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PROGRESS REPORTS TO

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PREFACE

This volume contains annual progress reports on research projects undertaken during 1979/80 within the South African National Antarctic Programme, as submitted to SASCAR in July 1980. It is the first of what will become an annual series. The format of the individual reports has not been standardized, but it is hoped that as from 1981 contributors will be guided by the instructions contained in the back of this volume. The volume is being distributed free to SASCAR members and participants in the programme for their information. The contents are not for publication or citing.

VOORWOORD

Hierdie publikasie bevat die jaarlikse vorderingsverslae wat handel oor navorsingsprojekte wat gedeurende 1979/80 binne die Suid-Afrikaanse Nasionale Antarktiese Program onderneem is, soos voorgelê aan WKAN in Julie 1980. Dit is die eerste uitgawe in 'n reeks wat voortaan jaarliks gepubliseer sal word. Aangesien daar nog nie eenvormigheid bestaan in die aanbieding van die individuele verslae nie, is riglyne agter in hierdie uitgawe ingesluit met die doel dat bydraers hul vanaf 1981 daardeur sal laat lei. Hierdie publikasie word kosteloos en slegs ter inligting aan lede van WKAN en deelnemers aan die program versprei. Inligting hierin vervat is nie vir publikasie of verwysing nie.

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1. ATMOSPHERIC SCIENCES

1. ATMOSFERIESE WETENSKAPPE

PROGRESS REPORT
IONOSPHERE AND AIRGLOW PHYSICS
REPORT FOR THE 1979/80 FINANCIAL YEAR
JULY 1980

Project Leader: Prof J.A. Gledhill
Department of Physics & Electronics
Rhodes University
GRAHAMSTOWN
6140

(A) Objectives:

The main objectives of this project are to observe and understand the behaviour of the upper atmosphere over South Africa, the South Atlantic Ocean (including the Geomagnetic Anomaly), the Southern Ocean and adjacent parts of Antarctica. In pursuance of the main objectives, much effort is channeled into the fields of electronics, computer hardware and software development and data handling, apart from direct analysis of data.

(B) Progress:

The research effort for the last year can be categorised broadly into the 20 projects listed under (C). In the following report of the progress made in these fields, numbers in parentheses refer to this list.
In turn, numbers in (C) refer to the list of papers and publications at the end.

In recent years progress in the understanding of the behaviour of the South Atlantic Anomaly region has been greatly helped by the availability of Satellite data to supplement the ground based observations. The results of this work have been reported at the 24th SAIP Conference as well as three International Conferences (1), (2), (8). More recently, Professor Gledhill has had the opportunity to study the Atmospheric Explorer C data from 1974 to 1977 while in the U.S.A. However, the acquisition of Satellite data is not without its problems, and some effort has gone into the extraction of the data from the tapes in a form compatible with the Rhodes I.C.L. computer (19). Progress in this direction is the subject of a seperate report.

Mr Ian Dore has commenced an MSc project (3) on the communications aspects of the oblique incidence data, while Mr G. Oberem has started working on a Ph D. degree involving the continuation of the work started by Rash & Poole (4),(16); Mr E. de Kock successfully completed his M Sc project on doppler-mode measurements made during his year at SANAE, in which hitherto unobserved fine structure in the echoes supplied evidence of turbulence in the ionosphere (7), (11).

In/..

In response to a communication from Dr. H. Rishbeth of the Appleton Laboratory in Slough, England, and effort was made to take advantage of recent lunar occultations of the celestial X-ray source SCO X 1 to establish an alleged influence on the D-region (5), (12). This project received no financial support, and our group is grateful to the Weather Bureau for the loan of 2 Omega receivers which were run at SANAE during 1980. The co-operation of the Hartebeesthoek Observatory in this connection is also gratefully acknowledged. All experiments thus far have failed to demonstrate SCO X 1 influence, and the project will probably be ceased at the end of 1980 and the end of the current group of occultations.

Routine recording of vertical and oblique incidence ionograms at SANAE and Grahamstown has proceeded well with very little equipmental data loss (9),and Airglow measurements at SANAE on suitable nights during Winter were similarly trouble-free (10). Mr J.S. Fisher successfully completed his M Sc degree which was involved with the development and construction of a real time Fast Fourier Transform analyser, forming an integral part of the ionosonde digitisation programme. This effort has proceeded well, however an attempt to convert the SANAE ionosonde to digital output at the end of 1979 was abandoned after repeated electronic failures threatened to prejudice the routine programme (23). It is now hoped to implement this change at the end of 1980. Meanwhile, efforts to digitise the three airglow photometers at Grahamstown are proceeding well, forming the basis of an M Sc degree for Mr C. Grujon (14)

Work in the new correlation ionosonde (MICROBAL) has been hampered by staff changes and is covered by a separate report (15). The project will have to be shelved due to withdrawal of financial support.

Routine scaling of vertical incidence characteristics at SANAE has been kept up to date, while the Grahamstown data is complete up to the end of 1977 (6). Various programmes have been developed to enable archiving of the data onto magnetic tape, as well as computer based bulletin production (17), (18). This is the first step towards the formation of a large data base which will be in a form readily accessible to high level computer analysis (20)

(C) Projects

(i) Analytical

(1) Analysis of Atmospheric Explorer C and Injun 5 data to provide particle precipitation maps over the anomaly region in general and during specific events. (1), (2), (10), (11), (12), (13).

(2) Analysis/..

(2) Analysis of AEC data during the event of 26/27 March 1976 (3), (9).

(3) Study of the relationship between maximum observed frequency (MOF) of the 2, 3 & 4 hop SANAE - Grahamstown HF paths, and the corresponding maximum usable frequencies (MUF) calculated from the SANAE & Grahamstown vertical incidence data.

(4) Continuation of the conversion of oblique incidence records to equivalent vertical incidence records taking E & F1 region ionisation into account (6)

(5) Analysis of Omega receiver data recorded at SANAE & Hartebeesthoek for evidence of SCO X 1 - related D-region effects (4)

(6) Scaling of SANAE and Grahamstown ionosphere characteristics for WDC and local use (18).

(7) Analysis of doppler-mode measurements at SANAE (8), (16).

(ii) Experimental

(8) Combined ionosphere and airglow measurements on Winter Cruise, July 1979.

(9) Quarter-hourly vertical incidence soundings at SANAE and Grahamstown, quarter-hourly oblique incidence soundings of SANAE - Grahamstown HF path. (18)

(10) Winter night-time airglow measurements made at SANAE during favourable moon /weather periods.

(11) Special doppler-mode measurements made at SANAE during 1979 to study ionospheric motions. (8)

(12) Measurement of the phase and amplitude of Omega signals at SANAE during 1980 using TRACOR receivers. (4)

(iii) Practical

(13) Conversion of existing analog ionosphere sounding equipment to computer control and digitisation of output to allow angle of arrival and ordinary/extra ordinary mode identification (5), (15).

(14) Conversion of airglow photometers to digital control and output to facilitate analysis and improve accuracy.

(15) Construction of a new type of correlation ionosonde. (MICROBAL)

(16) Development of Oblique Incidence Ionogram Scaling Programme in MSI 6800 SD BASIC.

(17) Development of ICL Fortran programmes to transfer scaled vertical incidence characteristics to and from magnetic tape, as well as editing.

(18) Development of ICL Fortran programmes to enable computer-based bulletin production/..

production of vertical incidence data.

(19) Development of ICL Fortran programmes to extract and handle Satellite data stored on magnetic tape.

(iv) Theoretical

(20) Investigations into the application of digital time series analysis to geophysical data.

(D) Publications and Papers.

(1) J.A. Gledhill
Paper No E.1, 24th SAIP Conference

(2) R. Haggard & J.A. Gledhill
Paper No E. 2, 24th SAIP Conference.

(3) J.A. Gledhill
Paper No E.3, 24th SAIP Conference.

(4) A.W.V. Poole
Paper No E. 4, 24th SAIP Conference

(5) A.W.V. Poole & J.S. Fisher
Paper No E. 11, 24th SAIP Conference

(6) J.P.S. Rash
Paper No E. 12, 24th SAIP Conference

(7) J.A. Gledhill, R.G. Key, C. Opland
Paper No E. 16, 24th SAIP Conference.

(8) E.J. de Kock, A.W.V. Poole, J.A. Gledhill
Paper No E.17, 24th SAIP Conference

(9) J.A. Gledhill, D.G. Torr, R.A. Hoffman
Paper No 70, 1st International Symposium on IMS results, Melbourne, Australia 1979

(10)/..

(10) J.A. Gledhill
Paper No 23.06, IAGA XV11 IUGG General Assembly Canberra, Australia 1979.

