWARD AND GOUGH ISLANDS.

Project Leader

W.R. Siegfried, FitzPatrick Institute, UCT.

Project Researchers

M.R. Lynch, N. Adams, C.R. Brown, FitzPatrick Institute, UCT.

Date

Second annual progress report, July 1980 - June 1981, submitted in June 1981.

1. Objectives

a. To determine the numerical status, productivity and population structure of Macaroni Eudyptes chrysolophus and King Aptenodytes patagonicus penguins at the Prince Edward islands, and Wandering Albatross Diomedea exulans and Rockhopper Penguin Eudyptes chrysocome at Gough and the Prince Edward islands, and monitor long-term changes in their populations.

b. To determine the food requirements of the above-mentioned seabirds in relation to their population dynamics at the Prince Edward and Gough islands.

c. To seek complementary approaches to the monitoring and theoretical modelling of interations between seabirds and their prey at Marion Island.

2. History of Project

The SCAR/SCOR - BIOMASS research programme is aimed at obtaining a deeper understanding of the structure and functioning of the Southern Ocean ecosystem, as a basis for future management of the ecosystem and its living resources (chiefly krill). Seabirds (chiefly penguins) are significant top consumers in the ecosystem, and changes in their trophodynamics should indicate changes in the abundance and distribution of their prey (chiefly krill). Macaroni and King penguins and Wandering Albatross were selected by the BIOMASS Working Party on Bird Ecology, as candidates for base-line censuses, and feeding and breeding biology studies at the Prince Edward and Gough islands.

The Project began in 1979 when populations of Macaroni and King penguins and Wandering Albatross at Marion Island were censused regularly during the period May 1979 - June 1980. The breeding success of these populations was monitored during the same period. Adults and chicks of Macaroni and Rockhopper penguins were collected for their stomach contents.

3. Scientific Progress

Objective (a)

During September 1980 - May 1981, various sub-populations of Macaroni and King penguins were censused at varying intervals at Marion Island, to determine the minimum effort necessary to detect meaningful change. A very large colony (of each species), surveyed (by tacheometric techniques) in 1979, was remapped. The breeding success of Macaroni Penguins was monitored. The results of the work done during 1979 and 1980 at Marion Island have formed

the basis for a long-term monitoring programme, scheduled fo implementation in July 1981. A description of this programme i being prepared, and will be submitted to SAJAR for publication, a a manual for operations in the future.

All Wandering Albatrosses in two areas at Marion Island wer censused regularly, according to methods established in 1979. Th breeding success of these birds was monitored. Fewer adults wer banded in 1980 than in 1979, as part of a test designed to measur the effect of human disturbance on the birds. A long-ter monitoring programme for this species at Marion Island is bein described. Mensural and plumage data and information o nest-spacing of Wandering Albatrosses were obtained at Marion Prince Edward and Gough islands. The precipitous terrain an inclement weather at Gough Island are major obstacles to intensiv fieldwork. It is hoped that helicopter assistance will b available to the team that plans to visit Gough Island later i 1981.

Objective (b)

Food samples were obtained from King, Macaroni and Rockhoppe penguins and Wandering Albatrosses. The identification of numerou items in these samples has been delayed, due to the lack of an expert taxonomist. Neverthless, one report has been completed an submitted to SAJAR for publication.

Physiological studies aimed at determining the energy and foo requirements of penguins and Wandering Albatrosses started in Ma 1981, at Marion Island. Measurements of the birds' metaboli rates and digestive efficiences are being made, using a variety o techniques.

Objective (c)

A draft manuscript dealing with a bioenergetics model for the large surface-breeding birds at Marion Island is undergoing revision at present.

4. Publications

Williams, A.J. and W.R. Siegfried. 1980. Foraging ranges of krill eating penguins. Polar Record 20: 159-162.

Williams, A.J. 1980. Diet and subspeciation in Gentoo Penguins. Bull. Brt. Orn. Club 100: 173-175.

Williams, A.J. and P. Laycock. (in press). Euphausiids in the diet of sub-Antarctic penguins. S. Afr. J. Antarct. Res.

PROGRESS REPORT

PROJECT TITLE: THE INFLUENCE OF SOUTHERN ELEPHANT SEALS MIROUNGA LEONINA (LINN.) ON THE COASTAL TERRESTRIAL ECOLOGY OF MARION ISLAND

PROJECT LEADER: Professor J D Skinner, Mammal Research Institute, University of Pretoria, Pretoria 0002

PROJECT RESEARCHER: K. PANAGIS

PROGRESS REPORT: Second Progress Report, June 1980 - May 1981.

OBJECTIVES

The changes occurring within elephant seal moulting/wallowing sites have never been studied in detail. The quantification and determination of these ecological changes will provide dynamic relationships between the seals and their resultant changes to be usable in the ecosystem research approach to Marion Island. The project aims to determine:

1. The extent of change and utilization of moulting areas.
2. The overall seal effect of nutrient input into the whole system. Is there a cycle?
3. Whether the rate and nature of recovery is similar at different sites.
4. The vegetational and soil variables which correlate with the seasonal haul-out pattern of the seals.
5. Whether significant terrestrial changes are occurring which can be correlated with seal numbers.
6. Whether there are differences and seasonal variations in soil organisms

HISTORY OF PROJECT

Preliminary data collection for the project was reported in the first progress report (June 1980). Fieldwork was undertaken from September 1980 to April 1981. Although the special character of the vegetation associatio with sea-bird and seal colonies have been recognized and others have

emphasized soil-nutrient levels and vegetational changes no detailed studies have been carried out. Data were collected on the seals, soils, vegetation and invertebrates of moulting/wallowing sites on Marion Island.

PROGRESS

Data were collected during the 1980/81 summer and are currently being processed. Processed information includes:

1. Moulting/wallowing sites on Marion Island consist of 36 separate areas ranging from 565 m^2 to 36 297 m^2 with a total area utilization of 312 447,96 m^2 on the island.

2. Wallowing sites occupied by current populations of elephant seals represent a decrease of 13,9% of the total number of sites previously occupied. Utilization within specific wallow study sites are still being processed.

3. Urine output determined from caged adult and sub-adult female elephant seals ranged from 633,1 and 216,4 ml per day respectively. The nutrient and calorific contents of the urine, feces and of whole seal carcasses is still to be determined.

Information has been collected on the seals (total numbers, utilization of areas, distribution within areas and intensity of use), soils (physical, chemical and geographical), vegetation (percentage cover, species composition, plant heights, vitality and chemical), invertebrates (species composition) to determine relationships between these. These are to be assessed following completion of laboratory analysis.

Objectives 1, 2 and 4 have been realized by data collection. Objective 3 involving the regeneration and recolonization of areas influenced by seals was assessed for the period available. Objectives 5 and 6 will be determined following the analysis of information required in objective 4.

PROGRESS REPORT TO SASCAR

Project Title

POPULATION DYNAMICS AND BIOLOGY OF SELECTED SPECIES OF SEABIRDS AT MARION AND PRINCE EDWARD ISLANDS, WITH PARTICULAR REFERENCE TO THEIR MINERAL AND ENERGY CONTRIBUTIONS IN THE TERRESTRIAL ECOSYSTEM.

Project Leader

W.R. Siegfried, FitzPatrick Institute, UCT.

Project Researchers

M. Schramm, A. Berruti, FitzPatrick Institute, UCT.

Date

Third annual progress report, July 1980 - June 1981, submitted in June 1981.

1. Objectives

a. To determine the mineral and energy contributions of nocturnal burrowing petrels, in the form of feathers, guano, corpses and eggs, to the Marion Island ecosystem.
b. To assess the effect of feral cat predation on nocturnal burrowing petrels.

2. History of Project

Seabirds are an important source of mineral and energy inputs to

the Marion Island ecosystem. The ornithological research carried out at Marion Island between 1973 and 1978 produced estimates of the energy and mineral element contributions of the large surface nesting seabirds. The second phase of the research aims to achieve the same objectives for the burrowing petrels, which are inherently more difficult to study. A population of feral cats has become established at Marion Island and may drastically have altered the island's species composition and abundance of petrel populations. The study aims to provide quantitative information on the effects of cat predation on the petrels.

3. Scientific Progress

Objective (a)

Factors (plant cover by species and total, altitude, slope, gradient and aspect, lava type, surface morphology, soil depth, moisture and organic content and drainage characteristics) which may determine the distribution of burrows of subterranean nesting petrels (chiefly six species) at Marion Island have been sampled in 189 quadrats (30 m X 10 m) in 13 study areas covering five main habitat types. A further 40 quadrats have been measured at other sites at Marion and the cat-free Prince Edward Island. Primary analysis of data (particularly soil parameters) has now been completed and a secondary computer analysis to determine which factors are important in nest site selection will be complete by June 1981. With the availability of high quality aerial photographs, an estimate of population sizes of petrels within limited areas of Marion Island will be possible.

Objective (b)

Data (described under objective a) on the abundance a distribution of petrels at Marion Island (cat-infested) and Prin Edward Island (cat-free) have been compared in an attempt assess the effect of cat predation. The small number of sampl from Prince Edward has made quantification difficult but petre were generally more abundant on Prince Edward Island. The maxim number of petrels recorded in a quadrat at Prince Edward was eig times higher than the corresponding maximum for Marion Island. I addition, Pelecanoides urinatrix, absent as a breeding species a Marion, was very abundant at Prince Edward.

The predation on petrels by a second predator, the skua Catharact antarctica, during its breeding season was assessed. Petre remains from 40 skua territories were analysed and compared wit the data on abundance and distribution of petrels. For certai species a positive correlation has been found between sku predation and petrel numbers.

The documentation of the breeding biologies of the petrel specie is a necessary prerequisite for determining energy and mineral contributions by each species. For this reason, the breedin biologies of Pterodroma macroptera, P. brevirostris and P. mollis were studied. The results have been written up, documentin burrow dimensions, breeding schedules, egg dimensions and weights, incubation and fledgling periods, chick growth rates and breedin success. Feeding rates of a P. mollis chick were determined usin an automatic activity recorder and the data have been written up. Specimens were collected for mineral and energy determinations: P. macroptera (2 eggs, 21 chicks, 8 adults); P. brevirostris (1 egg, 11 chicks, 13 adults); P. mollis (9 chicks, 10 adults); and, 97 specimens of six other species. Energy determinations of eggs

have been completed. Diet material (stomach samples and regurgitations) for P. macroptera (32 samples), Diomedea exulans (15 samples) and D. chrysostoma (40 samples) have been analysed. Analysis of P. brevirostris (74 samples), P. mollis (20 samples) and Pachyptila salvini (30 samples) material will be complete by June 1981. Morphometric data collected on all species of petrels have been added to a large data bank of seabird measurements.

4. Publications

Berruti, A. (in press). Displays of the Sooty albatrosses Phoebetria fusca and P. palpebrata. Ostrich.

Berruti, A., A.M. Griffiths, M.J. Imber, M. Schramm & J.C. Sinclair. (in press). The status of seabirds at Prince Edward Island. S. Afr. J. Antarct. Res.

Burger, A.E. 1980. An analysis of the displays of Lesser Sheathbills Chionis minor. Z. Tierpsychol. 52: 381 - 396.

Burger, A.E. (in press). Time and energy requirements for chick-rearing in Lesser Sheathbills. Condor.

Burger, A.E. & R.P. Millar. 1980. Seasonal changes of sexual and territorial behaviour and plasma testosterone levels in male Lesser Sheathbills Chionis minor. Z. Tierpsychol. 52: 397-406.

Burger, A.E. & A.J. Williams & J.C. Sinclair. 1980. Vagrants and the paucity of land bird species at the Prince Edward Islands. J. Biogeog. 7: 305 - 310.

Imber, M.J. & A. Berruti. (in press). Procellariiform seabirds as squid predators. In: Cooper, J. (Ed). Proceedings of the symp. on birds of the sea and shore. 1979. Cape Town: Afr. Seabird

Group.

Williams, A.J. 1980. The effect of attendance by three adults upon nest contents and chick growth in the Southern Skua. Notornis 27: 79 - 85.

Williams, A.J. 1980. Calculation of penguin proportionate egg weight. Notornis 27: 125 - 128.

Williams, A.J. 1980. Rockhopper Penguins Eudyptes chrysocome at Gough Island. Bull. Br. Orn. Cl. 100: 208 - 212.

Williams, A.J. 1980. Offspring reduction in Macaroni and Rockhopper Penguins. Auk 97: 754 - 759.

Williams, A.J. 1980. Aspects of the breeding biology of the Sub-Antarctic Skua at Marion Island. Ostrich 80: 198 - 202.

Williams, A.J. (in press). Why do penguins have long laying intervals? Ibis.

Williams, A.J. (in press). The laying interval and incubation period of Rockhopper and Macaroni Penguins. Ostrich.

Williams, A.J. (in press). Factors affecting the times of breeding of Gentoo Penguins at Marion Island. In: Cooper, J. (Ed). Proceedings of the symp. on birds of the sea and shore. 1979. Cape Town: Afr. Seabird Group.

Williams, A.J. (in press). Growth and survival of artificially twinned Rockhopper Penguin chicks. Ostrich.

Williams, A.J. (in press). The clutch size of Macaroni and Rockhopper Penguins. Emu.

Williams, A.J. & A.E. Burger. 1979. Aspects of the breeding

biology of the Imperial Cormorant Phalacrocorax albiventer at Marion Island. Le Gerfaut 69: 407-423.

PALYNOLOGY AND LONG DISTANCE DISPERSAL - SOUTHERN ISLANDS

Project leader : Prof. D.F. Toerien. Institute for Envoronmental Sciences, U.O.F.S., Bloemfontein

Project Researcher : Dr. L. Scott. I.E.S. U.O.F.S. Bloemfontein

Aim : The aim of the project is to study the age, origin and evolution of the biota on the Island. Fossil pollen and spore assemblages provide evidence of early plant communities on Marion. The investigation is necessary to improve our background understanding of the island ecosystem.

History : Up to March 1981 the research was conducted by Prof. E.M. van Zinderen Bakker. The results which provide data on airborne particles and the palynology of some peat cores are summarised in his recent report (1981). The work is now continued by Scott who started in April 1981. The island was visited during April/May 1981 and a series of samples for pollen analysis was collected from various sites. A post for co-researcher was advertised but no candidate with suitable qualifications came forward. Therefore Miss M. Steenkamp, a B.Sc-student, was appointed as research assistant on a half-day basis.

Progress : a) Sampling: The following samples were collected: 31 surface samples from various plant communities and altitudes; 111 borehole samples from six peat cores on Skua Ridge, Albatros Lakes and near the

meteorological station; 39 samples from the 6 m peat section at Kildalkey, 15 samples of relatively old pre-glacial deposits exposed along the coast at Long Ridge, Ship's Cove and Kildalky Bay; 14 samples from various other deposits. Plants in flower and sporulating bryophytes were collected in order to enlarge the reference collection of pollen and spores.

b) Processing of samples: Up to now fifty samples, including most of the surface and pre-glacial samples, have been processed by means of standard palynological techniques such as HF and KOH diqestion, acetolysis and heavy liquid mineral separation. Slides were mounted in glycerine jelly. The late Pleistocene and Holocene peat profiles are currently being processed. Here the technique of adding a known number of exotic pollen to weighted samples is being employed in order to obtain a quantitative estimate of fossil pollen and spore concentrations in the cores. The determinations will facilitate more accurate palaeoecological interpretations.

c) Results: Of the older pre-glacial deposits from along the coast only the organic-rich interglacial material from Kildalkey yielded pollen. Fluvial deposits from Long Ridge and Ship's Cove are pollen-barren. The results of the pollen analyses of the Kildalkey material are presented in Fig. 1. The samples represent pockets of peat in fluvially deported sands and gravel ovelying a basaltic lava

and underlying tills of two glacial episodes. According to K. Hall the available K/Ar dates (McDougall, 1971) from the interglacial lava flows broadly locate the samples between 276 000 ± 30 000 B.P. and 103 000 ± 10 000 B.P. with the possibility of the deposits being situated upon a lava sequence dated at 215 00 ± 20 000 B.P. The following pollen types were recorded: *Azorella*, *Acaena*, Gramineae, *Ranunculus*, *Montia*, cf. *Pringlea*, *Lycopodium magellanicum* and *Cotula*. In general Gramineae pollen is the most abundant type. The lower deposits directly above the lava contain high numbers of *Cotula* while the upper samples (approximately 2 m higher) contain relatively high percentages of *Azorella* and *Acaena*. It is interesting that *Azorella* is absent in the lowermost two samples. In most of the modern spectra which were briefly examined as well as in Late Pleistocene and Holocene spectra (Schalke & van Zinderen Bakker, 1971) this type is prominent. Its absence in these older deposits suggest that at first *Azorella* did not colonise this part of the island but arrived later. Whether it occurred elsewhere on Marion is uncertain. The high numbers of *Cotula* in the lower samples may suggest close proximity to the ocean.