(11) R. Haggard, J.A. Gledhill, D.G. Torr, R.A. Hoffman
Paper No 23,07, IAGA XV11 IUGG. General Assembly Canberra, Australia 1979

(12) J.A. Gledhill, R. Haggard, D.G. Torr, R.A. Hoffman
Paper read at AGU meeting, Toronto, Canada May 1980.

(13) J.A. Gledhill, D.G. Torr, R.A. Hoffman
Paper read at AGU meeting, Toronto, Canada May 1980.

(14) A.W.V. Poole
Proc IEEE Trans on Ant. and Prop. Vol AP - 27 No 4 Page 480 July 1979

(15) J.S. Fisher
M Sc Thesis April 1980

(16) E.J. de Kock
M Sc Thesis April 1980

(17) A.W.V. Poole
Paper No 16, Workshop on Digital Time Series Analysis with Geophysical Applications, Hermanus April 1980

(18) Monthly Bulletins of ionospheric characteristics sent to WDC.

ANNUAL PROGRESS REPORT - SANCGASS 1980

(i) Title: Magnetic Observatory of the CSIR
Head: Dr G J Kühn
Programme Leader - Antarctic Geomagnetism: Dr P R Sutcliffe
Programme Leader - Antarctic Electronicist: M B W Arlow

(ii) Objectives:

Research: To improve our understanding of magnetospheric substorms by studies of various substorm phenomena such as magnetic pulsations and various aspects of proton and electron aurora.

To improve our understanding of quiet variations in the geomagnetic field by studying these variations both locally and on a global scale.

To investigate a possible relationship between solar-magnetospheric and meteorological phenomena with the purpose of improving our understanding of climatological changes.

Routine Services: To provide adequate spatial and temporal coverage of magnetic field observations to supply in the requirements of local users (geological exploration and survey groups) and international users (reference data for global magnetic surveys) and to provide geophysical data for research purposes as required.

(iii) Brief History: Since its establishment as a magnetic recording station in 1932, the Magnetic Observatory has grown to the extent where it now is responsible for the operation of three magnetic recording stations in South Africa (a fourth, at Grahamstown, was closed in March 1980) as well as a

station at Marion Island and one at Sanae, Antarctica. The geomagnetic data are published annually and distributed to approximately 100 institutions throughout the world, including the World Data Centres. In addition photometric observations of proton and electron aurora are made in Antarctica, and cosmic ray neutron monitor observations are made in cooperation with Potchefstroom University at Hermanus and Tsumeb.

Previous research projects were concerned primarily with the study of magnetic and auroral phenomena observed during magnetospheric substorms, and with the magnetic quiet solar (Sq) variation in Southern Africa. The maximum entropy method of power spectrum analysis has been used extensively to study periodicities in geophysical time series.

(iv) Scientific Progress during 1979/80:

(a) Routine Services: Recording of the magnetic field variations was continued at the Observatory's magnetic recording stations. The recording station at Grahamstown was closed in March 1980 because the cost of maintaining the aging equipment could no longer be justified by the scientific value of the data.

The auroral programme at Sanae continued with monitoring by all-sky camera, and photometric recording of auroral pulsations at 427,8nm and proton aurora at 486,1nm.

The geophysical monitoring programme at Hermanus also includes the continuous operation of a 12NM64 neutron monitor, a 30 MHz riometer, and a 2-sensor bar fluxmeter.

(b) Research: The substorm research group involved itself in two fields of study during the past year. One of these, the study of proton aurora, was done as part of the Antarctic research activities and is reported on in the report compiled by the Antarctic research section. In the second field of study the changes in ellipticity of low latitude Pi2 magnetic pulsations were investigated. Some of the more interesting results obtained, are the following:

There is an annual variation in pre-midnight ellipticity.

The ellipticity changes throughout the night from positive to negative, the largest change being observed in November and the smallest during May.

These variations are in phase with annual and local time variations in plasmaspheric electron density.

An explanation that may be suggested for these observations is that a pulsation resonance region moves back and forth across the latitude of Hermanus in phase with changes in plasmaspheric electron density.

Much time was spent in reviewing techniques of time series analysis for presentation at the Workshop on Digital Time Series Analysis with Geophysical Applications, held at Hermanus in April 1980. The study of recent developments of maximum entropy spectral analysis led to the writing of a much improved FORTRAN routine based on work by Ulrych and Clayton for determining a spectrum. The new routine does away with the frequency shifts (incorrect location of spectral peak) that occur when the usual Burg algorithm is used.

In the magnetic quiet time variation research project much time was spent on a study of statistical data screening procedures. This was necessitated by the large number of mistakes encountered in magnetic data obtained from overseas observatories to study the hypothesis that the Sq variation pattern can best be interpreted in terms of two overlapping equivalent current systems.

The project on Solar-Terrestrial phenomena/ Weather relationships was for all practical purposes dormant during the past year. The reason for this is that one of the staff members associated with this project was seconded to the Antarctic Section of the Magnetic Observatory as Antarctic Geomagnetist in July 1979.

(v) Publications and Papers presented at Symposia:

Lambert, S and P R Sutcliffe (1980), Photometric Observations of proton aurora at Sanae and corrections for off-zenith viewing angles, (in preparation).

Scheepers, G L M (1980), Statistical Screening of Data, Paper presented at: Workshop on Digital Time Series Analysis with Geophysical Applications, Hermanus, CSIR Report S 238, p 81.

Smits, D P (1980), An introduction to filters in the frequency domain, Paper presented at: Workshop on Digital Time Series Analysis with Geophysical Applications, Hermanus, CSIR Report S 238, p 23.

Sutcliffe, P R (1979), Evidence of a low latitude resonance in Pi2 generation, Paper presented at XVII IAGA General Assembly, Canberra.

Sutcliffe, P R (1980), The longitudinal range of Pi2 propagation at low latitudes, Planet. Space Sci., 28, 9-16.

Sutcliffe, P R (1980), Introduction to digital Wiener filtering and predictive deconvolution, Paper presented at Workshop on Digital Time Series Analysis with Geophysical Applications, Hermanus, CSIR Report S 238, p 45.

Sutcliffe, P R (1980), An introduction to maximum entropy spectral analysis, Paper presented at Workshop on Digital Time Series Analysis with Geophysical Applications, Hermanus, CSIR Report S 238, p 61.

Sutcliffe, P R (1980), The practical application of maximum entropy spectral analysis, Paper presented at Workshop on Digital Time Series Analysis with Geophysical Applications, Hermanus, CSIR Report S 238, p 255.

Sutcliffe, P R (1980), Reversals in the polarization sense of Pi2 pulsations at low latitudes (in preparation).

(vi) List of personnel involved in research programmes:

(a) Substorm Phenomena: Dr P R Sutcliffe, D Smits

(b) Magnetic Quiet-time Variations: G L M Scheepers

(c) STP-Weather: Dr G J Kühn, (D Meyer)

(vii) New Equipment: An EDA fluxgate magnetometer was commissioned at Marion Island to serve as a back-up system for the present La Cour magnetographs that are adversely affected by strong winds.

A total of nine fluxbars are at present on order from Japan. Three of these will be used as sensors in a new pulsation magnetometer for Sanae, Antarctica. The remaining six sensors will be used in the construction of three transportable two-axis pulsation magnetometers. These magnetometers will be used to establish networks in South Africa and in Antarctica for specific projects of limited duration.

(viii) Envisaged future activities: Routine observations will be continued as in the past. No significant changes are envisaged, but equipment will be improved where necessary.

Research activities will be continued in the fields listed above.

PROGRESS REPORT

(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.

ANTARCTIC GEOMAGNETIC AND AURORA PROGRAMME

PROGRESS REPORT FOR 1979/80

(a) Program Leader: Dr P R Sutcliffe
Magnetic Observatory, P O Box 32,
Hermanus 7200

(b) Objectives of project:

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

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

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

(iv) To provide geomagnetic absolute values and secular variation data for use in the compilation of regional and world magnetic charts.

(c) Brief history of Project:

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 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.

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.

(d) Scientific Progress:

(i) A study was made of the interrelationship of proton and electron aurora and magnetic activity recorded at Sanae. Main findings are that in the evening sector, when Sanae is under the eastward electrojet, electron aurora tends to occur poleward of proton aurora, whereas the reverse applies in the morning sector below the westward electrojet. In the region of the Harang discontinuity the two types of aurora largely overlap.

(ii) The longitudinal range over which Pi2 pulsations are propagated at low latitudes was investigated. The results showed that the longitudinal extent over which Pi2's can be detected varies from a narrow range of longitudes either side of the 23 L.T. meridian in some cases to almost all longitudes around the Earth in others.

(iii) A comparative statistical study of Pi2 pulsations recorded simultaneously at Sanae and Hermanus was made. The study showed different frequency distributions of Pi2 power at the two stations with low frequencies dominating at Sanae and high frequencies at Hermanus. These results support other evidence for a low latitude resonance in Pi2 generation.

(iv) Recent advances in Maximum Entropy Spectral Analysis were investigated in order to develop improved techniques for analysing geomagnetic pulsations.

(e) Relevant Publications:

Lambert, S. and P.R. Sutcliffe (1980), Photometric observations of proton aurora at Sanae and corrections for off-zenith viewing angles, J.atmos.terr.Phys., (submitted).

Sutcliffe, P.R. (1979), Evidence of a low latitude resonance in Pi2 generation, Paper presented at XVII IAGA General Assembly, Canberra.

Sutcliffe, P.R. (1980), The longitudinal range of Pi2 propagation at low latitudes, Planet. Space Sci., 28, 9-16.

Sutcliffe, P.R. (1980), A comparison of the Burg algorithm and the bidirectional least squares estimator, Addendum to: The Practical Application of Maximum Entropy Spectral Analysis, Magnetic Observatory, Hermanus.

KOÖPERATIEWE WETENSKAPLIKE NAVORSINGSPROGRAM OP KOSMIESE STRALE EN DEELTJIEPRESIPITASIE

VORDERINGSVERSLAG 1979/80

Programdirekteur : Prof. P.H. Stoker, Departement Fisika
PU vir CHO, Potchefstroom.

11 Junie 1980

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1 Doelwitte

Die doelwitte van die projek is om

1.1 deur waarneming die primêre spektrum van kosmiese strale af te lei en te leer verstaan hoe die interplanetêre magneetveld, die aarde se magneetveld en die atmosfeer die spektrum van kosmiese strale bepaal gedurende 'n sonaktiwiteitsiklus en opvolgende siklusse, en

1.2 deur waarnemings op ionosferiese absorpsie van kosmiese ruis die spektrum (of hoogte) van presipiterende magnetosferiese elektrone te Sanae te bepaal en die tydsveranderinge van die spektrum te bestudeer in samehang met magnetosferiese waarnemings.

2 Geskiedkundig

Die projek het ontwikkel vanaf eerste waarnemings met 'n plaaslik-vervaardigde neutronmonitor te Hermanus vanaf 1957 met die I.G.J. en breedtegraadwaarnemings met 'n neutronmonitor in 'n Shackleton=bomwerper 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 RSA tydens aflos=reise was 'n noodwendige uitbreiding van hierdie eerste waarnemings. Waarnemings op kosmiese strale in die stratosfeer 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 Vordering

'n Onlangs-voltooide studie van resultate verkry met 'n wêreldwye opname van kosmiese strale op seevlak met neutronmonitors op die SA Hugenoot en op die RSA in 1976 tydens die periode van minimum sonaktiwiteit, het getoon dat daar 'n 22-jarige modulasiesiklus van kosmiese strale bestaan gesuperponeer op die bekende 11-jarige siklus. Die 1976-opname het geblyk ooreen te stem met die 1954-opname om Noord- en Suid-Amerika, maar nie met die 1965-opname oor Noord-Amerika nie.

Teoretiese studies van modulasie van kosmiese strale wat dr. H. Moraal die afgelope 18 maande gedoen het, het tot so 'n stadium ontwikkel dat 'n 22-jarige modulasiesiklus van kosmiese strale minstens kwalitatief in terme van hemisferiese ompoling van die solêre magneetveld elke 11-jaar gebring kon word. Hierdie werk word voortgesit en bring die belangrikheid van langtermyn monitering van kosmiese strale met vaste neutronmonitors weereens na vore.

'n Vergelyking van ons breedtegraadopnames in die gebied van die Suid-Atlantiese Oseaan met die in die Noord-Atlantiese oseaan toon dat afsnystyfhede vir gelyke intensiteite van kosmiese strale in die twee gebiede tot soveel as 0,3 GV by ongeveer 8 GV verskil. Die verklaring lê daarin dat sekulêre korreksies van die Inter= nasionale Geomagnetiese Referensieveld (IGRF) van 1965 se veld= model nie meer in 1976 'n korrekte beskrywing van die aarde se magneetveld gee nie, veral nie vir die sekulêre effekte in die gebied van die Kaapstadse geomagnetiese anomalie nie.

Noord-Suid-anisotropieë van kosmiese strale is deur dr. P.J. König met ballonvlugte in die suidelike halfrond waargeneem, met hoër intensiteit van kosmiese strale vanaf die Suidpoolgebied. In die noordelike halfrond kom die hoër intensiteit vanaf die noordpool= gebied. Dr. König het daarin geslaag om vir die eerste keer 'n aanvaarbare verklaring vir hierdie anisotropieë te kry uit 'n rekenaarstudie van bane van protone en elektrone in die magnetosfeer.

Stratosferiese X-strale is tydens 'n ballonvlug vanaf die SA Agulhas tussen Kaapstad en Gough-eiland in die oggend waargeneem. Hierdie X-strale moet afkomstig wees vanaf stralingsgordelelektrone in die magnetosfeer, wat in die atmosfeer presipiteer as gevolg van die uitsetting van die atmosfeer deur EUV verhitting deur die son. Stralingsgordelelektrone wat deur die Suid-Atlantiese Geomagnetiese Anomalie gedurende die minder-digte koel nagtelike eksosfeer dryf, se spieëlhoogtes sal stadigaan afneem, sonder om werklik te presipiteer. 'n Verhitte eksosfeer sal gedurende die oggend by uitsetting presipitasie van hierdie elektrone meebring.

Die eerste data op magneetbande van absorpsie van kosmiese ruis te SANAE gedurende 1979 word tans verwerk en sal analises baie bespoedig teenoor die metode van grafiese registrasie, waarmee data voor 1979 uitsluitlik geregistreer is.

4 Publikasies

A Konferensiepublikasies

1 Mischke, C.F.W., Raubenheimer, B.C., Stoker, P.H., and Van der Walt, A.J.: Experimental observations of secular changes in the vertical cutoff rigidity. Proc. 16th Int. Conf. on Cosmic Rays, Kyoto, Japan, 4,279, 1979.

2 Shea, M.A., Smart, D.F., and (König,P.J., Stoker, P.H. plus 23 other authors listed alphabetically): The ground-level relativistic solar proton event of May 7, 1978 : A composite report. Proc. 16th Int. Conf. on Cosmic Rays, Kyoto, Japan, 5, 226, 1979.

3 Potgieter, M.S., Raubenheimer, B.C., Stoker, P.H. : The latitude

distribution of cosmic rays at sea level during the recent period of minimum solar activity, Proc. 16th Int. Conf. on Cosmic Rays, Kyoto, Japan, 4, 352, 1979.

4 Stoker, P.H., Potgieter, M.S., Venter, A.J.: Variations in cosmic-ray primary spectrum from recordings at SANAE by neutron monitors at different sensitivities, Proc. 16th Int. Conf. on Cosmic Rays, Kyoto, Japan, 4, 358, 1979.

5 Moraal, H., Gleeson, L.J., Webb, G.M.: Effects of charged particle drifts on the modulation of the intensity of galactic cosmic rays, Proc. 16th Int. Conf. on Cosmic Rays, Kyoto, Japan, 3, 1, 1979.

B Publikasies in gespesialiseerde vaktydskrifte

1 Gleeson, L.J., Jensen,J.O., Moraal, H., Webb, G.M.: Three dimensional cosmic-ray modulation models with drifts. Voorgelê vir publikasie in Journal of Geophysical Research, 1980.

2 Stoker, P.H., Van der Walt, A.J., Potgieter, M.S.: The modulation of cosmic rays during solar minimum I; Experimental details. Voorgelê vir publikasie in South African Journal of Physics, 1980.

3 Potgieter, M.S., Raubenheimer, B.C., Stoker, P.H., Van der Walt, A.J.: The modulation of cosmic rays during solar minimum II; The cosmic ray latitude distribution at sea level during 1976. Voorgelê vir publikasie in South African Journal of Physics, 1980.

4 Potgieter, M.S., Moraal,H., Raubenheimer, B.C., Stoker, P.H.: The modulation of cosmic rays during solar minimum III. A comparison of the latitude distributions for the period of solar minimum during 1954, 1965 and 1976. Voorgelê vir publikasie in die South African Journal of Physics, 1980.