Another interesting aspect is that a small minority of the Compositae pollen grains which were recorded do not seem to belong to the *Cotula* type. In order

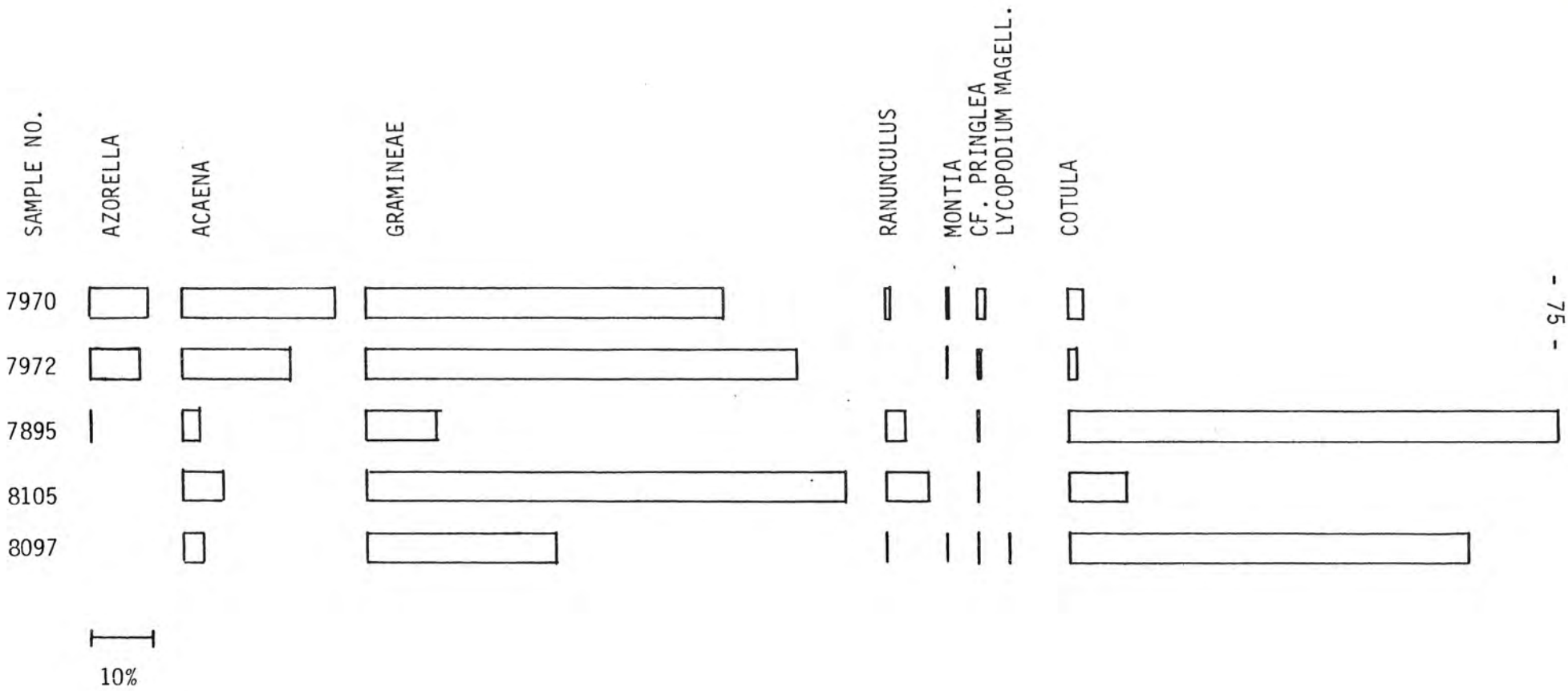
to find out whether these do not perhaps represent an extinct type on the island it will be necessary to study the pollen of *Cotula* in more detail to establish its morphological range.

The next phase of the work will involve the younger Late Pleistocene and Holocene deposits and also surface pollen spectra which will provide background information for the interpretation of the fossil spectra.

Bloemfontein
18 August 1981

L. SCOTT

FIG. 1. POLLEN PERCENTAGE DIAGRAM OF INTERGLACIAL DEPOSITS, MARION ISLAND



V. R. SMITH, Institute for Environmental Sciences, University of the OFS.

PLANT ECOLOGY OF MARION ISLAND: PROGRESS REPORT - APRIL 1980 TO APRIL/MAY 1981

CONTENTS:

1. PHYTOSIOCIOLOGICAL CLASSIFICATION AND ECOLOGICAL SURVEY OF THE VEGETATION OF MARION AND PRINCE EDWARD ISLANDS

A floristic and ecological account of the islands' vegetation is in press (N J M Gremmen, 1981: "The vegetation of the Subantarctic Islands Marion and Prince Edward, to be published by Dr W A Junk Publishers). This work represents the culmination of 18 months' field work and five years' laboratory and computer analysis and is the most comprehensive account of the distribution, ecology, phytogeography and floristics of any Subantarctic vegetation to date. In addition, a description of the Marion Island climate is provided which updates Schulze's 1971 account. Synchorological remarks are provided for each of the plant communities. A preprint copy of the manuscript has been submitted to S A S C A R and a summary is provided overleaf. The volume will appear late this year.

Summary

This study gives an account of the plant communities of the Subantarctic Islands Marion and Prince Edward.

Marion and Prince Edward Islands (46° 54' S, 37° 45' E) are comparatively young, volcanic islands, associated with the West Indian Ocean Ridge. They form small specs of land in the vast Southern Ocean, far removed from any continent (Africa is 1800 km to the NNW, Antarctica 2300 km to the South). The nearest land is formed by the Iles Crozet, 945 km East of the islands. Marion Island measures 290 km^2, Prince Edward 44 km^2. The islands lie 22 km apart from each other. They are the summits of shield volcanoes and their age is estimated to be about 0.5 million years. Two periods of volcanic activity have resulted in two distict series of lavas. Fine-grained, grey basaltic lava originated from eruptions between c. 275 000 and 100 000 years BP. A period of volcanic activity about 15 000 years ago resulted in strongly vesicular, black lava. Recently (1980) a small eruption took place at Kaalkoppie on Marion Island. Between the two periods of volcanic activity glaciers have covered Marion Island nearly completely. The glaciations are of the same period as the Würm- and Riss-glaciations in Europe. During these ice ages the Antarctic Convergence, the boundary between the cold Antarctic Surface Water and the c. 2° C warmer Subantarctic Surface Water, which is now situated about 250 km to the south of Marion and Prince Edward Islands, had shifted to a position north of the islands.

Marion Island consists of a central mountain area, reaching up to 1230 m above sea level, sloping down in all directions towards the sea. Along the west- and southcoast this slope abruptly ends in a 2-300 m high escarpment, which steeply descends towards a coastal plain. A radial pattern of elevated grey lava ridges, separating low-lying areas covered by black lava, is found, probably the result of radial faulting. About 130 scoriae cones mark the centres of eruptions of the second volcanic stage. The highland of Prince Edward Island, the summit of which reaches 672 m, gently slopes down towards the East. On the western side it ends abruptly in a c. 400 m high escarpment which descends towards a coastal plain. Towards the north and south the highland ends in high, precipitous cliffs, descending steeply towards the sea,

The climate of the islands is extremely oceanic, with an average annual temperature of 5° C, which shows very little diurnal and seasonal variation, a very high precipitation (2575 mm annually) and humidity, and with high wind speeds. Three soil-categories can be discerned: peat soils, soils of lowland slopes, consisting of a layer of organic

matter overlying a layer of clay, and fjaeldmark soils, which consist of clay containing often many rock fragments. The latter soils are sometimes very shallow. Weathering plays a minor role in supplying nutrients to the soil. The major source of mineral nutrients is the ocea directly via salt-spray (e.g. Na, Mg and K) or indirectly via excreta and other depositions by sea-going animals (notably N and P).

Marion and Prince Edward Islands are situated within the Subantarct Zone, i.e. south of the southern limit of growth of trees and woody shrubs and north of the southern limit of closed phanerogam communities. The flora of the islands shows a strong affinity to that of the other islands of the Kerguelen Province (Crozet, Kerguelen, Heard and Macdonal Islands). The total number of species is small: 23 indigenous species of vascular plants occur, and 72 mosses, 36 hepatics and 50 species of lichens have been identified. Of 2 further species of vascular plants the status on the islands has not conclusively been ascertained. The influence of man on the islands' ecosystems is comparatively small. Although sealing must have had a devastating effect on the population-sizes of Elephant Seal and Fur Seal, these seem to have recovered again. Most further influence is indirectly, as a result of, in most cases inadvertent, introductions of plant and animal species to the islands. On Marion 14 species of vascular plants have been introduced, of which four have disappeared again. Three species of vertebrates were introduced: cats, mice and trout. Of these the cats form a pest, heavily influencing the populations of small birds. Some insects appear to be introduced also. The only alien species recorded from Prince Edward Island is Poa annua.

The vegetation of Marion and Prince Edward Islands has been studied using the methods of the Braun-Blanquet School. Forty-one plant communities (on the level of subassociations) were distinguished, of which the floristic composition, structure, habitat-characteristics and the distribution on the islands has been described. All syntaxa in this study are newly described. As far as the data available in the literature allowed remarks are made on the distribution of these communities in other areas. The communities are grouped into 6 community-complexes, which comprise floristically and ecologically related syntaxa.

The first group of communities, united into the Crassula moschata complex, forms the vegetation of areas strongly affected by salt-spray. Three associations are discerned: the Cotulo plumosae - Crassuletum moschatae, Crassulo moschatae - Clasmatocoleetum vermicularis and Crassulo moschatae - Azorelletum selaginis. The distribution of these

is largely determined by the intensity of salt-spray deposition and by the soil water regime.

The vegetation of areas strongly influenced by trampling and manuring by animals is formed by the communities of the Callitriche antarctica - Poa cookii complex, viz. the Montio fontanae - Callitrichetum antarcticae, Callitricho antarcticae - Poetum annuae, Poo cookii - Cotuletum plumosae, Montio fontanae - Clasmatocoleetum vermicularis and Leptodontio proliferi - Poetum cookii. The distribution of these communities is largely dependend on the intensity of the influence by animals and on the water content and the proportion of organic matter in the soil.

Communities dominated by Acaena magellanica, united in the Acaena magellanica - Brachythecium complex, form the vegetation of springs, flushes, drainage lines and other sites with a pronounced lateral water-flow just above, or below the soil surface. The associations which make up this complex form a series from extremely wet habitats (e.g. springs) to comparatively dry sites (e.g. drainage lines on steep slopes) in the following order: Brachythecietum subplicati, Acaeno magellanicae - Drepanocladetum uncinati, Acaeno magellanicae - Brachythecietum rutabuli and Acaeno magellanicae - Agrostietum stoloniferae.

The communities which occur in oligotrophic mires form the Juncus scheuchzerioides - Blepharidophyllum densifolium complex. Most of the communities of this complex can be arranged into a single series, ranging in habitat from very wet (bog ponds) to comparatively dry (peat deposits with a groundwater level below 25 cm), in the following order: Community of Juncus scheuchzerioides (Ranunculus biternatus variant), Junco scheuchzerioidis - Drepanocladetum uncinati, Distichophylletum fasciculati, Blepharidophyllo densifolii - Clasmatocoleetum humilis, Uncinio compactae - Ptychomnietum ringiani and Lycopodio magellanici - Jamesonielletum coloratae. This series can also be interpreted as a successional series. The vegetation on peat soils with a comparatively high proportion of mineral matter is often formed by the Jamesonielletum grandiflorae. In water tracks through the mire expanse Bryo laevigati - Breutelietum integrifoliae occurs.

On well-drained slopes the vegetation is formed by the Isopterygio pulchelli - Blechnetum penna-marinae, the only association of the Blechnum penna-marina complex.

The vegetation of fjaeldmark areas is formed by the communities of the Andreaea - Racomitrium crispulum complex: Jungermannio coniflorae -

Racomitrietum crispuli (in the lowlands) and Andreaeo acutifoliae - Racomitrietum crispuli (at strongly exposed sites in lowland areas and at higher elevations). These communities show a very complex structure and are comparatively rich in species. This is a consequence of the complex nature of the fjaeldmark substrate and the cushion-forming habit of many species in this type of vegetation. In one of the subassociations of the Andreaeo - Racomitrietum a large part of the plants grows below the surface, in the hollows between the rocks making up the scoriae deposits on which this community occurs. Moss balls, unattached globular colonies of mosses, are locally abundant in fjaeldmark areas.

An ecological outline of the vegetation of Marion and Prince Edward Islands is given, in which the most important environmental gradients are described, and the communities arranged in series along these gradients. The most prominent factor influencing the distribution of the plant communities on the islands is the soil moisture regime. Gradients from organic to mineral soils and from somewhat sheltered to strongly exposed conditions run more or less parallel with the wet - dry gradient. Two series along wet-dry gradients can be formed, one comprising communities from habitats with no pronounced lateral water movement, the other consisting of communities from springs, water tracks and drainage lines, where lateral water-flow is pronounced. The first series contains most communities of the Juncus scheuchzerioides - Blepharidophyllum densifolium complex, the Blechnum penna-marina complex and the Andreaea - Racomitrium crispulum complex, while the second series consists of the communities of the Acaena magellanica - Brachythecium complex and one association of the Juncus-Blepharidophyllum complex. Only the communities of the Callitriche antarctica - Poa cookii complex and the Crassula moschata complex, i.e. the vegetation of areas strongly influenced by animals or by saltspray, do not fit into these series. They differ floristically strongly from all other vegetation on the islands.

2. MIRE GRASSLAND STUDY

Field work for this study was completed in September 1980. At approximately fortnightly intervals over the preceding year eight quadrats were harvested and above and below-ground plant material sorted into living and dead, vascular and cryptogamic components. Eight samples of peat were collected and immediately analysed for inorganic nitrogen. The rest of the soil samples and the dried plant samples were returned to South Africa. The chemical analysis of these materials (also including rain-water) is currently being carried out. Part of the data will be presented at the symposium on "Subantarctic Terrestrial Ecosystems" to be held at Rennes in July 1981.

3. DATABANK FOR PLANT ECOLOGICAL INFORMATION

An extremely large amount of standing crop and chemical analysis data has accrued as a result of activities within the plant ecology project. This data is now stored in a data bank in the UOFS computer archives. The bank is in the form of files, each representing one plant species. Elements within each file represent the community from which the species was collected. Information included in the bank is:

(1) Collection date.
(2) Standing crop or biomass of the various plant organs.
(3) Chemical composition of these organs.

To date the bank is complete for *Blechnum penna-marina*, *Agrostis magellanica*, *Poa cookii*, *Acaena magellanica* and *Azorella selago*. Six communities are represented: Closed and open fernbrakes, mires, fjaeldmark, flush and tussock grassland. At present the bank contains information for approximately 3000 samples.

4. BRYOPHYTE PRIMARY PRODUCTION INVESTIGATION

The objectives of this research, which forms the major emphasis of the plant ecology project during 1980 to 1982, are provided in the detailed project proposal submitted to and accepted by S A S C A R in 1980 (Document 4.3 - bryophyte studies). The main aim of the study has been to evaluate and select appropriate techniques for the measurement of bryophyte productivity on Marion Island and to initiate long-term

(yearly) growth studies with a view to obtaining reliable annual production studies.

Mr Shaun Russell was appointed to this project in September 1981 and immediately visited the island for an eight month period. Study sites were selected for growth studies using the following considerations:

(i) Are the bryophyte species present in the stand representative of the range of growth forms occurring for the species?

(ii) Is the stand representative of a recognizable, commonly occurring community?

(iii) Is there sufficient protection of the stand from animal interference?

(iv) Is the stand reasonably accessible.

Comprehensive floristic and habitat data were obtained for each stand following the procedure laid down by Gremmen in his 1975 report to S A S C A R and in an early version of his final (1981) manuscript.

Eighteen bryophyte species were selected for study and 9 techniques of estimating primary production assessed (including a gas-exchange technique). Table I indicates the growth method used for each species.

Chlorophyll contents of each species were determined throughout the year and the water relations of each species assessed. The results of these two activities will be compared with the community gradient analysis of Gremmen (1981) and preliminary analysis of the data indicates strongly clustered habitat-related components.

A major effort was made to establish a reference collection of bryophytes from Marion and Prince Edward islands. Five hundred specimens were collected, including some species not previously collected. Most of the specimens have been identified by Russell or Gremmen and the rest will be identified by Dr R E Magill of B R I, Pretoria. Microscope slides and photomicrographs were made of all specimens. The reference bryophyte collection will be housed at B R I and a duplicate collection at University of the O F S. This latter will be available for use on the island.

5. GUIDE TO THE MARION ISLAND VASCULAR FLORA

This guide was produced (one copy) by N J M Gremmen on Marion Island early in 1975. It included a photographic key to all of the vascular species as well as ecological notes of each species. It was intended for use by biologists and meteorologists who wanted an easy method of rapidly becoming acquainted with the vascular flora and the key was housed with the other scientific works in the island library. This has disappeared and Gremmen is producing another copy which will be submitted to D O T within the next few months.

6. INCIDENTAL RESEARCH ACTIVITIES

The discovery of a recent volcanic eruption at Kaalkoppie, Marion Island in November offered a unique possibilities for plant ecological research. Shaun Russell had some training in geology and geomorphology and visited the Kaalkoppie area with Aldo Berutti of the Fitzpatrick Institute. They spent two weeks surveying the area and writing up a report which has been circulated to all programme directors by DOT and which has now been written up for publication by Verwoerd (1981).

7. PUBLICATIONS ARISING FROM THE PLANT ECOLOGY PROJECT SINCE MARCH 1980

Gremmen, N J M and Smith, V R (in press). *Agrostis stolonifera* L. on Marion Island (Subantarctic). *S. Afr. J. Antarct. Res.* 9 or 10.

Smith, V R (1980). A phenol-hypochlorite manual determination of ammonium-nitrogen in Kjeldahl digests of plant tissue. *Communications in Soil Science and Plant Analysis* 11: 709-722.

Smith, V R, Bate, G C and Oosthuizen, M M (1980) ANDAT: An interactive, computerized manual for the chemical analysis of plants, soils and fresh-waters. *S. Afr. J. Sci.* (in press).

V.R. SMITH, Institute for Environmental Sciences, University of the OFS.

Progress Report : Decomposition studies on Marion Island. May 1981.

The project commenced on April 1st 1981 and noone has yet been appointed to the decomposition research post. A resumé has been made of decomposition and decomposition-related work carried out to date at Marion Island and at other Subantarctic sites.