5 König, P.J.: The diurnal wiping of the Electron radiation belt bottom in the South Atlantic. Voorgelê vir publikasie in die Journal of Geophysical Research, 1980.

6 König, P.J.: A. model for the anisotropic re-entry of albedo at Palestine. Voorgelê vir publikasie in Journal of Geophysical Research, 1980.

7 König, P.J., and Stoker, P.H.: Displaced iso-rigidity contours in the North Atlantic for 1975. Voorgelê vir publikasie in Journal of Geophysical Research, 1980.

22ND SASCAR ANNUAL REPORT

DURBAN SOLAR TERRESTRIAL PHYSICS GROUP

(i) Project Title: Durban Solar Terrestrial Physics Group

(ii) Director: Professor A.D.M. Walker

(iii) Objectives:

(a) Investigation of the micro and macro-structure of the plasmasphere and plasmasheet 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.

(iv) 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.

(v) Progress since 1979

On the basis of experience gained in the operation of a narrow band VLF direction finder, an improved version was installed at SANAE. We expect the system to be in operation sometime in 1980.

Ground based whistler recordings were made at SANAE during 1979 in cooperation with the U.S.A. (Siple); U.K. (Halley Bay), Argentina and France, (General Belgrano).

The association between VLF hiss and auroral light intensity has been studied for pulsating auroras by co-ordinated observations with a broad band VLF receiver and low light level TV system viewing the N_2^+ 1NG emissions. Power spectral analysis of the VLF hiss and auroral-light intensity fluctuations display a common peak at 1,34 Hz. Cross spectral analysis shows the auroral light intensity fluctuations to lead those of the hiss by times ranging between 0,11 and 0,16 seconds. This result does not appear to be compatible with a Gyroresonace or Čerenkov source mechanism.

A study of auroral activity associated with Pc 5 pulsations observed at Sanae is in progress. It has been predicted by Greenwald and Walker, on the basis of STARE observations, that the field aligned current associated with large pulsations should be sufficiently large to prouduce poleward moving auroral arcs.

In cooperation with the Canadian group VLF data has been retrieved at SANAE from ISIS I and II. Ion densities at the satellite altitude (1500 km) have been measured using observations of the lower hybrid resonance frequency cut off and compared with electron densities deduced from whistler dispersion on the same field line (or close to it).

Equatorial VLF and ELF data recorded at Quito by the ISIS satellites in 1977 will be used to try to interpret the mapping of VLF and ELF emissions observed at equatorial latitudes by the Ariel 4 satellite.

Over 2000 whistlers recorded on ISIS II from Quito have been analysed and the effect of the equatorial anomaly on whistler dispersion has been established .

Analogue recordings of the H component of geomagnetic pulsations were continued in 1979.

Analysis is under way of local electric field data detected by field mills and recorded on a chart at SANAE and the incidence of global lightning monitored by ELF recordings.

Theoretical work on the structure of hydromagnetic waves in the Pc 5 band has been continued. Statistical work on the occurrence of Pc 5 pulsations has been completed.

A vertical field mill and ELF receiver have been in operation at SANAE during 1979 to obtain both ELF and electric field data.

The data gathered from the two systems is being evaluated to investigate the relationship between solar activity, the vertical electric field data and thunderstorm activity.

PUBLICATIONS SINCE LAST PROGRESS REPORT

Durban Solar Terrestrial Physics Group

Greenwald R.A.** and Walker A.D.M.
Energetics of long period resonant hydromagnetic waves.
(Submitted to *Geophys. Res. Letters*, 1980).

Markson R.*, Blumenthal D.†, Sedlacek J.* and Muir M.
Atmospheric electrical plume detection: theory and field measurements.
Bulletin of the American Meteorological Society, 60, 1979, p98-109.

Muir M.S.
A possible mechanism linking solar events and terrestrial weather.
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Muir M.S.
The role of atmospheric electricity in Sun-weather relationships.
In *Solar-terrestrial Influences on Weather and Climate*,
ed. by McCormac B.M. and Seliga T. Dordrecht, Holland, Natal,
1979, p259-262.

Scourfield M.W.J.
Plasmaspheric convection patterns observed simultaneously from
two ground stations.
Planet. & Space Sci., 27, 643, 1979.

Scourfield M.W.J.
Evening (Harang) and morning discontinuities in ionospheric
electron drifts and their dependence upon the interplanetary
magnetic field.
J. Geophys. Res., (Submitted May 1980).

Walker A.D.M., Greenwald R.A.**, Stuart W.F.*** and Green C.A.***
STARE auroral radar observations of Pc 5 geomagnetic pulsations.
J. Geophys. Res., 84(A7), 1979, p3373-3388.

Walker A.D.M.
Modelling of Pc 5 pulsation structure in the magnetosphere.
Planet. & Space Sci., (1980, in press).

Walker A.D.M. and Greenwald R.A.**
Pulsation structure in the ionosphere derived from auroral radar data.
Geomag. & Geoelec. (1980, in press).

Walker A.D.M. and Greenwald R.A.**
Statistics of occurrence of hydromagnetic oscillation in the Pc 5
range observed by the STARE auroral radar.
(To be submitted to *Planet. & Space Sci.*, 1980).

Woods A.C., Scourfield M.W.J., Boynton D. and Roach M.A.
Plasmasphere convection patterns observed simultaneously from two
ground stations.
Planet. & Space Sci., 27, 1979, p643-652.

PAPERS DELIVERED AT CONFERENCES

IAGA General Assembly, Canberra, Australia, December 1979.

Walker A.D.M. and Greenwald R.A.**
Pulsation structure in the Ionosphere derived from auroral radar data.
IAGA Bulletin No. 43, 33a02, 1979, p33A.

Walker A.D.M. and Greenwald R.A.**
Determination of magnetospheric and ionospheric quantities by means of STARE observations of Pc 5 pulsations.
IAGA Bulletin No. 43, 33d05, 1979, p33D.

Annual Conference of the South African Institute of Physics, Bloemfontein, July 1979.

Hughes A.R.W. and Nugent B.
Plasma Distribution in the magnetosphere.
S.A.I.P., 1979, E10, p33.

Walker A.D.M. and Greenwald R.A.**
The electric field of Pc 5 geomagnetic pulsations as observed by the STARE auroral radar.
S.A.I.P., 1979, E19, p34.

A.G.U. Fall Meeting, San Francisco, Dec 3-7, 1979

Scourfield M.W.J.
Auroral Pulsations - Television Image and VLF Hiss Correlation.
Paper SM68, (EOS 60, No. 46, Nov 13, 1979).

A.G.U. Spring Meeting, Toronto, May, 1980

Scourfield M.W.J.
Evidence for the $\vec{E} \times \vec{B}$ drift of pulsating auroral forms.

Scourfield M.W.J.
Evening (Harang) and morning discontinuities in ionospheric electron drifts and their dependence upon the interplanetary magnetic field.

Fahleson Memorial Workshop on Magnetospheric Convection, Lindau October 2 - 5, 1979

Scourfield M.W.J.
Whistler studies of magnetospheric convection within the plasmapause.

Yosemite High Latitude Electric Fields Conference, Yosemite Jan 30, 1980

Scourfield M.W.J.
The Harang discontinuity and its morning counterpart - observations with STARE.

ANNEXURE 1

ITEM 12

Motivation for a Technical Assistant.

We have, for the past four years, out of funds which have from time to time become available, employed Mrs. Ann Nolte as a technical assistant. The need for such a part time assistant to be employed on a regular basis, is to perform the following duties:

1. For photographic processing and to make sonagrams from VLF audio data.
2. Perform operators duties on the group's mini computer, in particular make regular back up copies of discs and tapes, run routine programmes, and keep data disc and tape files updated.
3. Keep records and catalogues of scientific data and supply data for research needs of members of staff, post-graduate students and service requests from all other universities and programmes.
4. Keep stock records of consumable capital items of equipment, also logging and filing the records brought back each year from SANAE.
5. Act as Librarian for the Reprints, Preprints, Research reports and general literature held by the group.

Mrs. Nolte has over the past few years acquired the experience necessary to carry out all of these duties. However we cannot guarantee funds to employ her on a regular basis - particularly since her experience now makes her worth a great deal more than when she was learning the job. The need at the present time is for mornings only, part time employment.

It is suggested that the University scale for part time Administrative Assistants would be appropriate on the following salary scale :

R2390 x 130 to R2780 x 150 to R3530.

2. BIOLOGICAL SCIENCES

2. BIOLOGIESE WETENSKAPPE

PROGRESS REPORT

Project title: POPULATION DYNAMICS AND REPRODUCTIVE PHYSIOLOGY OF THE AMSTERDAM ISLAND FUR SEAL *Arctocephalus tropicalis* AT GOUGH ISLAND.