1. Marion Island

Joubert (1971) conducted a very superficial microbiological study on eight samples of rusty brown precipitates found in seepage pools at the entrance to petrel and prion burrows. Typical iron bacteria were not present and it was postulated that the ferric-containing precipitate originated from organic salts, the organic radicle being destroyed by bacteria or other microorganisms. The presence of Protozoa and ciliates was noted for "some of the samples".

Lindeboom (1979) conducted detailed studies indicating the importance of the role of microorganisms in the breakdown of uric acid on Marion Island. This author and Burger, Lindeboom and Williams (1978) provide estimates of the quantities of uric acid-nitrogen reaching the island ecosystem via surface nesting birds. Lindeboom (1979) also supplies some bacterial counts for various substrates and the temperature and nutrient characteristics of selected isolates. It appears that all of the lowland isolates studied were psychrotrophes, rather than psychrophiles, but that psychrophiles occurred at high altitudes. Nitrogen and phosphorus were found to be limiting factors for bacterial growth at unmanured sites on the island with nitrogen most often deficient.

Thirty-five species of Thecamoebae (Rhizopoda) from twelve peat and moss turf samples from the island are described by Grosspietch (1971), including one new species and five new varieties. A short account of the biogeography and ecology of these species is provided. Huntley (1971), De Villiers (1972, 1973), Kok (1974) and Burgers (1978) provide estimates of the numbers and biomass of earthworms and caterpillars in soils and peats of a wide variety of island sites and recent work (Gleeson, pers. com.) has extended these studies to even more sites. Taxonomic studies on Oribatei (Van Pletzen and Kok, 1971), Insects (Dreux, 1971; Vari, 1971; Kuschel, 1971) and earthworms (Sims, 1971) have been carried out, some including biogeographical considerations but none concerned with the ecology of the

various organisms.

Litter-bag studies of plant litter weight loss and nutrient content change have been carried out (Smith, unpublished). Current assessments of the decrease in tensile strength of Shirley test cloth will enable a comparison of the "decomposition potential" of the island soils with that of other Subantarctic and northern hemisphere tundra sites. A general survey of the distribution of soil microorganisms at twenty sites on the island is also currently being carried out.

2. Other southern subpolar areas

Decomposition studies involving litter-bags, Shirley test cloth, soil respiration and fungal colonization patterns on decomposing leaves have been completed on South Georgia, Signy and, to a lesser extent, on Macquarie Islands. Very little of the data has appeared in print but available results indicate high rates of decomposition in many Subantarctic plant communities. Reviews on decomposition in the Maritime Antarctic and Sub-antarctic may be found in Collins, Baker and Tilbrook, 1975 (Signy Island), Jenkin, 1975 (Macquarie Island) and Smith and Walton, 1975 (South Georgia). An excellent account of decomposition studies to date in the Antarctic and Subantarctic will shortly become available as chapter 2 of Dr R.M. Laws' book "Antarctic Ecology" (Smith, in press). Much comparative information on Southern subpolar decomposition phenomena is available in many of the chapters contained in the proceedings of the IBP Microbiology, Decomposition and Invertebrate Working Group Meeting held in 1973 (Holding *et al.*, 1974).

Conclusions from the above studies as well as observations and results of other ecosystem-orientated projects on Marion Island allowed the identification of the following key questions for the decomposition project.

1. What is the significance of decomposition processes within the Marion Island ecosystem regarding organic turnover, energy flow and mineral cycling?
2. What is the basic structure of the decomposer subsystem?
   (a) identification of decomposer organisms
   (b) Functional ecology of decomposer organisms : including functional ecology of invertebrate and physiological characterization of the microorganisms
   (c) Quantitative ecology of decomposer organisms.

3. What are the regulatory effects of the environment on the decomposer subsystem.
4. What are the rates of decomposition of organic substrates and of mineralization of essential nutrients by the decomposer organisms.

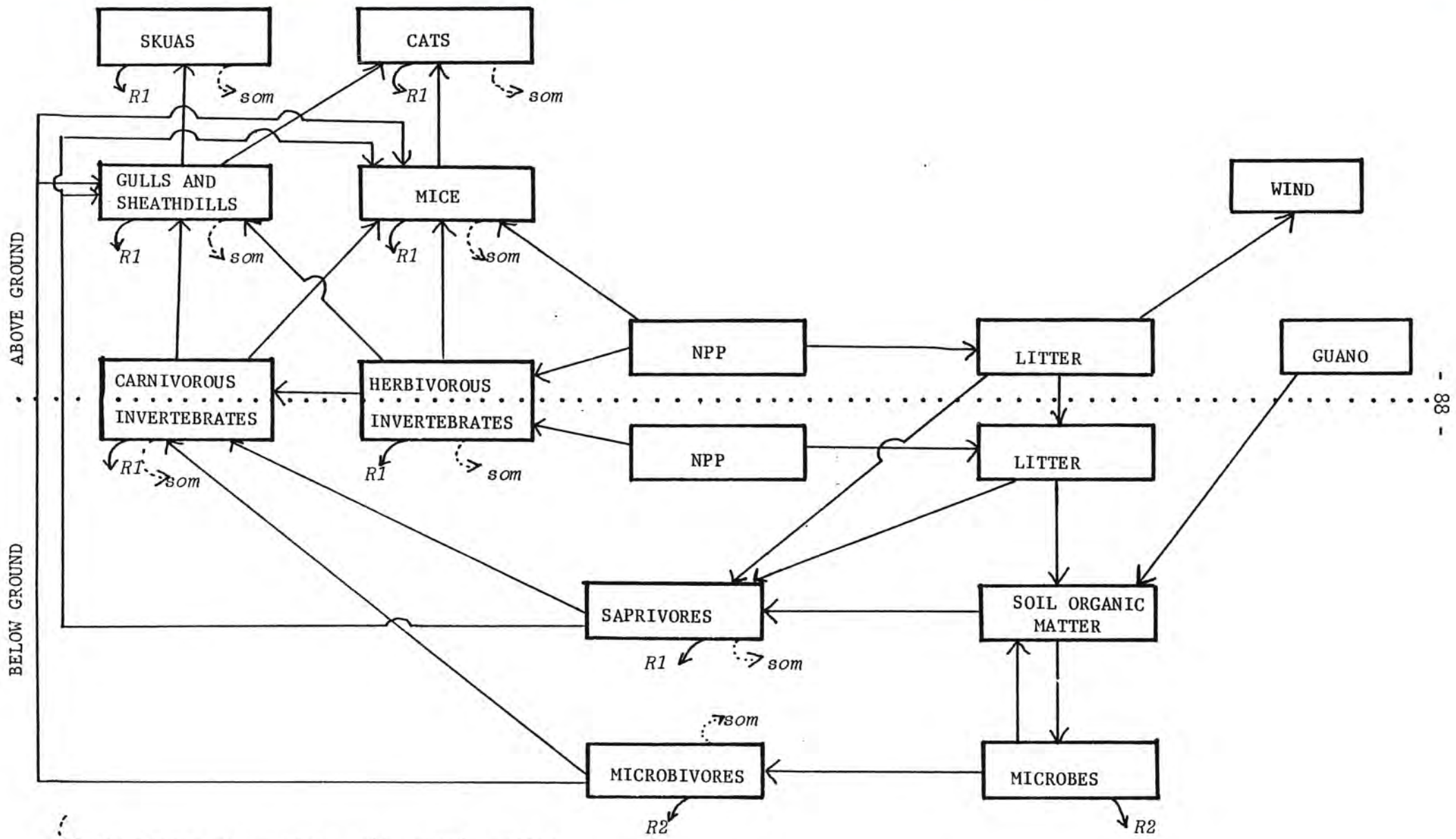
An indication of the significance of the decomposer subsystem in energy flow through the island ecosystem (question 1, above) is provided by the energy flow model depicted in Figure 1. This model, constructed for the low-altitude areas of the eastern coastal plain, simulates the transfer of energy from donor to recipient components and apportions the respiration of each component to either (a) the grazing subsystem (herbivores, carnivores and saprivores) or (b) the decomposition subsystem (microbes, microbivores and saprivores).
Several features of the model maximize the amount of energy passing through the grazing subsystem or decrease the amount available to the decomposition subsystem.

(i) Energy transfer between decomposer subsystem organisms and carnivorous invertebrates, mice and birds and subsequent transfers of this energy to higher trophic levels is ascribed to the grazing subsystem.
(ii) Wind is considered as an important agent removing litter from the island (50% of all above-ground litter produced is removed by wind for simulations 1 and 2 reported below).
(iii) Feathers and carcasses are not considered as energy inputs.
(iv) Herbivory was considered to be important and set at values which are probably much higher than expected for the island ecosystem.
(v) Carnivory, especially by mice, was set at high values for simulation 1 (Figure 2).
(vi) Natural mortality is not considered in the model.

Very few of the driving variable (consumption, egestion, excretion and respiration) values are known for the island organisms. Above and belowground net annual primary productions were taken to be 500 g each and the model assumes that this is constant over the entire simulation run. The amount of dead plant material is also assumed to be constant from year to year and soil microbial biomass is also kept constant. The amount of guano input was set at values presented by the Fitzpatrick Institute workers. Sheathbill predation on soil invertebrates was estimated from Burger's work and gulls are considered to exploit the soil invertebrates half as much as do the sheathbills. Sheathbills are considered to be predated upon by cats

Figure 1: Model of energy flow in a Marion Island ecosystem at the low-altitude coastal plain area.

Figure 1: Model of energy flow in the Marion Island ecosystem at the low-altitude coastal plain area.



and skuas in equal amounts and the transfer between mice and cats is taken from Van Aarde's data and from unpublished mouse population observations from Gleeson. All unknown values of feeding rates by carnivores were set high eg. mice were allowed to exploit 50% of the available arthropod species in any one year in simulation run 1. Mice were also considered to consume 10% of the above-ground plant material produced each year, a value probably much higher than actually occurs. Assimilation and respiration values of some carnivore species were derived from data on similar organisms studied elsewhere (mainly IBP tundra biome studies and South Georgia and Signy islands invertebrate work). All other transfers were ascribed arbitrary values which seemed "reasonable" to the author. The purpose of the model is to examine the amount of energy passing through the grazing and decomposition subsystems, as indicated by the amount lost in respiration by these two subsystems. Table 1 depicts the relative values of the compartments after 30 years simulation. The values are in "energy units" a currency roughly equated with biomass in this model. All of the decomposition subsystem components stabilized after a very few years (Figure 2). The time taken for the grazing chain components to stabilize varies according to the driving variable values. Cats and skua components do not stabilize since the model does not consider mortality from, or predation upon, these components.

Large changes in the transfer coefficients between some of the grazing subsystem components resulted in a redistribution of "energy unit levels" between these components and greatly affected the levels reached by decomposer subsystem components (Table 1, compare Sim 1 and Sim 2). However, it is interesting that soil organic matter levels were not affected and that 75% of the total energy respired was accounted for directly by the decomposer subsystem in both simulations. This value was reached after approximately 5-7 years. It therefore appears that, despite the lack of data required to set meaningful values to driving variable parameters, the model succeeds in the purpose to which it was applied in this account and indicates that the major proportion of the total secondary production in the Marion Island ecosystem is accounted for by the decomposer subsystem. Sim 3 (Table 1) presents the results of a 30 year simulation during which the amount of litter removed by wind each year was reduced to 40% of the value in Sim 1 and 2. The decresp/grazresp ratio was increased slightly and the extra energy apportioned to components receiving energy directly or indirectly from soil organic matter on approximately a *prorata* basis.

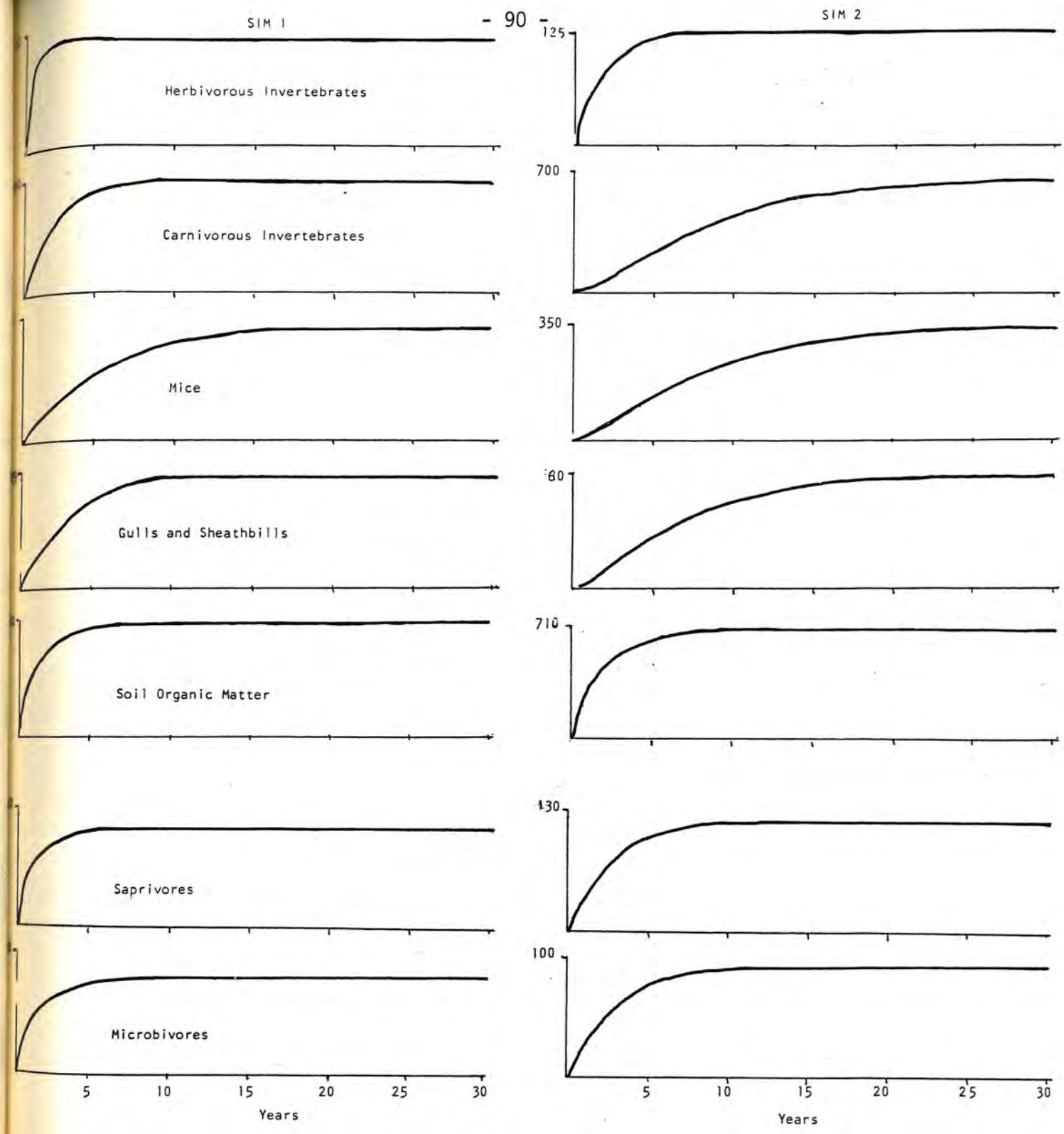


FIGURE 2: RESULTS OF SIM 1 AND SIM 2 (SEE TEXT) FOR SOME OF THE COMPONENTS OF THE MODEL DEPICTED IN FIGURE 1. VERTICAL AXIS IS IN "ENERGY UNITS".

Table 1: Accumulated totals of energy content after 30 years simulation for the components depicted in Figure 1.

Component	Sim 1	Sim 2	Sim 3
Herbivorous Invertebrate	18	123	123
Carnivorous Invertebrates	96	687	764
Mice	567	342	370
Bird	22	58	65
Cat	1577	1038	1118
Skua	72	179	197
Wind	4875	4875	1950
Soil Organic Matter	702	707	803
Microbivores	6	95	107
Saprivores	7	117	135
Grazing subsystem respiration	5723	5622	5950
Decomposition subsystem respiration	16634	16458	18717
Dec Resp/Graz resp	2.9	2.9	3.1

* Simulation 1 run allowing mice to exploit 50% of invertebrate production. Wind removes 50% of above-ground litter.
Simulation 2 run allowing mice to exploit 10% of invertebrate production. Wind removes 50% of above-ground litter.
Simulation 3 run allowing mice to exploit 10% of invertebrate production. Wind removes 20% of above-ground litter.

Other research activities in progess as part of the decomposition project in 1981 - 82.

1. Leaf tagging : a serious lack in our knowledge of vegetation dynamics on Marion Island concerns the rate of movement between living and dead plant material, especially for the tussock grass species. 550 *Poa cookii* tillers were tagged and the distribution of leaf age classes for each tiller noted. The tagged tillers were to be examined in September 1981 to obtain estimates of winter mortality. This follow-up is not possible due to the change in the ship's schedule for this year.
2. Litter-bag investigations : Approx 700 litter bags were exposed in the field between 1975 and 1979. The material from these bags has now been dried and ground and will be analysed chemically during the second half

of 1981.

3. Determination of input of nutrients; precipitation analysis : Precipitation is being measured at 40 sites on the island and the collected sample are being analysed chemically. The results of this study will be available early in 1982.
4. Tensile strength testing of Shirley Test Cloth strips. These strips have been exposed in the field and their loss in tensile strength will be assessed at the Biodeterioriation Centre, Birmingham in July 1981. This will provide a data base which can be compared with those from other tundra sites, including one Subantarctic site.

M.G. STEYN, Institute for Envionmental Sciences, University of the OFS.

NITROGEN CYCLING ON MARION ISLAND: PROGRESS REPORT, APRIL 1980 to MARCH 1981

1. INTRODUCTION

This project assesses the role of microorganisms in the nitrogen cycle of the island ecosystem. In addition, the sources and sinks of nitrogen in the ecosystem are identified and quantified. Flow pathways of nitrogen (mineralization, nitrification, denitrification and fixation) are the major phenomena addressed by this project.

Mr M G Steyn returned from a year's stay on the island in September 1980. During this time he conducted field and laboratory studies into the phenomena listed below:

2. PROGRESS AND RESULTS TO DATE

(i) MPN content and enrichment cultures of nitrifying organisms from mire peats.

Previous work has indicated that some mire peats contain significant quantities of nitrate, indicating the occurrence of nitrification of ammonia, unusual in the waterlogged, cold and acid conditions. A medium based on that recommended by Valera and Alexander (Plant and Soil, 1961, 15: 268-280) was used and isolates were incubated at 20°C for 30 days. The presence of nitrification was indicated by the lowering of pH, production of gas and the production of nitrite. Enrichment cultures were carried out to indicate the presence of the following organisms:

1. Thiobacillus
2. Azotobacter
3. Aerobic cellulose decomposers
4. Anaerobic cellulose decomposers
5. Nitrosomonas
6. Nitrobacter

The cultures were maintained by transferring to fresh medium monthly and incubating at 20°C.

The presence of Thiobacillus could not be detected. Azotobacter appeared to occur in all soil samples and the presence of aerobic and anaerobic cellulose decomposers was also indicated for all these samples. Nitrosomonas appeared to occur in all the samples but it was not possible to definitely establish the occurrence of Nitrobacter.

(ii) Nitrification in soil columns

Glass tubes filled with air-dried, sieved peat samples which were subsequently saturated with water or ammonium chloride solution were exposed in the field or in the laboratory at 20°C. Every 21 days the columns were eluted with water and the concentrations of ammonia, nitrite and nitrate nitrogen in the eluate determined. The experiments were unsuccessful since, after two or three elutions, it became impossible to leach the columns, even with suction. A modification of the procedure was tried whereby the air-dried peat was mixed with sterile river sand before filling the columns. This enabled up to five eluates to be obtained before clogging occurred. The results were very variable amongst replicates and the occurrence of nitrification could not be definitely established. However, there was strong evidence for nitrate reduction and denitrification.

(iii) Nitrogen fixation by heterotrophic bacteria

Incubations to detect nitrogen fixation by bacteria were carried out in the study mire in which the standing crop and soil chemistry were monitored during the 1979/80 season.

To obtain a soil/plant core with minimal disturbance, a glass incubation vessel was designed to be used as a soil corer (Fig. 1). To obtain the core, both the rubber bung and the serum stopper were removed and the glass tube rotated between the hands whilst being gently pressed into the waterlogged soil. At a suitable depth, (approximately 12 to 15 cm), the vessel was twisted sharply to break the soil core and then removed with the intact core. The rubber stoppers were then replaced and the vessel containing the core placed such that the level of the vegetation within the tube was the same as the surrounding vegetation. The incubation vessels were left *in situ* for 24 hours to thermally equilibrate, before the insertion of the different gas phases.

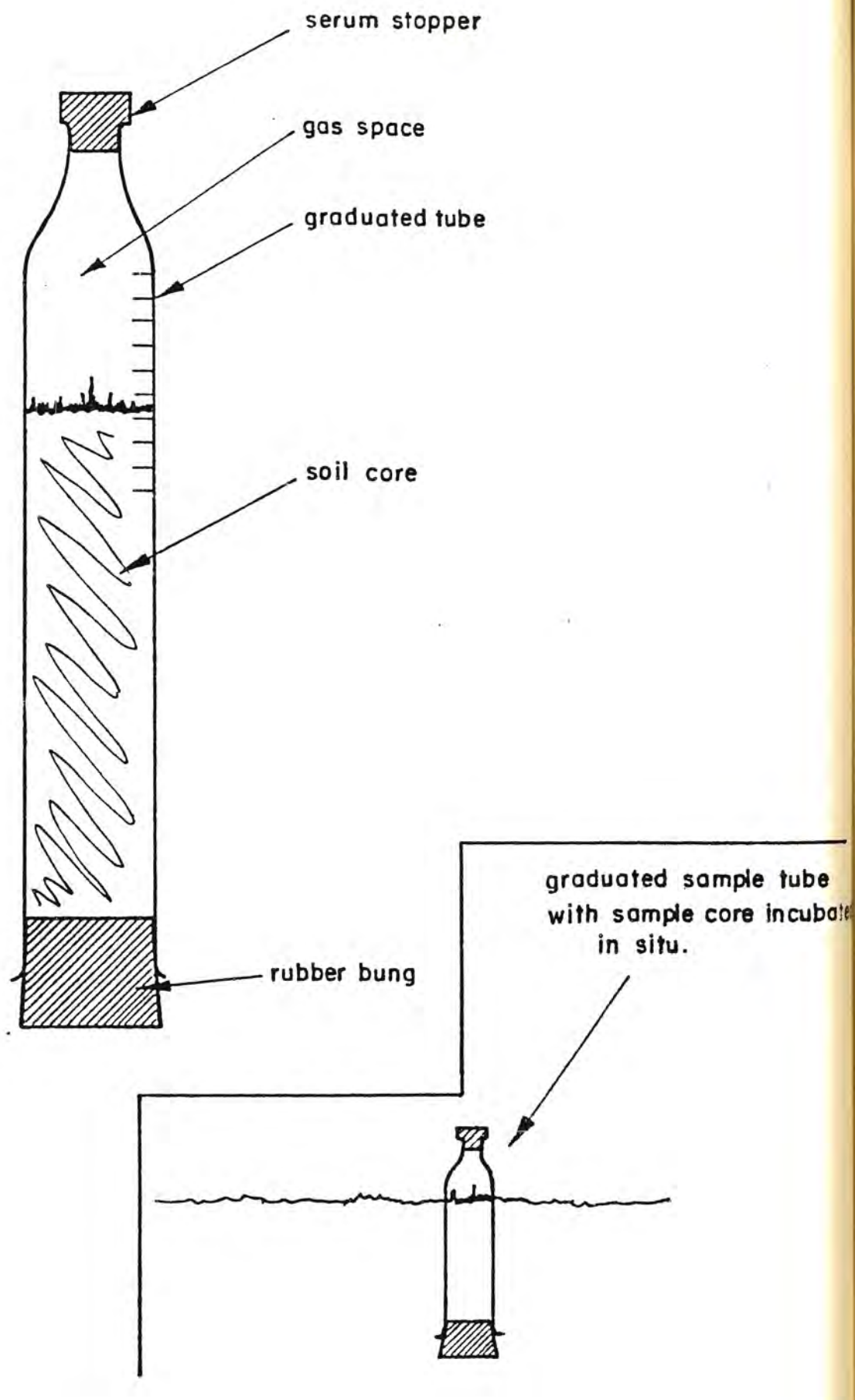


FIGURE 1

Diagram of incubation vessel for acetylene reduction assays in Marion Island mires

Cleaned ("scrubbed") acetylene gas was obtained by slowly bubbling commercial acetylene from a standard cylinder through two jars of concentrated sulphuric acid and collecting the cleaned gas in an inflatable rubber bladder. The gas was extracted from the bladder by hypodermic syringe for each experimental treatment. For anaerobic treatments, the gas phase above the thermally equilibrated soil/plant core was first flushed out with argon, using a 50 mℓ syringe. Appropriate quantities of acetylene gas were injected into the gas space above each core to give a final acetylene concentration of 0,1 atmospheres. After incubation *in situ*, gas samples were withdrawn using evacuated 'Venoject' tubes. The procedure employed has been described in detail by Schell and Alexander (1970). The gas samples were returned to the laboratory for analysis.

Incubations from the initial pilot trial using this technique were analysed on the gas chromatograph of the NIWR, CSIR.

On completion of the incubations and removal of the gas samples the volumes and wet weights of the soil/plant cores were individually determined, after which the cores were oven-dried at 80°C and reweighed. Ethylene production rates were calculated on the basis of surface area and also on the basis of the mass of the soil core.

A single 1,0 mℓ gas sample from each evacuated tube was introducted into a Varian Aerograph gas chromatograph equipped with a 2 metre long, 2 mm internal diameter stainless steel column filled with Porapak R and run at a temperature of 60°C (Stewart *et al.*, 1968). The ethylene and acetylene content of each gas sample was recorded graphically on a chart recorder linked to a Hewlett-Packard 3352B Data System. The ethylene concentration in each gas sample was computed from the area of chart under the ethylene peak and recorded.

The results of the pilot trial are presented in Table 1. It is evident that the replicate ethylene production rates based on the dry weights of cores showed good agreement, while the rates based on area were less precise. Endogenous ethylene production within the cores, both aerobically and anaerobically, occurred at rates approximately 10% of those measured for cores supplied with acetylene. Anaerobic (microaerophilic) acetylene reduction rates were consistently 20-25%

TABLE 1. Ethylene production rates of aerobic and anaerobic soil/plant cores in the study mire, Marion Island.

Sample No.	Description	Inc. time (h)	Core wet weight (g)	Core dry weight (g)	H_2O volume of core (mℓ)	Gas volume of core + tube (mℓ)	Total core volume (mℓ)	C_2H_4 per 3 mℓ vial (µℓ)	C_2H_4 per gas space in tube (µℓ)	C_2H_4 per liq. space in core (µℓ)	Total volume of C_2H_4 (µℓ)	µℓ C_2H_4 per gram dry wt per day	µℓ C_2H_4 per cm^2 per day	mg N_2 per m^2 per day (approximate since not corrected for 28 hours)
1.	Aerobic + C_2H_2	28	69,75	5,30	64,45	30	135	0,0227	0,2266	0,0627	0,2893	0,0545	0,0761	0,289
2.	"	"	60,77	5,06	55,71	45	120	0,0146	0,2190	0,0542	0,2732	0,0540	0,0719	0,272
3.	"	"	49,52	4,01	45,51	45	105	0,0114	0,1717	0,0443	0,2160	0,0539	0,0568	0,209
Mean											0,2595	0,0541		0,257 S.D. = ± 0,042
4.	Argon + C_2H_2	"	53,89	4,84	49,05	45	105	0,0171	0,2559	0,0472	0,3031	0,0626	0,0737	0,303
5.	"	"	61,02	4,95	56,07	40	120	0,0195	0,2601	0,0541	0,3142	0,0635	0,0826	0,315
6.	"	"	73,30	5,50	67,80	25	150	0,0339	0,2824	0,0660	0,3484	0,0633	0,0917	0,353
Mean											0,3219	0,0631		0,324 S.D. = ± 0,026
7.	Aerobic + no C_2H_2	"	65,29	5,08	60,21	37	130	0,0018	0,0228	0,0055	0,0283	0,00557	0,00744	0,0310
8.	"	"	52,23	4,01	48,22	47	105	0,0011	0,0178	0,0049	0,0227	0,00566	0,00597	0,0249
Mean												0,00561	0,00671	0,02795 S.D. = ± 0,00431
9.	Argon + no C_2H_2	"	55,63	4,02	51,61	45	105	0,00131	0,0195	0,0052	0,0247	0,00614	0,00650	0,0271
10.	"	"	55,62	4,89	50,73	45	110	0,00153	0,0229	0,0054	0,0283	0,00579	0,00744	0,0310
Mean												0,00596	0,00697	0,02905 S.D. = ± 0,00276

higher than aerobic rates. When calculated on an aerial basis, as the mass of atmospheric nitrogen fixed per square metre per day, the rates, though low, indicate that significant quantities of atmospheric nitrogen are being fixed despite the low ambient temperatures (mean air temperature 2,5 cm above ground = -1,7°C). During the warmer summer months, fixation of atmospheric nitrogen could contribute markedly to the nitrogen budget of the mire. In the waterlogged soils of this mire, both aerobic (at the surface) and anaerobic (=microaerophilic) fixation should be important.

Based on these results a major effort into assessing the spatial and temporal variation in nitrogen fixation by bacterie was carried out during the 1980/81 summer season, when approximately 350 incubations were performed. Unfortunately, the incubation atmospheres from these trials have not been analysed for ethylene content since a gas chromatograph has not been available. The request for funds to purchase a GLC was not supported by SASCAR in 1980.

(iv) Nitrogen fixation by moss-cyanobacteria associations

During the 1971/72 expedition the occurrence of *Nostoc commune* in the intercellular spaces of the leaves of a moss (cf. *Grimmia insularis*) was noted. Croome (1973) established that *N. commune* was an active and significant fixer of nitrogen in some mire areas on Marion Island. Since then the occurrence of moss-cyanobacteria relationships for a number of moss species has been noted.

A preliminary investigation into the possible fixation of nitrogen by the moss-cyanobacteria associations was initiated in September 1979. The results obtained for this investigation are shown in Table 2. Under the microscope, the four species (1 lichen and 3 mosses) examined showed numerous epiphytic algae. However, the lichen and two of the three mosses did not reduce acetylene. The third moss, *Ditrichum strictum* (Hoog F & Wills) Hamp. demonstrated low, but significant ethylene production rates. It is possible that the low ambient temperatures during the incubation may have prevented or reduced the rate at which acetylene is reduced to ethylene. This would indicate that the single species in which acetylene reduction was recorded would probably show higher rates of acetylene reduction during the summer months. In addition, those species which did not show acetylene reduction may be capable of acetylene reduction in summer.

TABLE 2. Biomass measurements and ethylene production rates of lichen and moss samples on Marion Island.

Sample No. / SPECIES	Incubation time (hr)	Wet weight (g.)	Dry weight (g.)	C_2H_4 per injection (µℓ)	C_2H_4 per bottle (µℓ)	C_2H_4 per gram wet weight	C_2H_4 per gram dry weight	C_2H_4 per gram dry weight per day	($\mu l\ C_2H_4/g/d$) mean
1. Usnea sp. (lichen)	48	1,64	0,66	-ive	0	0	0	0	0
2. "	48	1,46	0,78	-ive	0	0	0	0	
3. Ditrichum strictum (Hook F. & Wills) Hamp.	48	9,48	1,92	0,027	2,25	0,237	1,17	0,585	0,595
4. " "	48	10,43	2,06	0,030	2,50	0,240	1,21	0,605	
5. Notoscyphus natalensis Sim	48	19,27	1,65	-ive	0	0	0	0	0
6. " "	48	9,93	0,87	-ive	0	0	0	0	
7. Jamesoniella colorata (Lehm) Sprua	48	12,70	1,84	-ive	0	0	0	0	0
8. " "	48	5,73	0,96	-ive	0	0	0	0	

The incubation atmospheres of the pilot investigation were analysed for ethylene using the GLC of the NIWR. During February 1981 an intensive investigation into nitrogen fixation by cyanobacteria-moss associations was carried out for the following moss species:

Ditrichium strictum, Grimmia falcata, Brachythecium subplicatum, Distichophyllum fasciculatum, Dicranoloma billardieri, Brachythecium rutabulum, Ptychomnion ringianum, Jamesoniella colorata, Racomitrium crispulum, Marchantia berteroana, Peltigera polydactyla, Blepharidophyllum densifolium, Dampylopus arboricola, Lophocolea randii, Stereocaulon cymosum.

During these incubations the temperature, light intensity and humidity in each incubation vessel were monitored. The incubation atmospheres have not been analysed for ethylene content due to the unavailability of a GLC.

(v) Nitrogen fixation by lichens

In February 1980, an investigation of possible nitrogen fixation by two lichens was carried out. The incubation atmospheres samples during these trials have not yet been analysed for ethylene content because a GLC is not available.

(vi) Seasonal changes in inorganic nitrogen contents of a mire peat

Eight replicated samples of peat from the study mire grassland were analysed fortnightly for ammonium, nitrite and nitrate nitrogen. Ammonium contents were low in September, increasingly throughout the summer. The peak value was reached in June, after which ammonium levels declined sharply. Nitrate-N levels were negligible throughout the season. Nitrate-N concentration varied throughout the year but were generally low. In December, during the time of maximum plant growth, nitrate-N contents in the peat were zero.

(vii) Bacteriological investigation of selected island sites

At twenty sites (in the Ship's Cove - Hendrik Fister Kop - Trypot Beach triangle), maximum and minimum thermometers were placed in the soil. These were read and reset every fortnight. In January and

July 1980 two soil samples, representing two soil depths, were taken at each site for bacterial counts and isolation. Fungi were also isolated. Ten bacterial and two fungal isolates from each sample were brought to South Africa for physiological characterization using an API-20E system. The results of these characterizations are currently being analysed using a multivariate analysis programme and the resulting cluster classification will be compared with botanical and chemical data for each site.

NAAM VAN PROJEK: DIE INVLOED VAN DIE WILDE KATBEVOLKING, FELIS CATUS, OP DIE TERRESTRIELE EKOSISTEEM VAN MARIONEILAND EN DIE DOELTREFFENDHEID VAN JAG AS 'N BYKOMSTIGE BEHEERMAATREEL.

PROGRAMLEIER: J D Skinner, Soogdiernavorsingsinstituut, Universiteit van Pretoria, Pretoria 0002

PROGRAMNAVORSER: P J van Rensburg, Soogdiernavorsingsinstituut, Universiteit van Pretoria, Pretoria 0002

EERSTE VORDERINGSVERSLAG Maart 1981 - Junie 1981

1. Doelstellings

(1) Om te bepaal tot watter mate feline panleukopaenia en ander siektes die katbevolking beïnvloed.

(2) Om vas te stel wat die huidige predasiedruk op die prooisoorte van huiskatte is.

(3) Om vas te stel watter plantkundige veranderinge plaasgevind het weens 'n afname in prooisoorte (grawende stormvoëls) as gevolg van predasie deur huiskatte.

(4) Om vas te stel hoe 'n kunsmatige vermindering in predasiedruk bogenoemde sal beïnvloed.