Project leader: J.D. Skinner, Mammal Research Institute, University of Pretoria, Pretoria, 0002.
Project researcher: M.N. Bester, Mammal Research Institute, Univ. of Pretoria.
Progress report: Third progress report, June 1979 - June 1980.

Project objectives: (1) Determine vital parameters in the population dynamics of *A. tropicalis*.

(2) Study the reproductive physiology and body growth patterns.

(3) Study local and long range movement patterns.

(4) Investigate feeding habits.

(5) Stock identification.

History of project: The behaviour and annual cycle of this species were investigated (Oct. 1974 to September 1977) and the results contained in a D.Sc. Thesis (Bester, M.N. 1977). The fieldwork of this project was undertaken from October 1977 to November 1978, and processing of results to date. The processing period was interrupted to investigate the presence, and density of seals in the marginal zone of the South Atlantic pack-ice during winter (July/August 1979) to determine possible long range movement of fur seals (Bester, in press). Furthermore, a study on aspects of the population ecology of the southern elephant seal *Mirounga leonina* was undertaken from September 1979 to February 1980 at Kerguelen Island, inclusive of a visit to Amsterdam Island, and preliminary investigation of *A. tropicalis* occurring there. By June 1979, skull measurements of culled seals at Gough (n = 220) and those collected in the field (n = 20) were completed, and suture indexed to be correlated with age. A sample of study skins was prepared, and the functional morphology (with regard to temperature regulation) of selected skin samples investigated. Census data were processed (inclusive of those of *M. leonina* occurring at the Island).

Progress 1979/80:

1. The planning and construction of a low-speed tooth-cutting machine has been completed and sectioning of teeth for age determintation is underway. The feasibility of the use of roentgen rays in collaboration with a radiologist (Dr. I. van Niekerk) to photograph incremental lines in teeth as a supplement to the above is being investigated.

2. The study of the functional morphology of selected skin samples (histological) have been completed, written up in the form of a report and will be prepared for publication.

3. Negotiations to identify food items procured from stomach contents of culled specimens through the School of Environmental Studies (Univ. of Cape Town) are in progress.

4. Experts on parasitology are being solicited to identify parasites (internal) collected from culled specimens.

5. The male reproductive systems have been histologically prepared to determine seasonal activity (testes and epididymes).

6. Four publications, directly related to this programme and associated with it, have been prepared, submitted to scientific journals, and are in press (listed).

7. Hormone assays - the technology of, and purchase of equipment are programmed and the processing of samples (plasma and urine) at the MRI have to be delayed until the facilities have been set up.

Project objective:

(1) Has partly been realized - the population size, breeding population composition, annual pup yield and intrinsic rate of natural increase up to 1977/78 have been determined - the establishment of fecundity rates, age of first reproduction and senescence, age distribution and survivorship in progress. Objective (2) dependent on Item 7 listed above (Progress 1979/80); local and long range movement patterns (objective 3) entirely dependent on resightings of tagged animals (and therefore continued monitoring) and stock identification dependent on the number and quality of comparative samples being obtained from populations from other Islands (Marion and Amsterdam Islands). This project will be completed (under the new project title) by March 1982, progress to date centred on the processing of samples, rather than interpretation and representation.

Publications:

1. BESTER, M.N. (in press). A note on winter seal observations in the South Atlantic pack-ice. S. Afr. J. Antarct. Res. 9.

2. BESTER, M.N. (in press). Population increase in the Amsterdam Island fur seal Arctocephalus tropicalis at Gough Island. S. Afr. J. Zool.

3. BESTER, M.N. (in press). The southern elephant seal Mirounga leonina at Gough Island. S. Afr. J. Zool.

4. VOISIN, J.-F. and BESTER, M.N. (in press), The specific identity of giant petrels Macronectes at Gough Island. In: Proceedings of a Symposium on Birds of the Sea and Shore, ed. J. Cooper. African Seabird Group, Cape Town.

PROGRESS REPORT

Project title: POPULATION ECOLOGY OF THE SOUTHERN ELEPHANT SEAL *Mirounga leonina* at KERGUELEN ISLAND.

Project leader: J.D. Skinner, Mammal Research Institute, University of Pretoria, Pretoria, 0002.

Project researcher: M.N. Bester, Mammal Research Institute, University of Pretoria, Pretoria, 0002.

Progress report: Second progress report, June 1979 - June 1980.

Project objectives:

1. Population size and therefore trend(s).

2. The influence of these changes on the social structure of the population.

3. The influence of possible changes in the social structure of the population on mortaility rate in adults and pups.

4. The age structure of the population and associated population parameters by aid of recovery of previously marked or tagged animals.

5. The existence of possible intermingling with the populations of neighbouring Islands, and dispersal and dispersion from tag recoveries.

History of project:

This project is a continuation of an already existing programme undertaken by TAAF since 1970, and the cooperative study between South Africa (SASCAR) and the French (TAAF) commenced in September 1977. The results of the first phase of the cooperative programme (summer of 1977/78) are briefly summarized in the first progress report (June 1978 - June 1979), and contained in a comprehensive document serving as a final project report to SASCAR and TAAF. Three scientific publications eminated from this (listed).

Progress 1979/80:

During the summer of 1978/79 no research was undertaken at Kerguelen. Information procured during the 1979/80 summer is being processed. In addition the population size of the Kerguelen fur seal *Arctocephalus gazella* of the well defined and accessible Courbet Peninsula was determined. Processed information can be briefly summarized as follows:

1. Estimated minimum population size (elephant seals) over a more extensive census area than searched in previous years is 118080. The same census area as covered in 1977 indicated a population size of 115117 showing an intrinsic rate of decrease of 1,0 percent in two years.

2. The adult female component showed a 1,0 percent decrease, and the adult male component a 6,0 percent increase since 1977.

3. The adult male population size is however not significantly different from that expected, when expected population size is based on the mean intrinsic rate of decrease ($\bar{r}$) of -0,019 estimated from data available from 1958 to 1977. The observed adult female population size on the other hand do not closely fit the expected population size (mean intrinsic rate of increase of + 0,014).

4. A more significant relationship exists between the number of breeding males and the shape (e.g. length) of large harems than with the number of adult females.

5. Pups (underyearlings) show a post-weaning dispersion phase before leaving the Island and apparently randomly mix (tagged animals) which presents the possibility of estimating the annual pup yield through mark-recapture experiments.

6. The present A. gazella population size is approximately 639 (non-breeding) being mostly adult males and small immatures, and provides a baseline value to assess likely future changes. Evidence exists that A.gazella breeds elsewhere on Iles Kerguelen.

Five papers are being prepared by Bester (SASCAR) and Lenglart (TAAF), two of which are Lenglart's responsibility (pup dispersion and harem structure), the remaining three being compiled by Bester (population size, composition and change; dispersion of immatures in relation to their birthsites; and the status of A. gazella at Kerguelen) One publication titled "Fur seals Arctocephalus gazella and leopard seals Hydrurga leptonyx at Kerguelen" have been completed and submitted for publication.

Project objective 1 and 2 have been realized, but needs future monitoring. Project objectives 2 - 5 have partly been realized, but needs continued monitoring. Under objective 5, information on local dispersal can be processed, additional information would enhance the quality of the results. This also applies to immatures dispersion - the remainder (intermingling) depending on opportunity.

Publications:

1. VAN AARDE, R.J. 1980. Harem structure of the southern elephant seal Mirounga leonina at Kerguelen Island. Rev. Ecol. (Terre Vie) 34 : 31 - 44.

2. VAN AARDE, R.J. (in press). Fluctuations in the population of Southern Elephant seals, Mirounga leonina, at Kerguelen Island S. Afr. J. Zool.

3. VAN AARDE, R.J. & PASCAL, M. 1980. Marking southern elephant seals on Iles Kerguelen. Polar Rec. 20 : 62 - 65.

MARION ISLAND MARINE BIOLOGY

Project Leader: Professor John R.Grindley
Researcher: William Blankley
(School of Environmental Studies, University of Cape Town)

Progress report for the period June 1979 to June 1980.

Objectives

To study the intertidal community structure of Marion Island including quantitative studies of the fauna around the coasts of the islands.