(5) Om ruimteverbruik deur huiskatte te definieer.

(6) Om vas te stel of georganiseerde jag gedurende die somermaande wanneer koste in ag geneem word, 'n effektiewe addisionele beheermaatreël sal wees.

2. Geskiedenis van Program

'n Deeglike evaluering van beskikbare gegewens aangaande die Marioneiland huiskatbevolking het daartoe aanleiding gegee dat die Spesiale Evalueringsgroep aangaande die Marioneiland katte, aangestel deur die Biologiese Komitee van WKAN, ondermeer voorgestel het dat verdere navolging van die bevolking noodsaaklik is. Die Komitee se uiteindelike voorstelle vir

verdere navorsing is in die doelstellings van hierdie projek uiteengesit. Die voorstelle gemaak deur hierdie groep het tot gevolg gehad die goedkeuring van 'n projek om (1) die effek van die huidige katbevolking op die Marioneiland ekosisteem te evalueer; (2) om die invloed van die biologiese beheermaatreël feline panleukopaenia te evalueer, en
(3) om 'n ondersoek te loods op die doeltreffendheid van jag as 'n addisionele beheermaatreël.

Die projek is verder ook georienteerd ten opsigte van die definieering van ruimteverbruik deur die bevolking.

3. Wetenskaplike vordering

Die voorbereiding van 'n volledige projekvoorstel is gevolg deur voorbereiding vir die uitvoer van die aspekte ingesluit onder die doelstellings. Veldwerk het in aanvang geneem gedurende Mei en heinings vir die vier "katvry" gebiede word tans opgerig. Dié sal gevolg word deur die verwydering van alle katte uit hierdie gebiede om sodoende die effek van verminderde predasiedruk op die prooispesies van katte na te volg.

Radio-opsporingsapparaat is nou beskikbaar en die poging om katte lewendig te vang en toe te rus met hierdie toerusting word tans onderneem. Die ruimteverbruik, jageffektiwiteit en kontaktempo van katte sal dan bepaal kan word.

Publikasies

Geen publikasies is tot dusver voorberei nie.

PALINOLOGIE EN LANGAFSTANDVERVOER - SUIDELIKE EILANDE

Programleier : Prof. D.F. Toerien, Direkteur, Inst. vir Omgewingswetenskappe, U.O.V.S. Bloemfontein.

Programnavorser : Prof. E.M. van Zinderen Bakker, Inst. vir Omgewingswetenskappe, U.O.V.S. Bloemfontein.

Datum : Derde jaarlikse vorderingsverslag, April 1980 tot April 1981.

1. Doelstellings : Die kennis van die paleoekologie van Marion Eiland en van die ouderdom, oorsprong en evolusie van die eiland biota is onontbeerlik vir 'n goeie begrip van die eilandekosisteem en sal bydra tot die kennis van die Suidelike Oseaan. Die doelstellings sal benader word deur die analises van boormonsters en lugmonsters en die bepaling van ouderdomme en paleotemperature van grondmonsters.

2. Geskiedenis van Program

: Tydens die 1965-66 ekspedisie is op die eilande Marion en Prince Edward boorkerne van veenafsettings versamel. Die resultate het aangetoon dat tydens die laaste Würm maksimum van Europa, >14 000 jaar gelede, die temperatuur 2 - 3°C kouer was as vandag. Hierdie afkoeling het gelei tot 'n vergletsering soos later bestudeer deur Dr K.J. Hall. Die gegewens stem ooreen met die CLIMAP-resultate vir die Suidelike Oseaan waarvolgens die noordelike verplasing van die Polêre Front slegs gering was. Ongeveer 12 600 jaar gelede het volgens die stuifmeelgegewens klimaattoestande soos vandag ingetree.

Die borings van 1965/66 was onvoldoende gedateer, meer borings was nodig ook van ouer materiaal en die invloed van langafstandvervoer was nie bekend nie.

3. Wetenskaplike Vordering

Taak a : Borings van Dr K.J. Hall

In die vorige verslag is die voorlopige resultate van die stuifmeelanalise van twee borings, wat Dr Hall tussen die morenes 2 en 3 by die Albatrosmeer op Marion-eiland gedoen het, bespreek en die vermoede uitgespreek dat die monsters besmet is. Die twee borings was onvolledig en is versamel in reënagtige weer.

Nuwe analises het bevestig dat die monsters nie betroubaar is nie. Op dieptes van meer as 2,30 m is in monsters met 'n ouderdom van >4 000 jaar Caryophyllaceae-stuifmeel gekry. Soorte van hierdie familie is in historiese tyd deur menslike aktiwiteite na die eiland gebring. Hierdie waarnemings bewys ook dat die ^{14}C-ouderdomsbepalings nie betroubare resultate kan oplewer nie.

Twee ouderdomsbepalings is nou beskikbaar en wel:
Boring A : 2,40-2,50 m diepte : 4710±70 B.P. (Pta 2724)
Boring B : 2,35-2,40 m diepte : 4610±60 B.P. (Pta 2725)
Besmetting met 'n klein hoeveelheid resente plantmateriaal kan verantwoordelik wees vir hierdie resultate. Volgens die stuifmeelresultate kan die monsters nie ewe oud wees nie en moet boring A waarskynlik veel ouer wees. Dit is baie gewenst dat 'n aantal nuwe borings gemaak word om die belangrike probleem van die ouderdom van die glasiale stadia en interstadia en hulle paleoekologie te bestudeer.

Die pollenspektra van die borings van Hall gee aanwysings oor die invloed van die fauna op die vegetasie. Die gegewens sal in nuwe borings gedateer kan word.

Taak b : Pikkewynkolonie by Bullard

Die veenmonsters, wat Dr H.J. Lindeboom by Bullard Beach versamel het, is weer ondersoek. Die veenafsetting het 'n ouderdom van 4800±100 jaar. Die

6 monsters wat versamel is, is onvoldoende om uit die resultate konklusies te maak, maar dit lyk of tussen ±5 000 en ±2 500 jaar gelede die omgewing droër en miskien effens warmer was en daarna vogtiger.

Dit is baie belangrik dat baie meer monsters versamel word vir stuifmeelanalise en ^{14}C-ouderdomsbepaling.

Taak c : EM-skandeerwerk

Deurdat in 1980 die aflosreis vertraag was en die eiland nie kon besoek word nie kon geen materiaal vir EM-skandeerwerk versamel word nie.

Take d,e,f : Sien Taak c.

Taak g : Lug- en sneeumonsters

Eweas in die vorige jaar is weer groot probleme ondervind met die versamel en behandeling van die monsters van die Tauber-opvangapparate op die verskillende eilande. Die onnoukeurigheid van die betrokke persone het nie verbeter nie en tengevolge van die moeilike kontak het berigte die persone dikwels met veel vertraging bereik.

Die monsters wat van Argentinië, die Kerguelen en Macquarie eiland ontvang is was meesal uitgedroog of totaal besmet met fungi en alge. Van Marion en die engelse eilande, Suid-Georgië en Signy, is baie goeie medewerking verkry.

Marion. Tauber-opvangapparate was geplaas op Junior's Kop (303 m hoog) en Hendrik Fister Kop (333 m hoog). Die inhoud was meesal met tussenpose van 3 - 5 weke versamel. 'n Beperkte aantal monsters van 1978, 1979 en 1980 het goeie resultate opgelewer. Weens die onreëlmatige versameltye kan die gegewens nie kwantitatief vergelyk word nie. Die volgende konklusies kan uit figure 1 en 2 afgelei word:

- die aeroplankton op Junior's Kop was baie ryker as die van Hendrik Fister Kop, wat 1 500 m verder die land in gelee is. Dit moet miskien aan die heersende windpatroon toegeskryf word.
- eksotiese elemente kom in die aeroplankton praktties nie voor nie behalwe één Pinus-stuifmeelkorrel wat op 9-2-1979 opgevang is.
- Stuifmeel en spore word baie selde opgevang behalwe 'n paar graskorrels en 'n paar spore van *Lycopodium magellanicum*.
- Die hoofsaak van die aeroplankton bestaan uit reste van die flora en fauna wat om die voet van die heuwels voorkom, soos: reste van Bryophyta, hoëre plante en Pteridophyta, dele van insekte, Rhizopoda (*Nebela* en *Difflugiella*) en eensellige alge.

Dit is merkwaardig dat selfs 'n aantal Cladocera, wat algemeen in die poeltjies op die eiland voorkom, ook in die aeroplankton gevind word.

Verder is 'n 15-tal eksemplare van die Chironomidesoort *Limnophyes pusillus* Eaton opgevang (determinasie : Dr B.R. Stuckenberg, direkteur Natal Museum).

Die resultate bewys dat die materiaal deur sterk winde uit die laagland oor die eiland versprei word. Sneeumonsters, wat tydens die 1965-66 ekspedisie ondersoek is is van 'n heeltemal ander karakter. Hulle is baie arm aan aeroplankton en bevat veral sporomorfa (*Notofagus*) wat oor groot afstande vervoer is.

Suid-Georgië en Signy

Die analises is nie afgesluit nie en die monsters van 1980/81 word spoedig verwag.

5. Publikasies : 'n Publikasie oor die resultate sal voorberei word so gou die nuwe monsters van Suid-Georgië en Signy geanaliseer is.

Die volgende publikasie is van 'n algemene aard:

Van Zinderen Bakker, E.M. Origin and general ecology of the Marion Island ecosystem. *S. Afr. J. of Antarctic Research* 1978(8) : 13-21 (publ. in 1981).

6. Algemeen : Die werk sal voortgesit word deur Dr L. Scott van IVO, Bloemfontein.

Bloemfontein
15 Julie, 1981

E.M. VAN ZINDEREN BAKKER

Figure 1 en 2
Die vierkante gee die totale aan vir Mosse, Insekte en Algae.

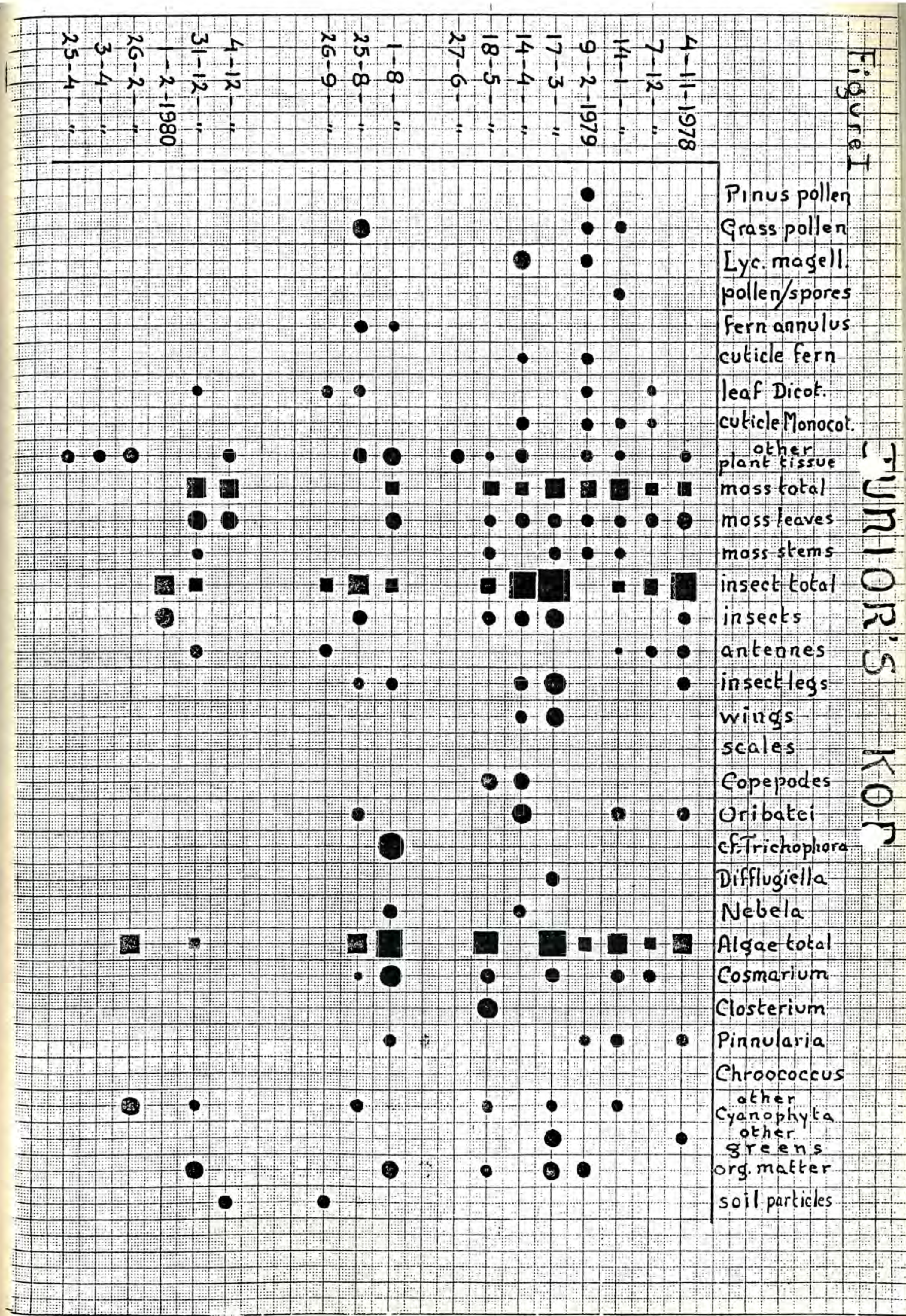
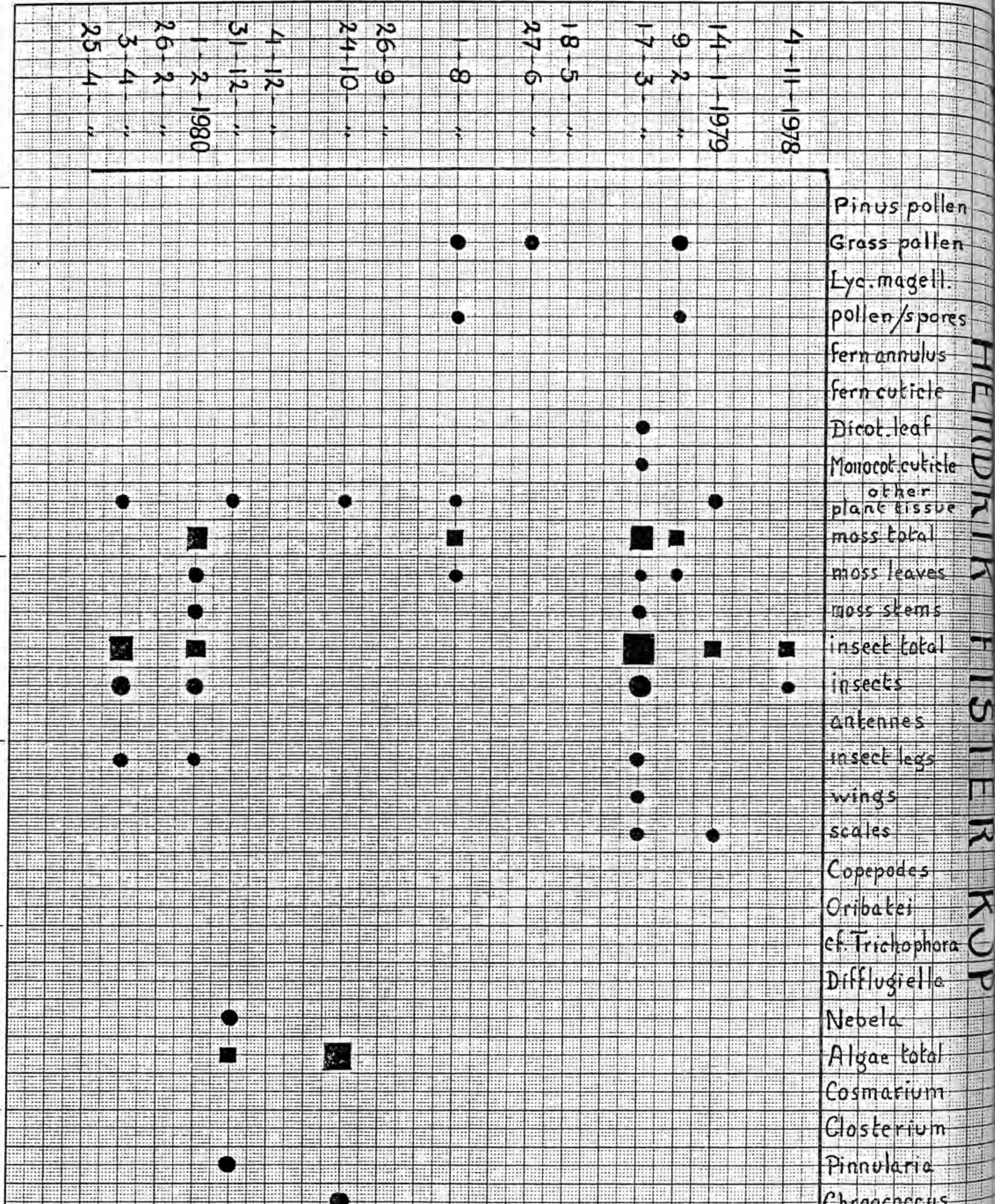


Figure I
JUNIOR'S KOP
4-11-1978
7-12- "
14-1- "
9-2-1979
17-3- "
14-4- "
18-5- "
27-6- "
1-8- "
25-8- "
26-9- "
4-12- "
31-12- "
1-2-1980
26-2- "
3-4- "
25-4- "
Pinus pollen
Grass pollen
Lyc. magell.
pollen/spores
fern annulus
cuticle fern
leaf Dicot.
cuticle Monocot.
other plant tissue
moss total
moss leaves
moss stems
insect total
insects
antennes
insect legs
wings
scales
Copepodes
Oribatei
cf. Trichophora
Difflugiella
Nebela
Algae total
Cosmarium
Closterium
Pinnularia
Chroococcus
other Cyanophyta
other greens
org. matter
soil particles



4-11-1978
14-1-1979
9-2
17-3
18-5
27-6
1-8
26-9
24-10
4-12
31-12
1-2-1980
26-2
3-4
25-4
Pinus pollen
Grass pollen
Lyc. magell.
pollen/spores
fern annulus
fern cuticle
Dicot. leaf
Monocot. cuticle
other plant tissue
moss total
moss leaves
moss stems
insect total
insects
antennes
insect legs
wings
scales
Copepodes
Oribatei
cf. Trichophora
Difflugiella
Nebela
Algae total
Cosmarium
Closterium
Pinnularia
Chroococcus
other Cyanophyta
other greens
org. matter
soil particles
HENDRIK FISTERKOP

4. EARTH SCIENCES

4. AARDWETENSKAPPE

GEOCHRONOLOGIC AND ISOTOPIC INVESTIGATIONS OF CRUST-MANTLE EVOLUTION IN QUEEN MAUD LAND, ANTARCTICA, AND IN THE SUB-ANTARCTIC ISLANDS

Dr. J. M. BARTON Jr. AND PROFESSOR H. L. ALLSOPP (PROJECT LEADERS)
Mrs. Y. E. COPPERTHWAITE (PROJECT RESEARCHER)
BERNARD PRICE INSTITUTE OF GEOPHYSICAL RESEARCH
UNIVERSITY OF THE WITWATERSRAND
1 JAN SMUTS AVENUE
JOHANNESBURG 2001

FIRST ANNUAL PROGRESS REPORT, APRIL 1, 1981 TO MARCH 31, 1982
SUBMITTED IN JUNE, 1981

OBJECTIVES:

1. To detail the character of the mafic rocks in the Ahlmann and Giaever Ridges, Gjelsvic and Svendrup Mountains, Borg Massif and Kirvan Escarpment of Queen Maud Land, Antarctica, and the Sub-Antarctic Islands in order to investigate what these rocks can tell us about the pattern of crust-mantle evolution in the area.
2. To provide any new geochronologic and isotopic data as may become necessary to complement future geological studies of metamorphic, sedimentary and granitic rocks in the areas mentioned above.

HISTORY OF PROJECT:

Over the past several years, various workers at the Bernard Price Institute of Geophysical Research (B.P.I.) have been involved with geochronologic studies of rocks collected by Geological Survey of South Africa expeditions to Queen Maud Land in the vacinity of the S.A.N.A.E. Base. These samples came primarily from the Ahlmann Ridge and Borg Massif and analytical results indicated that important tectonic events affected this region ∿1700 m.y. ago, ∿1000 m.y. ago and ∿480 m.y. ago. There is also an indication of an ∿2800 m.y. to ∿3000 m.y. age for granitic rocks from Annandagstoppane to the west. The quality and quantity of samples collected was not always ideal for isotopic study and it was felt by the end of 1979 that about as much information as could be reasonably expected had been gleaned from them.

With the advent of renewed geologic field activity in Queen Maud Land under

S.A.S.C.A.R., it was deemed appropriate to initiate this new project of isotopic and geochronologic investigations as an element in a cooperative scientific programme to delineate the tectonic evolution of the region near S.A.N.A.E. Base. Mafic rocks of several ages are abundant in this area and provide direct evidence as to the nature of the Earth's mantle at several points in time. In addition, mafic rocks of certain compositions are diagnostic of specific tectonic environments. It was decided, therefore, to concentrate our efforts in the study of these mafic rocks over the next four years.

The Sub-Antarctic Islands formed as centres of volcanic activity along the mid-oceanic ridges surrounding Antarctica. These ridges are the locus along which Gondwanaland broke asunder. The break-up of Gondwanaland is the most recent tectonic event to affect the rocks in Queen Maud Land and hence the study of the mafic rocks on the Sub-Antarctic Islands is considered to be a natural extention of the study of mafic rocks near S.A.N.A.E. Base.

In preparation for commencement of this project, one of us (J.M.B.) took part in the geological expedition during the 1980/81 S.A.N.A.E. Relief Voyage. This expedition was primarily initiated to enable us to gain first hand knowledge of logistic conditions at and near S.A.N.A.E. Base. Nevertheless, suites of mafic rocks were collected from Krylen, Annandagstoppane, Jekselen and Grunehogna. In addition, a suite of samples was collected from West Wind Beach on Bouvet Island. These samples arrived at the B.P.I. shortly before commencement of this project.

SCIENTIFIC PROGRESS:

This project has only been functioning for two months at the time of writing this report. During this period, study of the suite of samples from Krylen has begun. Mr. J. Krynauw of the Geology Department of the University of Natal at Pietermaritzburg is investigating the mineralogy, petrology and chemical compositions of these samples. We have begun to investigate their Sr-isotopic compositions. The samples come from a layered body of diorite and gabbro containing some quartzite xenoliths that may have been sandstone from the country rock. The samples are altered. The results of Rb-Sr isotopic analyses suggest an age of $\sim$765 m.y. for these rocks and a large initial $^{87}Sr/^{86}Sr$ ratio ($\sim$0.713). In addition, these data indicate that these samples have not been closed systems to Rb and Sr or that that they had heterogeneous Sr-isotopic compositions $\sim$765 m.y. ago. Whether the

∿765 m.y. age indication reflects the time of emplacement or a later alteration event is unclear and resolving this point must become an issue of great importance. If the age does reflect emplacement, then these mafic rocks from Krylen were probably derived from an "undepleted" mantle source characterized by high $^{87}Sr/^{86}Sr$ ratios than was the case for the Jarassic Kirwan (and in South Africa the equivalent Karoo) volcanics. The significance of this is that, although elsewhere in Australia, and also in Tasmania, similarly high $^{87}Sr/^{86}Sr$ ratios have been reported, such rocks have not previously been found in Queen Maud Land (see also NP10 proposal).

Professor W.J. Verwoerd of the Geology Department at the Unviersity of Stellenbosch led an expedition to Marion Island during April-May, 1981, to investigate the recent volcanic eruptions there. A suite of samples from both the recent eruptic rocks and older lavas were collected. Professor Verwoerd and Dr. D. Cornell of his Department plan to undertake chemical analyses of these samples and we at the B.P.I. will analyse selected samples for their Sr, Nd and possibly Pb isotopic compositions.

Note: The B.P.I. last year proposed a seeond project, involving the use of the fission-track dating technique, to study the mechanism and timing of the break-up of Gondwanaland, particularly between Antartica and the eastern coast of South Africa. Funding was not available to establish this project in its own right during the financial year beginning April 1, 1981, although we were given authorization to divert, at our discretion, a certain portion of the funding from the project described above to initiate the fission-track project. It is hoped that this project will become a separate entity beginning in the financial year starting April 1, 1982. Future progress reports will appear separately, but the present position is as follows. An offer of appointment has been made to Mr. D. Lux who is shortly expected to complete his Ph.D. (on a project concerned with the geochronology and isotopic characterization of young volcanics) at the Ohio State University. He has also had limited experience of rock fission-track method. Accordingly Mr. Lux is well qualified to contribute (during the remainder of 1981) to the studies on mafic instrusives outlined above. Arrangements, subject to confirmation, have been made for him to spend some six months in Melbourne to study the fission-track method. If Mr. Lux accepts the offered appointment this information and further details regarding the fission-track project will be forwarded as soon as possible.

PROGRESS REPORT, APRIL 1981 - J.R. KRYNAUW

Approximately 60 samples of mafic intrusives and granodiorites were collected from Krylen, Annandagstoppane, Jekselen and Grunehogna in Western Dronning Maud Land during January, 1981. These samples are presently being processed for isotope determinations (separate project) and major and trace element analyses (including REE determinations). Thin sections of the Krylen samples have been completed, and initial studies indicate that these rocks have been affected by a period of retrograde metamorphism prior to intrusion of Jurassic (?) dykes in the area.

J.R. KRYNAUW
27 April 1981.

AKTIWITEITSVERSLAG AAN W K A N

PROJEKTITEL : 'N SEDIMENTOLOGIES-STRATIGRAFIESE ONDERSOEK VAN DIE HÖGFONA-, RAUDBERGET- EN FASETTFJELLET-FORMASIES IN DIE BORGMASSIVET

PROGRAMLEIER : Mnr C D Potgieter
Departement Geologie
Universiteit van Stellenbosch
STELLENBOSCH 7600

PROGRAMNAVORSER : Vakant

DATUM : Die eerste jaarlikse vorderings-aktiwiteitsverslag, Maart 1981 tot Junie 1981, ingehandig in Junie 1981.

1. Die vakante poste vir twee navorsingsstudente is geadverteer in die kwartaallikse Nuusbulletin van die G V S A en daar is ook inligtingspamflette aan hoofde van verskeie Geologiese instansies gestuur. Verskeie navrae is ontvang alhoewel 'n suksesvolle kandidaat tot dusver nog nie gevind is nie. Potensiële kandidate word gekortwiek deur hoofsaaklik militêre verpligtinge, asook verbintenis aan een of ander organisasie. Twee aansoeke was afkomstig van Staatsbeurshouers, maar aangesien dit nie meer die Geologiese Opname se beleid is om personeel na Anarktiese Navorsing te sekondeer nie, was ook hierdie aansoek onsuksesvol.

2. Kwotasies vir 'n draagbare gammastraalspektrometer is aangevra vanaf 3 instansies naamlik Chemtron, Geometrics en Scintrex. Na vergelyking van die werksvermoë en verskillende eienskappe van die verskillende tipes gammastraalspektrometers, sowel as beraadslaging met dr B Corner van die R A K, is besluit op die G A D-1 van Scintrex. Verdere en finale kwotasies word ingewag vir die gemodifiseerde G A D-1 wat in temperature van tot -40°C kan werk.

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3. Daar is begin met die versameling van literatuur- en litera= tuurverwysings, kaarte en algemene inligting wat betref die Ahlmannryggen- en Borgmassivetgebiede.

4. Twee Geologie Werkgroepvergaderings is in die Departement Geologie, Universiteit van Natal in Pietermaritzburg bygewoon. Hierdie werksgroepe het baie bygedra tot die eliminering van misverstande, ontmoeting met ander wetenskaplikes wat ook aan geologiese projekte deelneem, sowel as die koördinasie en uit= bouing van die huidige projek.

C D Potgieter

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C D POTGIETER

20 Mei 1981

ANTARCTIC METEORITE STUDIES

Arch M. Reid
Department of Geology
University of Cape Town

First progress report, January 1980 to December 1980, submitted in June 1981.

1. OBJECTIVES

(a) Organisation of a cooperative investigation on five basaltic achondrite meteorites collected by the U.S. Antarctic expedition in 1976-78 as a consortium leader appointed by the Meteorite Working Group of the National Science Foundation.

(b) Mineralogic and petrologic study of achondrite meteorites from the Antarctic.

2. HISTORY OF THE PROJECT

Studies of achondrite meteorites have allowed insight into the nature of geologic processes, particularly accretionary and early magmatic events, very early in solar system history. The limited availability of material has constrained such studies and left many ambiguities and unanswered questions. Discoveries of meteorite material in Antarctic ice have doubled the number of achondrite meteorites known: the new samples are exceptionally well preserved and are readily available for scientific study.

The meteorite research programme at University of Cape Town was expanded in 1980-81 to allow work on these new samples.

3. SCIENTIFIC PROGRESS

A major activity on this project has been the processing of Antarctic meteorites at the Johnson Space Center in Texas. The procedure involves the initial descriptions, which are made available to potential investigators, and the cutting and chipping to provide material for detailed investigations. The procedures used are almost identical to those developed for working with lunar samples, with careful documentation, including photography, of every step in the process. Such detailed processing is essential in order to provide investigators with the type of sample they require and to document the relationship of that sample to the whole.

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This is doubly difficult with heterogeneous, commonly small, meteorite samples. Most time was spent on the basaltic achondrite meteorites which are complex breccias of rock and mineral fragments representing a regolith on the original parent body. Special efforts were made to select 'clean' samples of igneous rock which occur as clasts in a complex breccia matrix. Clasts separated from the Antarctic polymict eucrite breccias range in weight from 10 to 600 mg: the expenditure in time to separate pure material tends to be inversely proportional to weight.

In order to understand the magmatic processes that produced these samples it is necessary to work with 'pure' igneous rock samples and not with the total breccia which is a multi-component mixture. The fine grained nature of these breccia precludes working with large clasts and forces the investigator to separate and work with extremely small samples. Fortunately we have succeeded, through cooperative efforts, in using 1-200 mg samples to provide:

(a) textural and petrographic information (using small polished thin sections)

(b) mineral analyses (electron microprobe)

(c) major element composition (electron microprobe on fused beads)

(d) rare earth element analyses and other trace elements (isotope dilution)

(e) metallic iron determination (magnetic measurements)

(f) Sr and Nd isotopes (mass spectrometry)

(g) oxygen isotopes

In this manner we are able to categorise very small samples and this has already led to some surprising results (see below).

The organisational aspects of this study require cooperative work, on carefully selected samples, by a number of laboratories. We have initiated cooperative work with laboratories at:

State University of New York at Stony Brook
J. Papike - petrography and mineral chemistry

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American Museum of Natural History,, New York
M. Prinz - petrography and mineral chemistry
University of Oregon
R. Schmitt - neutron activation analysis
University of Chicago
R. Clayton - oxygen isotopes
University of California at San Diego
D. Macdougall - track studies
Johnson Space Center, Texas
J. Wooden, D. Bogard, R. Brown, L. Nyquist - rare earth elements, Sr isotopes, Nd-Sm isotopes, major elements.

These studies are currently underway and preliminary data has begun to appear in the literature.

The results to date include preliminary descriptions of the achondrites in the U.S. Antarctic collections made in recent years and a comparison with the samples in the Japanese collections. The more detailed studies are not complete but some interesting findings are already apparent. Some of the more exciting scientific finds are listed below.

(i) Most Antarctic diogenites belong to a single texturally unique group and may all be pieces from a single fall or shower.

(ii) The Antarctic eucrites also form a unique group distinct from almost all other eucrites.

(iii) Very similar and distinctive polymict eucrites occur at Allan Hills and Yamato Mountains, two sites almost 3000 km apart.

(iv) The Allan Hills polymict eucrites contain clasts of igneous fragments that are compositionally and isotopically unique and may constitute a new class of eucrite.

(v) The relative abundance of the various types of chondrite meteorites in the Antarctic collections appears to be like that for other regions of the world but this does not seem to hold for the achondrites.

(vi) Two new samples of Shergottite meteorites have been found in the U.S. collections. One of these has a young age (< 1.3

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billion years), much less than the other basaltic meteorites but similar to the other two known Shergottites. The other Shergottite is a large sample (7.9 kg) that has not yet been dated. The interest in this group of meteorites derives from their similarity to terrestrial basalts and their apparent young ages. The intriguing question is where in the solar system igneous activity could have arisen a billion years ago as the smaller bodies such as the asteroids would have cooled off much earlier in solar system history. The new Shergottite is also unique in showing the only known extraterrestrial undisturbed igneous contact.

As with most new sets of samples and data these studies raise as many new questions as they answer. The prospect of progress is good however as students of meteorites have in this collection, for the first time, a source of material that is available in adequate amounts, that has been properly curated from the time of collection and that is being studied in an organised comprehensive manner.

4. PUBLICATIONS

(i) Published

Wooden, J.L., Reid A.M., Brown R., Bansal B., Wiesmann H and Nyquist L. (1981) Chemical and isotopic studies of the Allan Hills polymict eucrites. Lunar and Planetary Science XII.

Reid A.M. and Schwarz C.M. (1980) Antarctic polymict eucrites (abstract). Meteoritics, 15, 353-354.

King T.V.V., Score R., Schwarz C.M., Reid A.M. and Mason B.H. (1980) Summary statistics of the 1977 and 1978 Antarctic meteorite collections and a glimpse of the 1979 collection (abstract). Meteoritics, 15, 315-316.

Antarctic Meteorite Newsletter: various contributions.

(ii) Accepted for publication

Score R., King T.V.V., Schwarz C.M., Reid A.M. and Mason B.H. (1981). Category description of stony meteorites. Smithsonian Contrib. Earth Sci.

Reid A.M. (1981) Antarctic achondrites. Smithsonian Contrib. Earth Sci.

Wooden J.L., Brown R., Reid A.M., Bansal B., Shih C.-Y., Wiesmann H. and Nyquist L. (1981). Antarctic polymict eucrites: do their compositions define a new class of basaltic achondrites? Proceedings XII Lunar and Planetary Science Conference.

Reid A.M. and Score R. (1981) Preliminary investigation of the achondrites in the 1979 U.S. Antarctic meteorite collection. Proceedings VI Symposium on Antarctic meteorites.

VERSLAG OOR VULKANOLOGIESE ONDERSOEK OP MARION-EILAND, 16 APRIL - 13 MEI 1981

W J VERWOERD
DEPARTEMENT GEOLOGIE, UNIVERSITEIT STELLENBOSCH

OPSOMMING

Die ekspedisie het daarin geslaag om 'n begrip te kry van die aard en die omvang van die vulkaniese erupsie van 1980 en ook om materiaal te versamel met die oog op verdere geologiese navorsing. Die erupsie was van die spleet-tipe en is aansienlik groter as wat uit die eerste verslae geblyk het. Nie minder nie as 4 lokaliteite oor 'n afstand van 9 km is gevind en die volume lawa wat uitgevloei het word op ongeveer 5 miljoen kubieke meter gestel. Die weerstasie word nie op die oomblik bedreig nie, maar aandag moet gegee word aan die moontlikheid van 'n toekomstige bedreiging.