History of the Project

Preliminary marine biological studies were undertaken by Mr.N.Fuller during the expedition of 1965/66. He prepared a preliminary report in 1967. Thirteen taxonomic reports appear in the monograph on Marion and Prince Edward Islands covering many of the groups of intertidal marine fauna collected during the 1965/66 expedition. Mr.A.F.de Villi carried out further studies of the intertidal fauna and flora. This was entitled 'Littoral ecology of Marion and Prince Edward Islands' and published in 1978 in the South African Journal of Antarctic Resear Through the co-operation of TAAF and with the use of the French ship 'Marion Dufresne' marine biological investigations were carried out in the sea around Marion and Prince Edward Islands during March 1976. The benthic fauna and flora, hydrology, water chemistry, primary productivity, phyto and nannoplankton, zooplankton, meiobenthos and fishes all received study. A representative set of identified specimen: are being sent to South Africa.

Progress

Mr.W.Blankley left for Marion Island on 22 May 1979. The central aim of work completed was to provide a quantitative description of the major trophic pathways operative within the intertidal and subtidal community. It also involved a sampling program to ascertain biomass and species association patterns. Caging experiments and field observations were useful in deducing the feeding and growth rates of selected species. Where possible data on the reproduction and behaviour of the major species were collected.

The main study area was Transvaal Cove but various other sites around the island were visited and studied briefly whilst comparative data were collected during a six-day stay on Prince Edward in June, 1980.

Biomass and species association data were obtained from 150 x 0,1m^2

scraped quadrats in the intertidal and splash zones. Subtidal biomass will be estimated from 200 photo-quadrats.

Trophic pathways were studied on the basis of prey item frequencies in the diets of major predators. 400 cases of predation in the starfish, Anasterias rupicola, have been analysed and the gut contents of 250 fish of the three local species were collected and will be used to ascertain predator/prey size ratios. Data on the marine food of the gulls and paddies were also collected. Other feeding observations and the examination of stomach contents of frozen samples of animals such as limpets, polychaetes, isopods, amphipods and bivalves will add to the food web.

Feeding rates were estimated for Nacella (Patingera) delesserti on kelp and Anasterias on Nacella using controlled caging experiments for six months.
Information on the reproduction of Anasterias, the three fish species and other minor species was collected. Growth rates of Nacella were obtained from marked, released animals.

PUBLICATIONS

El-Sayed, S.Z., Benon, P., David, P., Grindley, J.R. and Murail, J.F. 1979. Some aspects of the water column studied during the "Marion-Dufresne" cruise 08. CNFRA (Comite National Francais des Recherches Antarctiques) 44: 127-134.

Grindley, J.R. & Lane, S.B. 1979. Zooplankton around Marion and Prince Edward Islands. CNFRA (Comite National Francais des Recherches Antartiques) 44: 111-125.

Grindley, J.R. 1980. Marion Island Marine Biology. S.Afr.J.Antarct. Res. (In press).

Grindley, J.R. and de Villiers, A.F. 1980. Intertidal ecology of Marion and Prince Edward Islands. S.Afr.J.Antarct.Res. (In press).

Grindley, J.R. and Lane, S.B. 1980. Plankton and productivity of the waters around Marion Island. S.Afr.J.Antarct.Res. (In press).

PROGRESS REPORT : DEC.1979 to JUNE 1980.

Project title: The ecology of the house mouse (*Mus musculus*) on Marion Island.

Project leader: J.D. Skinner.

Researcher: J.P. Gleeson.

Funding: Dept. of Transport.

Duration of project:. 1979 - 1981.

Objectives: The house mouse on Marion Island has been found to be primarily insectivorous. This illustrates an interrelationship between the mice and the islands invertebrate fauna. The mice have a direct effect on the vegetation through their utilization of some plant material in their diet and in nest building. The study introduces a new aspect into the energy/ mineral cycle research at Marion Island. 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 reporductive trends in the populations.
4. Determine primary food (prey) items.
5. Determine the energetic requirements of individual mice.

Fieldwork commenced in April 1979, and was completed in May 1980. This report covers progress from December 1979 until June 1980.

Progress: Fieldwork during this phase continued in the same manner as before, namely a two-monthly live trapping programme on five fixed grids. As well as a snap-trapping programme, trapping in various habitats.

A. Live trapping: A total of six trapping sessions were conducted through the year. Using Hayne's (1949) method of density estimate, a yearly population trend was found. Minimum mouse densities occurred during November-December, with peak densities during May-June. With one exception in a biotically influenced beach area, with a peak density during February. Use of assessment lines allows calculation of actual area of effect of grids, and resultant mouse density.

B. Snap-trapping: An ongoing programme of trapping in similar habitats to the live trapping grids was continued. In addition a variety of habitats, and areas, around the island were trapped. This confirms distribution around the island, and relative indices of abundance may be determined.

Distribution: The mice have been found to be distributed from sea-level, where they utilize the beaches, up to approximately 450 m. Higher density areas occur below 150 m, which corresponds to the coastal plain area. An estimate was made of total island distribution, during two circuminsular expeditions. This was based on indirect evidence such as runways, burrows and seed collections in nests. Rough estimates of high, medium and low densities could be made.

Distribution in the main study area has been more accurately determined.

Stomach content analysis: Prey items in stomach contents were estimated using percentage appearance by volume. This continued on a monthly basis, and data were calculated to show monthly trends. These data show that *Pringleophaga marioni* larvae constitute the primary prey item in the diet of the mice throughout the year. Other invertebrates of importance include. *Pringleophaga marioni* adults and pupae, *Ectemnorrhinus similis* adults and larvae and *Myro* spp. Several other species of invertebrates are also found to be occasionally utilized.

Plant material (primarily seed) was maximally utilized from November to February, during peak growth periods of the grass species *Agrostis megallanica* and *Poa cooki*.

Reproductive data:

Pregnant females were still caught during March, but it would appear that sexual activity was reduced from April. Hitological data collected, still need to be analysed.

Invertebrate investigation: This work continued throughout the year, and initial data show seasonal trends in some of the main macroinvertebrate species.

Publications: Progress report January to December 1979.

No further publications to date.

Acknowledgements: Financial and logistic support from the Department of Transport is gratefully acknowledged.

MARINE ISLAND MARINE BIOLOGY

Project Leader: Professor John R.Grindley
Researcher: P.Haxen
(School of Environmental Studies, University of Cape Town)

Progress report for the period June 1979 to June 1980.

Objectives

To study the biology of Durvillea antarctica and other marine algae of Marion Island including their productivity around the coasts of the islands.

History of the Project

Preliminary marine biological studies were undertaken by Mr.N.Fuller during the expedition of 1965/66. He prepared a preliminary report in 1967. Thirteen taxonomic reports appear in the monograph on Marion and Prince Edward Islands covering many of the groups of intertidal marine fauna collected during the 1965/66 expedition. Mr.A.F.de Villiers carried out further studies of the intertidal fauna and flora. This was entitled 'Littoral ecology of Marion and Prince Edward Islands' and published in 1978 in the South African Journal of Antarctic Research. Through the co-operation of TAAF and with the use of the French ship 'Marion Dufresne' marine biological investigations were carried out in the sea around Marion and Prince Edward Islands during March 1976. The benthic fauna and flora, hydrology, water chemistry, primary productivity, phyto and nannoplankton, zooplankton, meiobenthos and fishes all received study. A representative set of identified specimens are being sent to South Africa.

Mr.Peter Haxen (B.Sc.Hons) left for Marion Island on the 22nd May 1979 and in April 1980 elected to stay a further six months on the island to complete his work. Problems were encountered in measuring kelp productivity initially and this extended stay should allow the completion of the planned work. The work on marine algae is concentrated on the kelp Durvillaea antarctica but includes some work on the offshore kelp Macrocystis pyrifera. Work has included regular monthly growth measurements, monthly reproductive studies, monthly sampling of cohorts, studies of amphipod and Nasella grazing, holdfast fauna and flora and kelp mortality and beach cast. Population structure has involved the analysis of 2 tonnes of stripped material. Samples for calorific and chemical analysis in Cape Town have been collected. Bacterial culture studies are in progress to investigate rates of decay and detritus production.

A primary study site situated at Transvaal Cove has been chosen. Biomass per metre of shore has been established on the basis of eight two-metre wide transects. All plants in each transect have been harvested and eight measurements made on each. 1500 plants have been analysed in total. This will allow the distribution of biomass within samples and within different areas to be established.

Despite numerous difficulties reasonably successful measurements of productivity of Durvillaea have been achieved as well as some remarkably interesting measurements on Macrocystis. A combination of techniques has been necessary to obtain productivity results. Mortality has been established from marked plants and from entire populations and periodic stripping. The severity of mortality is related to storm severity.