AANBEVELINGS

1. Ten einde die regte advies te kan inwin oor maatreëls om die gevare van toekomstige vulkaniese erupsies die hoof te bied, moet 'n geskikte persoon oorsee gestuur word om ondersoek in te stel na (a) vordering op die gebied van vulkaanvoorspelling (b) beskikbaarheid van die nodige apparatuur (c) koste van installering van 'n geofisiese netwerk op beperkte skaal in verhouding tot die beperkte risiko op Marion. Die beste plekke om te besoek vir hierdie doel is Japan, Hawaii en Ysland.

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Prof Verwoerd beoog reeds om in September in Japan 'n vulkano= logiese konferensie by te woon en indien hy voldoende finan= siële steun kan kry sal hy die reis oor Hawaii en Ysland voortsit. 'n Verdere verslag oor hierdie aspek sal dus metter= tyd gelewer word.

2. Die beste manier om 'n vulkaan te monitor is om 'n opgeleide persoon ter plaatse te hê. Dit is dus baie wenslik dat daar 'n voortgesette geologiese program onder beskerming van S A N K A N goedgekeur moet word, sodat daar elke jaar vir ten minste een of verkieslik twee geologiese navorsers of assistente op Marion voorsiening gemaak kan word.

3. Die maak van 'n akkurate topografiese kaart van die eiland, soos reeds voorgestel deur die biologiese program, behoort nou 'n hoë prioriteit te verkry aangesien dit 'n noodsaaklike voorvereiste sal wees vir enige geofisiese netwerk wat met vulkanologiese voorspelling in verband staan.

4. As 'n dringende maatreël wil ek voorstel dat die S A Lugmag gevra word om gedurende die vaart van S A Agulhas in November 1981 weer 'n opgeleide fotograaf met die nodige toerusting saam te stuur, ten einde ten minste 'n strook vertikale lugfotos oor die aktiewe spleet en die geassosieerde lawavloeiings (kyk fig. 2) te bekom. Weerstoestande behoort dan baie gunstiger te wees as gedurende Mei vanjaar toe alle pogings om hierdie essensiële foto's te kry misluk het.

1. INLEIDING

Die nuus dat 'n vulkaniese erupsie op Marion-eiland in die omgewing van Kaalkoppie plaasgevind het is op 12 November 1980 na Suid-Afrika oorgesein nadat vyf ekspedisielede dit toevallig op 4 November ontdek het tydens 'n staptog om die eiland. Die waarneming is op 25 November bevestig deur mnre S Russell en A Berruti. In 'n breedvoerige verslag gedateer 5 Desember vermeld hulle die feit dat die lawa plek-plek nog warm is en dat fumaroliese aktiwiteit nog aan die gang is. Die datum van die erupsie word geskat op tussen Februarie en Oktober 1980, waarskynlik eerder naby die end van September. Die gebied wat geaffekteer is word gestel op ongeveer 10 hektaar (0,1 vk km).

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Aangesien vulkaniese aktiwiteit nog nooit tevore op Marion-eiland waargeneem is nie, is bogenoemde verslag verwerk en in verkorte vorm vir publikasie in 'n wetenskaplike tydskrif aangebied (Verwoerd, Russell en Berruti, in die pers).

Op 28 Februarie 1981 is 'n tweede lokaliteit waar kleinskaalse erupsies blykbaar kort tevore plaasgevind het en fumaroliese aktiwiteit nog aan die gang was ontdek deur mnre G Kerley en J Karnezos naamlik aan die voet van Staatspresident Swartpiek. Oortuigende bewyse in die vorm van foto's is aan die geologiese span verstrek na hul aankoms by Marion.

Tydens 'n vergadering van belanghebbende wetenskaplikes by die W N N R op 27 Februarie 1981 is aanbeveel dat 'n geologiese ekspedisie van ongeveer 6 man so gou moontlik moet ondersoek instel na die omvang en risiko van vulkaniese erupsies op Marion. Op 13 Maart 1981 is prof W J Verwoerd amptelik deur die W N N R gevra om so 'n ekspedisie tydens die volgende aflosvaart van die S A Agulhas te lei en om wetenskaplike navorsing wat daaruit sal voortspruit te koördineer.

2. DOELSTELLINGS VAN EKSPEDISIE

Benewens die hoofdoel soos hierbo geformuleer is daar gevoel dat die geleentheid benut moet word om ook ander oogmerke van wetenskaplike belang te bereik. Gevolglik is 'n program van werksaamhede vooraf opgestel, waarvan die hooftrekke as volg was, in volgorde van prioriteit:

1. Dokumentering van erupsie by Kaalkoppie (kartering; fotografie; temperatuurmetings; monstering van lawa, sublimate en gas).

2. Verkenning uit die lug en op die grond vir verdere tekens van vulkaniese aktiwiteit.

3. Monstering van ouer suksessie vir K-Ar-ouderdomsbepaling.

4. Monstering van jonger suksessie vir geochemiese ontleding.

5. Verkenning van Prins Edward-eiland.

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6. Bestudering van problematiese ysafsettings ten einde menings= verskil te probeer oplos.

3. EKSPEDISIELEDE

Na enkele onsuksesvolle pogings om vrywilligers te werf, het die ekspedisie uiteindelik as volg daaruit gesien:

1. Prof W J Verwoerd, Dept Geologie, Universiteit Stellenbosch
2. Dr D H Cornell, senior lektor, " " "
3. Mnr J Swart, senior tegniese beampte, Dept Geologie, Universiteit Stellenbosch
4. Mnr J A Conradie, M.Sc. student, " "
5. Mnr W S Seimons, geoloog, O'okiep Copper Company, Nababeep
6. Mnr J Moore. Ph.D. student, Prekambriese Navorsingseenheid, Universiteit van Kaapstad

4. VERSLAG VAN WERKSAAMHEDE

Volledige logistiese ondersteuning deur die Departement Vervoer het baie gehelp maar tog moes ekspedisielede self vooraf heelwat voorbereiding in 'n beperkte tyd afhandel. Die grootste probleem was die beplanning en konstruksie van gas-monsterapparaat uit glas en vleklose staal. Die Navorsingskomitee van die Universiteit Stellenbosch het R680 hiervoor beskikbaar gestel. Verder sou die ekspedisie nié so 'n groot sukses gewees het sonder die gees= driftige hulp van 'n hele aantal persone en instansies nie (Kyk Bedankings).

Die skip het Kaapstad op 16 April verlaat en Marion op 21 April bereik. Weerstoestande was nie gunstig genoeg om nog voor die aankoms met helikopterverkenning te begin nie. Die geoloë was egter gelukkig om reeds op 23 April by 'n kampplek bo-op die plato= rand oos van Kaalkoppie afgelaai te word en met veldwerk te begin. Soos beplan, het hulle vir 8 dae in die veld gebly. Slegs vir een dag (30 April) het die weer sodanig opgeklaar dat vlaktafel= kartering by Kaalkoppie gedoen kon word en is die grootste deel van die kaart deur Seimons en Conradie voltooi. Intussen doen Cornell en Moore 'n opname met meetlyn en kompas by Truterkop en Wolfie, meestal in digte mis en reën. Gedurende die nag van 27 April word een tent deur reën en stormwind platgeruk en word alle klere en toerusting deurweek. Die ongunstige weer word

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benut deur monsters te neem en die hele gebied tussen Swartkoppunt en Cold Ridge in die suide tot Kampkoppie in die noorde te voet te verken.

Na een dag op die skip vertrek die geoloë weer vroeg op Sondag 3 Mei: een groep na Kaalkoppie om die kartering te voltooi en die tweede groep na Staatspresident Swart-piek. Dit sneeu egter te veel daar en hulle word by Triegaardtbaai afgelaai om die steil kuskranse te monster. Gelukkig word albei groepe die volgende dag opgepik. Op 5 Mei volg drie kort uitstappies na kritieke monster= lokaliteite (Santa Rosa-vallei, Crawfordbaai, Macaroni Bay en Ships Cove), en word die moontlikheid van 'n onlangse erupsie in Black Haglet Valley ondersoek, met negatiewe resultate. Teen hierdie tyd is die grootste deel van Marion onder sneeu bedek en blyk dit nutteloos te wees om die hoë pieke te probeer bereik.

Twee dae (6 en 7 Mei) kampeer die geologiese span op Prins Edward-eiland. Dit is genoeg tyd om die hele eiland te deurkruis. Geen teken van vulkaniese aktiwiteit word gevind nie maar waardevolle geologiese waarnemings word gedoen, onder andere uit die helikopter. Min waarde kan geheg word aan die sinsnede in J H Marsh se boek "No Pathway Here" (1948) : "....wisps of steam were reported by Lieut. Grindley on the hill behind the cave on Prince Edward Island" (p 89).

Op die laaste dag (9 Mei) word die geoloë skielik opgeroep om nog 'n moontlike nuwe vulkaankeël te gaan ondersoek naamlik in die omgewing van Arthur's Hill, weer met negatiewe resultate, maar dit gee hulle die geleentheid om die suidoostelike hoek van die eiland uit die lug te verken.

Die skip het dus 18 dae in die omgewing van die eilande vertoef en daarvan is 14 dae onder taamlik moeilike omstandighede in die veld deurgebring. Die volgende take is bevredigend afgehandel:

1. 'n Kaart op skaal 1: 2 000 wat die nuwe vulkaankeëls, lawa= vloeiings, splete en fumarole in die omgewing van Kaalkoppie akkuraat aantoon is voltooi. Vertikale lugfotos deur die lugmagfotograaf (korp. Robertson) sal hopelik gebruik kan word om dit mee af te rond. Dit is 'n groot verbetering op die

voorlopige sketskaart.

2. Twee nuwe lokaliteite waar lawa uitgevloei het is ontdek ongeveer halfpad tussen Kaalkoppie en President Swartpiek (Fig 1). Dit is ook op kaart gebring en die omvang van die lawavloeiings is in breë trekke bepaal. Om dit akkuraat te doen sal verdere lugfotos nodig wees.

3. Twee monsters gas is by twee fumarole op Kaalkoppie se binnelandse vloeiing versamel en na Stellenbosch gebring vir ontleding. Temperature tot 160°C is gemeet waar die gas uitkom.

4. Verteenwoordigende monsters is ook geneem van die nuwe lawa en van mineraalneerslae by die fumarole, met die oog op chemiese en mineralogiese ondersoek

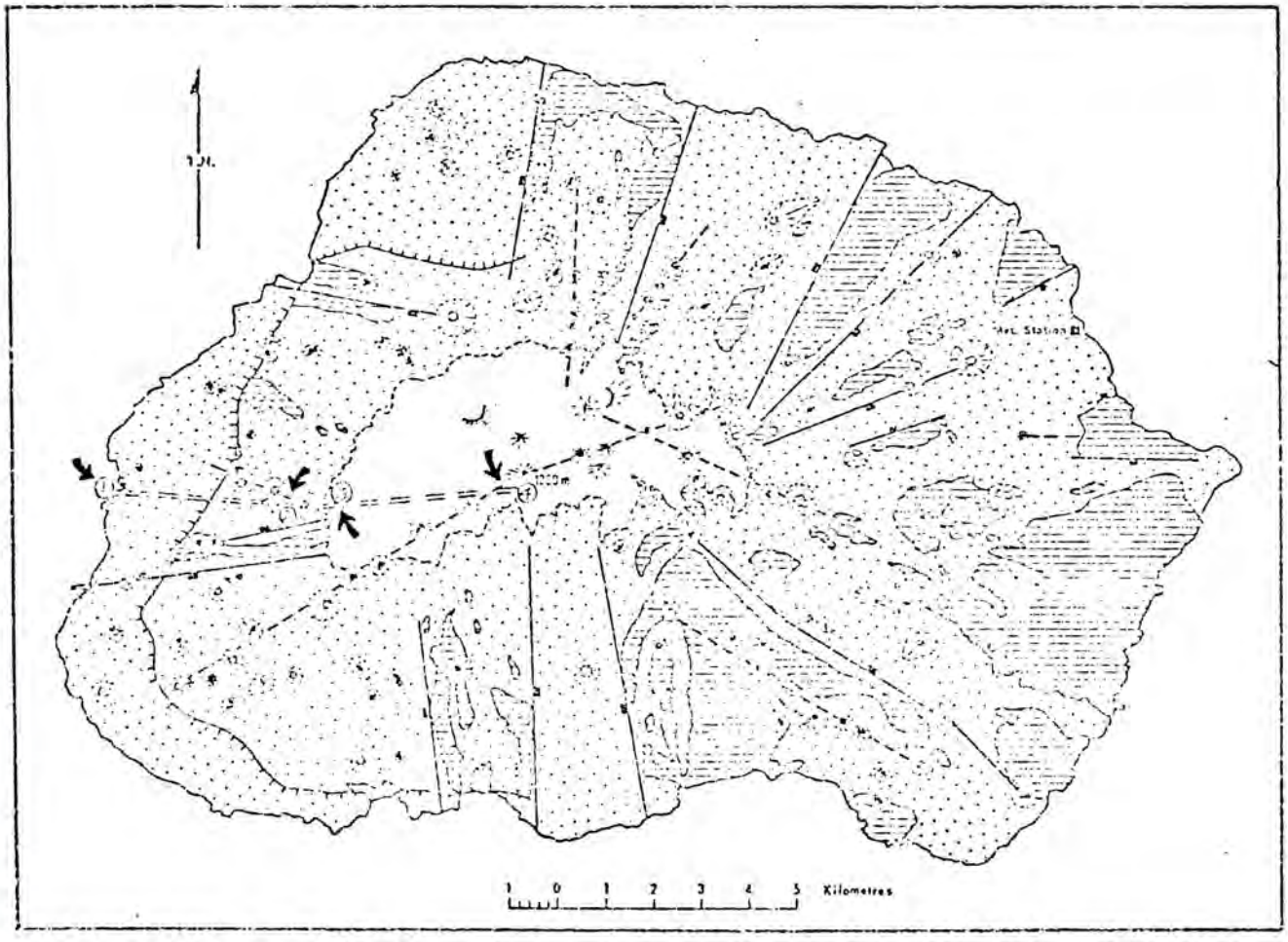

FIG 1 Die dubbele onderbroke lyn toon die 1980-spleet, met pyle in die rigting van die vier nuwe erupsiesentra. Let op die radiale verskuiwings soos tevore afgelei. Horisontale lyne toon ouer (Pleistoseen) suksessie, stippels en keëls jonger lawas. Blanko area was sneeubedek in 1961 toe dit gefotografeer is.

5. Die grootste deel van beide Marion- en Prins Edward-eilande is uit die lug verken en op 'n paar plekke op die grond onder= soek vir tekens van onlangse vulkaniese uitbarstings. Hierdie taak is egter aan bande gelê deur sneeu, mis, reën en wind; veral aan die westekant.

6. Stratigrafiese profiele van die ouer suksessie is gemeet by die steil kranse van Triegaardtbaai, Crawfordbaai en oos van Santa Rosa Hill. Elke lawavloeiing in die suksessie is gemons= ter met die oog op ouderdomsbepaling. Soortgelyke monsters is geneem op kritieke plekke by Ship's Cove en Macaronibaai. Dit sal help om Hall se chronologie van die Pleistoseentyd op Marion te toets.

7. Nuwe waarnemings is gedoen wat verbeterings op die bestaande vulkanologiese kaarte moontlik maak bv by Swartkoppunt en Moeder-en-Kind.

8. Foto's is geneem om 'n beter begrip van die geologiese struk= tuur te kry, veral wat betref die steil en ontoeganklike suidkus van Prins Edward-eiland.

Dit blyk dus dat meeste van die oogmerke van die ekspedisie wel bereik is. As die ongunstige weer, die beperkte tyd en die groot aantal ander take wat terselfdertyd met die hulp van die helikopters gedoen moes word in ag geneem word, kan die ekspedisie as uiters suksesvol bestempel word. Dit sou nie moontlik gewees het sonder die heelhartige samewerking van die kaptein en sy bemanning en veral die helikopterpersoneel nie. In dié opsig was dit baie voordelig vir die geologiese span om op die skip gestasioneer te wees eerder as op die weerstasie, want dit het hulle in voortdurende direkte kontak met mekaar geplaas. Die koördinasie deur mnr van Mazijk en die doeltreffende radiokommu= nikasie het ook grootliks tot die sukses bygedra.

Die volgende paar oogmerke het ongelukkig skipbreuk gely:

1. Die erupsiesentrum aan die voet van Staatspresident Swart-piek kon nie bereik word nie. Die eerste poging om dit te voet te bereik moes op 24 April gewonne gegee word as gevolg van verslegtende weer. Daarna is verskeie pogings per helikopter

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aangewend, maar tevergeefs. Later was daardie deel van die eiland onder dik sneeu bedek.

2. Vertikale lugfoto's op groot hoogte van 'n strook tussen Kaalkop=pie en Staatspresident Swart-piek het hoë prioriteit geniet, maar geskikte weerstoestande wou net nie aanbreek nie.

3. Daar was nie juis tyd oor om noukeurig te kyk na die probleme=tiese ysafsettings tussen die ouer grys lawas nie.

4. Indien meer tyd beskikbaar was sou verdere monsters (veral van jonger swart lawas) vir geochemiese ondersoek geneem kon gewees het.

5. NAVORSINGSRESULTATE

Voldoende gegewens is deur die ekspedisie ingesamel om in die vorm van 'n wetenskaplike referaat aan te bied. Prof W J Verwoerd beoog om dit te doen by geleentheid van die "I A V C E I International Symposium on Arc Volcanism" in Japan gedurende September vanjaar. Dit sal hopelik egter net die begin wees van 'n voortgesette geolo=giese navorsingsprogram onder beskerming van die Subkomitee vir Aardwetenskappe van S A N K A N, waarvoor daar reeds projekvoorstelle by die W N N R ingedien is.