Supplementary studies include monthly nitrate analyses, studies of conceptacle development, and investigations of the nature and role of holdfast fauna. Some information on grazing rates of amphipods has been established and agar isolation plates have been made to study bacterial breakdown. Some information on the subtidal Durvillaea 'willana' has been obtained. The astonishing results obtained with Macrocystis pyrifera indicate that this study needs to be expanded.

PUBLICATIONS

El-Sayed, S.Z., Benon, P., David, P., Grindley, J.R. and Murail, J.F. 1979. Some aspects of the water column studied during the "Marion-Dufresne" cruise 08. CNFRA (Comite National Francais des Recherches Antarctiques) 44: 127-134.

Grindley, J.R. & Lane, S.B.1979. Zooplankton around Marion and Prince Edward Islands. CNFRA (Comite National Francais des Recherches Antarctiques) 44: 111-125.

Grindley, J.R. 1980. Marion Island Marine Biology. S.Afr.J.Antarct. Res. (In press).

Grindley, J.R. and de Villiers, A.F.1980. Intertidal ecology of Marion and Prince Edward Islands. S.Afr.J.Antarct.Res.(In press).

Grindley, J.R. and Lane, S.B.1980. Plankton and productivity of the waters around Marion Island. S.Afr.J.Antarct.Res.(In press).

PROGRESS REPORT - JUNE 1980

Project title: The Genetic and Ecological Relationships 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: First Progress Report, March 1980 - June 1980.

Objectives:

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

History: 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 presence of the two species of fur seals on the Island necessitates the achievement of the above objectives. The monitoring of the population trend is included in the South African Antarctic Research Programme 1978 - 1982. The project commenced in March 1980.

Progress March 1980 - June 1980.

1. An extensive literature survey has been carried out and techniques have been investigated.

2. A preliminary field trip to Marion Island during the May Relief Voyage was undertaken and the working conditions evaluated.

Publications: No publications have been prepared to date.

PROGRESS REPORT

a. 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.R. Lynch and W.R. Siegfried.

b. 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 at Gough and Prince Edward islands, and to monitor long term changes in their populations.

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

c. To seek alternative approaches to the monitoring and modelling of interaction between seabirds and their prey at Marion Island.

c. History of the 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. Seabirds (chiefly penguins) are significant top consumers in the ecosystem.

Changes in the trophodynamics of selected seabird species (chiefly penguins) should indicate changes in the abundance and

distribution of prey (chiefly krill) of these species. Three of the species (Macaroni and King Penguins, and Wandering Albatross) selected by the SCAR Sub-committee on Bird Biology breed at the Prince Edward islands, and Gough island. Base-line census data and breeding biology data on these three species are available for Marion Island.

d. Scientific Progress.

Objective a. The populations of Macaroni and King Penguins (if present) were counted every 2-5 days between August and June 1980, at colonies of varying size at Marion Island. Four colonies of each species were counted. One very large colony of each species was surveyed in May 1979 using tacheometric techniques, and maps of the colonies produced (Appendix 1). The size of the colony will be estimated by multiplying the colony area (stratified according to gradient) by density of breeding birds in each area. Breeding success of Macaroni Penguins was determined. The results, and a long term monitoring programme for these species (dates and locality and methods of census; data storage) to be drawn up by November 1980.

All Wandering Albatrosses in two study areas at Marion Island were censused every 2-5 days between August and June 1980. Breeding success of these two populations were determined. All adults encountered (more than 120 birds) were banded, measured, weighed and their plumage colouration categorised according to a standardised key. A long term monitoring programme for this species (date, locality and method of census; data storage)

will be drawn up by November 1980.

The distribution and abundance of Wandering Albatross chicks at Prince Edward Island was determined in August 1980. A total of 658 nearly fledged chicks were recorded.

The entire area of Gough Island was searched in November 1980 to map distribution and abundance of Wandering Albatross, and to band chicks and adults. A total of 796 chicks were counted, and 72 chicks and three adults were banded. Mensural and plumage data were obtained for three adults. The write-up of comparative mensural and plumage data of adults will await further fieldwork at Gough Island in October 1980. Similar surveys are being carried out at South Georgia, Macquarie Island and the New Zealand islands. The precipitous terrain and inclement weather at Gough Island is a major obstacle to fieldwork, so that it may be necessary to delay intensive research until preliminary results of Marion Island work and the planned Gough Island trip in October 1980 are available, and allow more detailed planning.

Objective b. Adult and chick Macaroni and Rockhopper (Eudyptes chrysocome) penguins were collected prior to feeding chicks (adults) or immediately after being fed (chicks), at stages throughout the chick fledgling period. Totals of 10 adults and 20 chicks of each species were collected. Data on meal size (stomach contents and chick's weight before and after feeding), chick growth (mass and mensural from hatching to fledging) and feeding frequency were obtained.

Casts of regurgitated food remains from Wandering Albatrosses (15 samples) and from Grey-headed Albatrosses (40 samples). The stomach contents of 32 Pterodroma macrapetra, 74 Pterodroma brevirostris, 20 Pterodroma mollis and in excess of 20 Pachyptila vittata have been collected. Analysis of these samples (mass, volume, and numerical abundance, and size of prey) should be completed for penguin material by November 1980, and for the rest of the material by April 1981. Specimens requiring identification will be sent to P. Laycock (School of Environmental Studies, University of Cape Town) from July 1980.

Objective c. A data bank of 1 232 weights from seabirds of 27 species has been created to establish standard weights for each species for international use in modelling studies. The data bank also contains mensural, locality, date, age, and sex data for each bird. This data bank will be added to at the end of each fieldwork period.

A seabird energetics model (Furness, R.W. 1978. Energy requirements of seabird communities: a bioenergetics model. J. Anim. Ecol. 47: 39-53) will be used by Furness to model the energy requirements of the larger surface breeding birds at Marion Island using data on breeding biology obtained in 1974-1978. Write-up should be completed by April 1981.

Relevant publication

Williams, A.J. and W.R. Siegfried (in press). Foraging ranges of krill-eating penguins. Polar Record

Appendix 1.

Bickerton, I.B. 1979. Marion Island: Kildalkey Bay King Penguin Colony and Bullard Beach Macaroni Penguin Colony Mapping. FitzPatrick Institute.

MARION ISLAND: KILDALKEY BAY KING PENGUIN COLONY AND BULLARD BEACH MACARONI PENGUIN COLONY MAPPING

I.B. BICKERTON

JULY, 1979

INTRODUCTION:

Long-term monitoring of changes in the breeding populations of king and Macaroni penguins on Marion Island has been proposed as part of the Southern Oceans Research Programme. To implement this it would be necessary to establish, within 5% accuracy, the areas of the king penguin colony at Kildalkey Bay and the Macaroni penguin colony at Bullard Beach, these being two of the largest breeding colonies of these birds on the island. (See Fig. 1 for localities).

With establishment of the areas of the two colonies, densities of birds counted in quadrats set up within the colonies could be extrapolated to total colony area, to give population estimates. Further, the densities of birds utilizing ground inclined at greater than 5° might be expected to be greater than those for horizontal ground, due to decreased horizontal spacing with increased vertical spacing of the incubating birds. Therefore map areas of inclined ground (i.e.: $> 5^{\circ}$) would have to be established and quadrats representing these areas set up in the field.

For regular monitoring, colony boundaries, horizontal areas and inclined areas within the colonies would have to be demarcated with beacons, the positions of which would be shown on colony maps. This would enable field workers conducting censuses to precisely identify map points in the field.