Wat die laboratoriumondersoek van die ekspedisie se monsters be=tref sal die volgende medewerkers almal bydraes lewer:

DR E E BARTEL, Departement Chemie, Universiteit Stellenbosch.
Massaspektrometriese analise van gasmonsters. Reeds aan die gang.

DR J BARTON, Bernard Price Instituut, Universiteit Witwatersrand.
Sr en Nd isotoopbepalings. Vier monsters gestuur.

PROF D HUNTER, Departement Geologie, U N Pietermaritzburg.
Ontledings vir die seldsame aarde-elemente. Monsters word binnekort gestuur.

DR A LE ROEX, Departement Geochemie, Universiteit Kaapstad.
Geochemiese modellering. Wag vir terugkeer uit V S A einde 1981.

MNR M KURZ, Woods Hole Oceanographic Institution, V S A.
Helium-isotoopbepalings. Monsters reeds gestuur.

DR I McDOUGALL, Australian National University. K-Ar-ouderdoms=
bepalings en Ar-isotope. Wag op sy reaksie op uitnodiging.

DR D H CORNELL EN MEV A M UTTLEY, Departement Geologie, Universiteit
Stellenbosch. Roetine geochemiese analise en geochemiese
interpretasie.

MNR J SWART, Departement Geologie, Universiteit Stellenbosch.
X-straaldiffraksie en identifikasie van fumaroliese minerale.

PROF W J VERWOERD, Departement Geologie, Universiteit Stellenbosch.
Fisiese vulkanologie en kompilasie van resultate.

6. BEVINDINGS

1. Die onlangse vulkaniese aktiwiteit op Marion-eiland is van heelwat groter omvang as wat aanvanklik vermoed is. Die totale volume lawa wat uitgevloei het, word beraam op sowat 5 miljoen kub. meter. Dit is egter steeds minder as die meeste vorige erupsies op die eiland en is 'n klein erupsie volgens wêreldstan=daard.

2. Die uitbarsting was nie beperk tot Kaalkoppie nie, maar het ook by drie ander plekke in 'n reguit lyn tussen Kaalkoppie en Staatspresident Swartpiek te voorskyn getree (Fig. 1).

3. By elkeen van hierdie lokaliteite, is dit duidelik dat dit 'n spleeterupsie is, met tientalle openinge kort opmekaar gerang=skik. Die spleet strek dus (hoewel nie ononderbroke nie) oor 'n afstand van 9 km van kruin tot kus, en bevestig vorige interpretasies dat die eiland deur radiale krake gekenmerk word (Fig. 1).

4. By lokaliteite 2 en 3 het lawavloeiings vir 2,5 km langs die helling afgevloei tot op die kusvlakte (Fig. 2).

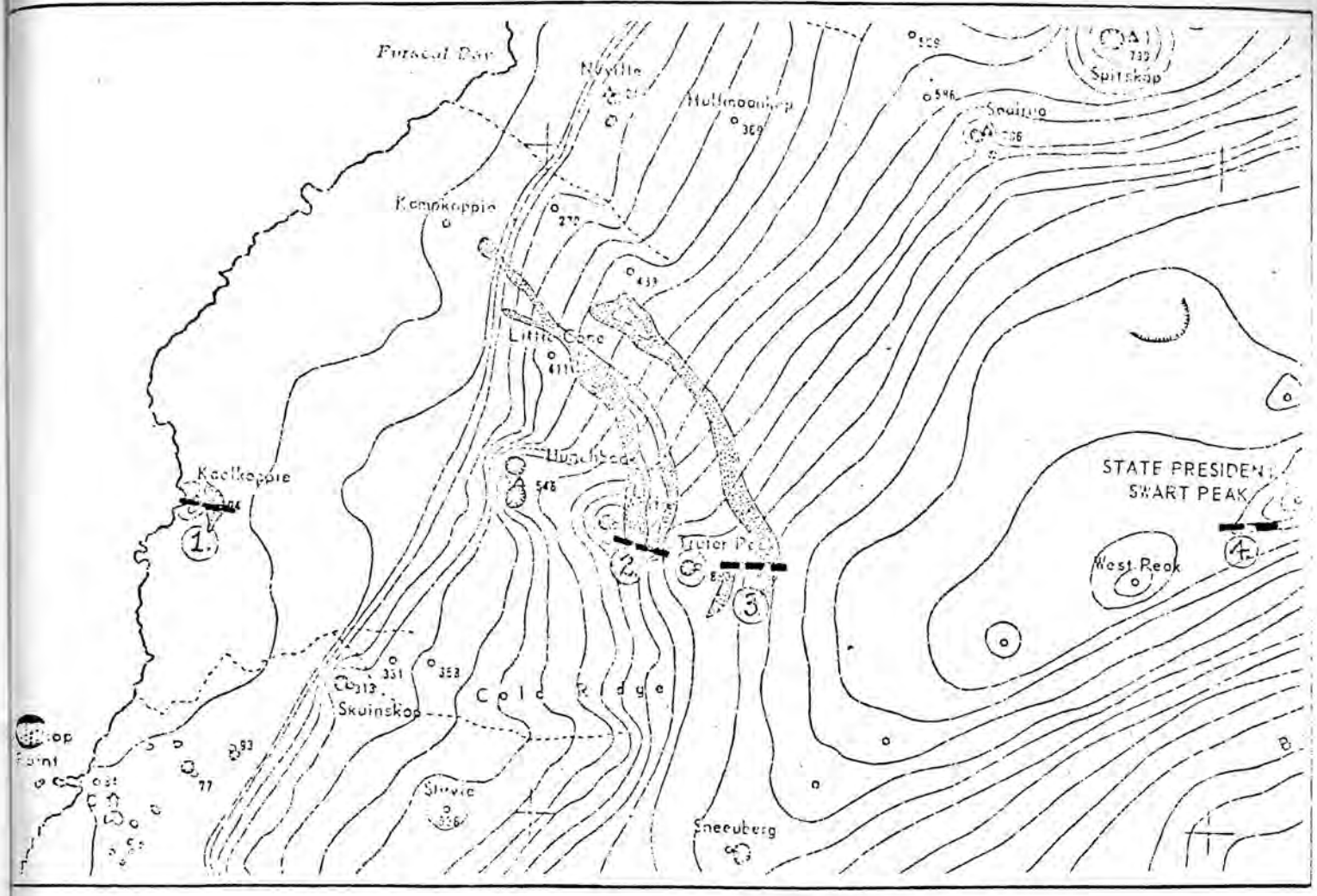

FIG 2 Sketskaart van splete en lawavloeiings van 1980.

5. Die vulling van die spleet het blykbaar besonder stilweg geskied. Dit blyk onder andere uit die feit dat die swak, ongekonsoli= deerde tuf van Kaalkoppie deurkruis word deur 'n gang slegs 20-30 cm dik, met min tekens van versteuring deur druk of skok= golwe.

7. BEDANKINGS

Die W N N R word bedank vir die inisiatief om die geologiese ekspe= disie op die been te bring. Die Departement Vervoer word bedank vir logistiese steun en voorsiening van toerusting aan ekspedisie= lede. Die Universiteit van Stellenbosch word bedank vir vrystelling van akademiese verpligtinge, en so ook die O'okiep Copper Company vir verlof toegestaan. Sonder die hulp van 30 Eskader van die S A Lugmag op Ysterplaat sou dit onmoontlik gewees het om die ekspedisie se taak in so 'n kort tyd suksesvol uit te voer.

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Waardevolle ondersteuning is ook gelewer deur lede van die 37ste aflosspan op Marion-eiland. By name wil ek graag die volgende bedank vir hul bydraes op verskillende gebiede: mnr E Fitschen, mnr J Krynauw, dr P R Condy, mnr R van Mazijk, kapt W Leith, kommandant R Dean en al vyf lede van die geologiese span.

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(geteken) W J VERWOERD

26 Junie 1981

Verwysing: Verwoerd W J, Russell S and Berruti A (in die pers) 1980 volcanic eruption reported on Marion Island. E Planet Sci Lett.

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GUIDELINES FOR THE PREPARATION OF

PROGRESS REPORTS

TO

SASCAR COMMITTEES

GUIDELINES FOR THE PREPARATION OF INTERIM PROGRESS REPORTS AND FINAL PROJECT REPORTS TO SASCAR AND ITS SUB-COMMITTEES

These guidelines are an extension of those contained in the 1980 Volume of PROGRESS REPORTS TO SASCAR. Reports to be included in these volumes will be photocopied directly from those submitted to CSP. These guidelines have therefore been drawn up in the hope of introducing a degree of standardization to the format of reports contained in these volumes, particularly with respect to Interim Progress Reports.

SASCAR has approved a new system which has a direct bearing on the submission of NP10 forms and progress reports. This currently relates more to the Biological and Earth Science Sub-programmes. It is as follows:

1. Project Proposals - all on the CSP NP10 form, to reach CSP by 30 June each year through normal routes.

2. First Project Report - in the case of new projects being funded for the first time from 1 April, the first report which is due by 30 June the same year will in future take the form of a full description of the project, its rationale (also indicating how the project fits into the objectives of the relevant component of the National Antarctic Programme), the anticipated manpower requirements and fieldwork schedule over the entire duration of the project and the review of literature. Authors will be able to use this report to expand on what can be accommodated in the first proposal (NP10 form). For guidance, this report can be divided into sections similar to those on the NP10 form, but the layout is generally flexible and authors may exercise their own discretion. The report should, however, be confined to 10 pages or less and on the front page, authors must include the project details as indicated in the guidelines for interim progress reports below.

3. Final Project Report - not later than two months before the cessation of funds (eg by 31 January for 31 March) for a project, a final project report will in future be required. This report would normally comprise copies of published scientific papers and/or manuscripts in press, with an overall synthesis. Theses are not acceptable as a final project report. The general policy in this respect is that a project is not completed until the results are in press or published, and theses and internal reports do not meet this requirement.

4. Interim Progress Reports - submitted along with annual follow-up project proposals (NP10 forms), throughout the duration of the project.

The guidelines for the preparation of Interim Progress Reports are given below:

The report should be first identified as follows:

Project Title (in capitals)	-	as given on the NP10 forms
Project Leader	-	name and address
Project Researcher(s)	-	name(s) and address(es)
Date	-	the report should be dated (eg third interim progress report, June 1981)

and then continued on the front page under the following headings:

1. Objectives - referring to the objectives as stated in the previous NP10 form.

2. History of Project - referring briefly to scientific progress made in the project since its implementation, so that section 3 below can be read in context with the first project report.

3. Scientific Progress - made during the year under consideration (eg July 1980 - June 1981), with particular emphasis on specific scientific findings and/or achievements, such as answers to key questions given in the previous or original NP10 form. This section should be confined to approximately four typed pages.

4. Acknowledgements - only if necessary and should then be made only for assistance outside the normal duties of the parties concerned.

5. Publication - list separately; (i) those published, (ii) those accepted (ie in press and not in preparation) for publication and (iii) relevant internal reports which are likely to remain unpublished. Listings under these sub-headings include only those published or in press since the previous interim progress report was submitted and only those which have originated directly from the work being funded by SASCAR.

Please type in 1,5 spacing on one side of A4 pages. As these reports will not be edited or retyped, please make sure that clean original copy is submitted, so that it can be photocopied as is. Reports may be submitted in English or Afrikaans.

Although we have requested the body of the interim progress report (ie scientific progress made during the year under consideration) to be limited usually to four typed pages, researchers may if they wish increase this to not more than 10 pages. However, in this event please note that the emphasis throughout must be placed on scientific progress and not matters related to logistical aspects. If, for reasons beyond the researchers control, logistical and/or equipment problems prevented any scientific progress from being made in the year under review, an "activity" report explaining these matters and what was done about them may be added as an addendum to the progress report.

Thank you for your cooperation.

RIGLYNE BY DIE VOORBEREIDING VAN

VORDERINGSVERSLAE

AAN

WKAN-KOMITEES

RIGLYNE BY DIE VOORBEREIDING VAN TUSSENTYDSE VORDERINGSVERSALE EN FINALE PROJEKVERSLAE AAN WKAN EN DIE SUBKOMITEES

Die onderstaande is 'n uitbreiding op die riglyne wat in die 1980 uitgawe van VORDERINGSVERSLAE AAN WKAN verskyn het. Verslae wat in hierdie volumes ingesluit word, sal direkte fotostatiese afdrukke wees van verslae wat aan KWP gestuur word. Hierdie riglyne is dus saamgestel met die oog op standaardisering van die formaat van verslae wat in hierdie volumes gebind word, in besonder ten opsigte van Tussentydse Vorderingsverslae.

'n Nuwe sisteem, wat direkte betrekking het op die indiening van NP10-vorms en vorderingsverslae, is deur WKAN goedgekeur. Die sisteem is huidig meer van toepassing op die Biologie- en Aardwetenskap-subprogramme en is as volg:

1. Projekvoorstelle - elk op die KWP NP10-vorm, om KWP deur die normale kanale teen 30 Junie elke jaar te bereik.

2. Eerste Projekverslag - in die geval van nuwe projekte wat vir die eerste keer vanaf 1 April fondse ontvang, sal die eerste verslag wat teen 30 Junie van die betrokke jaar ingedien moet wees, die volgende behels: 'n Volledige beskrywing van die projek; logiese motivering (waarin ook aangedui word hoe die projek inpas by die doelstellings van die betrokke komponent van die Nasionale Antarktiese Program); die verwagte mannekragbehoeftes en veldwerkskedule gesien oor die algehele duur van die projek; 'n literatuuroorsig. Opstellers kan in hierdie verslag uitbrei op punte wat in die eerste projekvoorstel (NP10-vorm) voorkom en kan dus die verslag indeel om ooreen te stem met die afdelings van die NP10-vorm alhoewel die formaat buigbaar is, en aan die opsteller se diskressie oorgelaat word. Hierdie veslag moet egter beperk word tot 'n maksimum van 10 bladsye en op die voorblad moet projekbesonderhede verskyn soos hieronder voorgeskryf vir tussentydse vorderingsverslae.

3. Finale Projekverslag - moet ingedien word ten minste twee maande voordat fondse aan 'n projek gestaak word (bv 31 Januarie vir 31 Maart). Hierdie verslag sal normaalweg bestaan uit afskrifte van gepubliseerde wetenskaplike verhandelings en/of manuskripte in druk, met 'n oorsigtelike samevatting. Tesisse is nie aanvaarbaar as finale projekverslae nie. Die algemene beleid wat hier geld, is dat 'n projek nie afgehandel is voordat resultate in druk of gepubliseer is nie en derhalwe voldoen tesisse en interne verslae nie aan die vereiste nie.

4. Tussentydse Vorderingsverslae - word ingedien saam met jaarlikse projekopvolgvoorstelle (NP10-vorms) vir solank as wat die projek duur.

Die riglyne by die voorbereiding van Tussentydse Vorderingsverslae word hieronder verskaf:

Die verslag moet eerstens geïdentifiseer word:

Naam van Projek (in hoofletters)	-	soos dit op die NP10-vorm voorkom
Programleier	-	naam en adres
Programnavorser(s)	-	naam(name) en adres(se)
Datum	-	die veslag moet gedateer word (bv derde tussentydse vorderingsverslag, Junie 1981.)

en dan op dieselfde bladsy voortgesit word onder die volgende hoofde:

1. Doelstellings - verwys na die doelstellings soos uiteengesit in die vorige NP10-vorm.

2. Geskiedenis van Program - verwys kortliks na wetenskaplike vordering sedert begin van program, sodat punt 3 (volgende) in verhouding tot die program as 'n geheel gesien kan word.

3. Wetenskaplike Vordering - vordering soos gemaak in die betrokke jaar met besondere klem op spesifieke wetenskaplike uitvindings en/of prestasies soos bv antwoorde op die sleutelvrae wat op die vorige of oorspronklike NP10-vorm voorkom. Hierdie gedeelte moet tot ± vier getikte bladsye beperk word.

4. Erkennings - slegs waar nodig en dan ook net vir buitengewone betrokkenheid wat nie onder normale werksverpligtinge sorteer nie.

5. Publikasies - lys afsonderlik:

   (i) gepubliseerde werke,
   (ii) werke wat vir publikasie aanvaar is,
   (iii) toepaslike interne verslae wat waarskynlik nie gepubliseer sal word nie.

   Slegs werke wat sedert die vorige vorderingsverslag gepubliseer, of aanvaar is vir publikasie en werke wat 'n direkte uitvloeisel is van die programnavorsing, word onder die bogenoemde subhoofde gelys.

Verslae moet asseblief in 1,5 spasiëring op een kant van A4-velle getik word. Maak asseblief seker dat ons 'n skoon, oorspronklike afskrif van die verslag ontvang waarvan fotoafdrukke gemaak kan word, aangesien die verslae nie nagesien of oorgetik gaan word nie. Vorderingsverslae mag in Engels of Afrikaans geskryf word.

Alhoewel daar onder punt 3 gespesifiseer word dat die gedeelte oor "Wetenskaplike Vordering" tot vier getikte bladsye beperk moet word, mag hierdie gedeelte vermeerder word tot 'n maksimum van tien bladsye indien die navorser dit nodig ag. In so 'n geval moet egter daarop gelet word dat die klem regdeur op wetenskaplike navorsing val en nie op sake wat betrekking het op die logistiese aspek nie. Indien omstandighede buite die navorser se beheer, logistiese en/of toerustingprobleme veroorsaak het dat geen vordering in 'n betrokke jaar gemaak is nie, mag 'n "aktiwiteitsverslag" waarin hierdie omstandighede of probleme (asook wat daaromtrent gedoen is) omskryf word, as 'n addendum by die vorderingsverslag ingesluit word.

Dankie vir u samewerking.