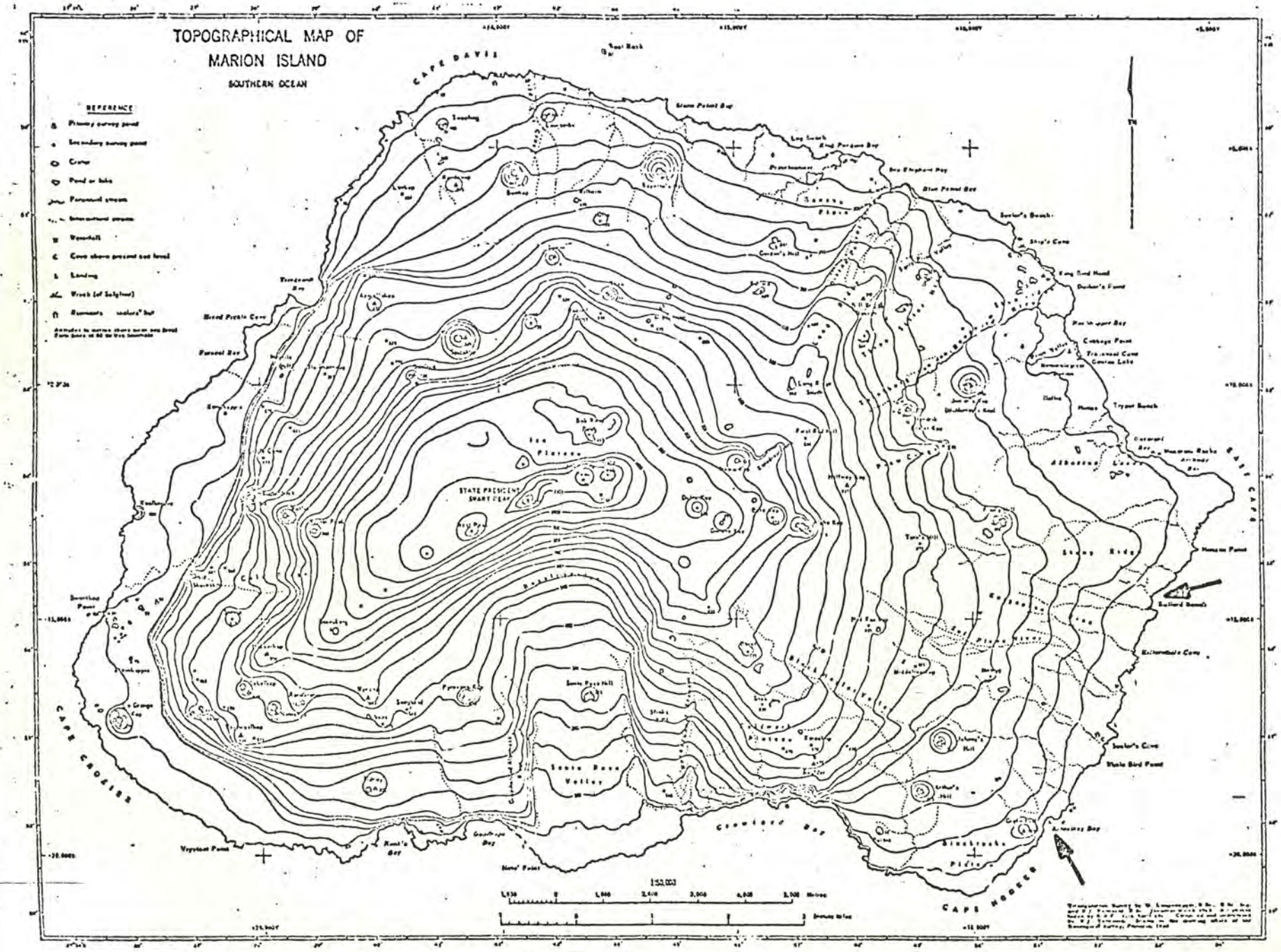
Since no recent aerial photographs of Marion Island are available (the only set having been flown in 1961 by the R.A.F., Hall, pers. comm.) field surveys and mapping of the king penguin colony at Kildalkey Bay and Macaroni penguin colony at Bullard Beach were carried out in June 1979 during a one month cruise of the S.A. Agulhas.

MATERIALS AND METHODS

At each colony the following procedure was adopted:

Reconnaissance of the colony on foot was first carried out to establish where the outer edges of the colony of breeding birds lay. Generally, these coincided with the perimeter of the eroded ground.

FIG 1: Map showing colony localities.



At Kildalkey the king penguins were ashore rearing chicks, and their distribution could be used to estimate the boundaries of the utilized ground. At Bullard however, the Macaroni penguins had already returned to sea and the boundary of utilized ground was determined by presence or absence of moulted feathers.

The colony boundary was then staked out with 1m long wooden stakes either driven into soft ground or supported by cairns of stones.

The edges of ground inclined at more than 5° (as estimated with the naked eye), within the boundary of the colony, were also marked out with wooden stakes.

Using standard tacheometry techniques (viz. theodolite reading to 20" and staff), the positions of stakes as well as relevant topographical features (e.g. streams, waterfalls and trypots) were surveyed in.

At Kildalkey, the entire colony was surveyed from a single point whilst at Bullard a traverse, consisting of three set up points, was used.

The tacheometry data were reduced and maps of the colonies were drawn to a scale of 1:1000. As the beaches adjacent to the colonies had not been surveyed in (being outside the colony breeding areas), their positions were determined from measurements obtained from oblique photographs taken during the survey.

The direction to true north was taken from a topographical map of Marion Island by Langenegger and Verwoerd (1965).

Areas for horizontal ground and horizontal areas for inclined ground were obtained using a digitizer connected to a programmed WANG 2200 computer, a facility kindly supplied by the Department of Land Surveying at the University of Natal, Durban. In addition, inclined areas of inclined ground were obtained by division of these areas into triangles. Inclined areas for individual triangles were calculated and summed to give the total inclined area. The difference between the inclined and horizontal areas for any one inclined area was expressed as a percentage of the horizontal area (i.e. percentage increase due to slope).

FIG 1: Map showing colony localities.

RESULTS

(See accompanying maps).

(1) Kildalkey Bay king penguin colony

The colony boundary is indicated by solid lines connecting beacons. Broken lines indicate the edges of inclined ground within the colony. Positions of streams and the beach are shown. Beacon A near the centre of the colony was the theodolite set up point.

Ground inclined at greater than 5° comprises the areas demarcated by beacons 16 to 19 and beacons 21 to 35 plus 49 on the slopes of Green Hill and was designated as inclined ground. The remaining ground in the colony, although not entirely horizontal was nowhere inclined at more than 5° and was designated as horizontal ground.

Table 1 gives the ground level elevations of map points for Kildalkey Bay with beacon 7, the lowest surveyed point, as datum of 0,00m. The highest point was beacon 30 having an elevation of 33,92m.

Table 2 gives horizontal and inclined areas for Kildalkey Bay. Inclined ground comprised 20,20% of the total king penguin colony. The increase in area due to inclination of the ground was less than 3,35% of the horizontal map area for inclined ground.

(2) Bullard Beach Macaroni penguin colony

The colony boundary is indicated by solid lines connecting beacons. Broken lines indicate the edges of inclined ground within the colony. Positions of the stream, waterfall, beach, trypot and drainage line are shown. Beacons A, 47 and B were theodolite set up points.

Ground inclined at more than 5° comprises the areas demarcated by the trypot, beacons 1 to 4, 49 to 41, B. Waterfall, 39 and 40; points S_3 to S_6 and beacons 32 to 38. The remaining ground in the colony, although not entirely horizontal, was nowhere inclined at more than 5° and was thus designated as horizontal ground.

The area trypot - 40 - 39 - B. Waterfall - S_2 - S_1 - trypot although adjacent to the stream bed, appeared as though it might be used by the birds for nesting and was thus included in the colony.

The areas designated as stream and stream bed, did not appear to be used for nesting and were excluded from the colony area.

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Table 3 gives the ground level elevations of map points for Bullard with the base of the trypot as datum of 0,00m. Map point descriptions are given. The highest point was beacon 16 with an elevation of 47,64m. The lowest point was S_1 with an elevation of -0,07m. Many of the beacons were placed on top of the bank just away from the edge of the eroded ground 1 - 3m below, as the ground on top of the bank was soft and stakes could be hammered in.

Table 4 gives horizontal and inclined areas for Bullard Beach. Inclined ground comprised 20,26% of the total Macaroni colony. The increase in area due to inclination of the ground was not greater than 5% of the horizontal map area for inclined ground.

TABLE 1: Ground level elevations of map points for Kildalkey Bay. The elevation of beacon 7, the lowest surveyed point, was taken as datum. This was at the top of the splash zone. Beacon descriptions are given.

Beacon	Description	Elevation (m)
A	1m stake in stone cairn	+ 4,07
1	1m stake in ground at base of cliff	+ 3,51
2	1m stake in stone cairn	+ 0,63
3	1m stake in stone cairn	+ 0,82
4	Rock pinnacle (base)	+ 0,93
5	1m stake in stone cairn	+ 0,27
6	1m stake in stone cairn next to log	+ 0,24
7	1m stake in stone cairn	0,00
8	1m stake in stone cairn	+ 0,03
9	1m stake in ground at edge of eroded ground	+ 1,94
10	1m stake in ground at edge of eroded ground	+ 0,87
11	1m stake in ground at edge of eroded ground	+ 1,02
12	1m stake in ground at edge of eroded ground	+ 0,91
13	1m stake in ground at edge of eroded ground	+ 0,48
14	1m stake in ground at edge of eroded ground	+ 2,72
15	1m stake in ground at edge of eroded ground	+ 4,69
16	1m stake in ground at edge of eroded ground	+ 6,33
17	1m stake in ground at edge of eroded ground	+ 7,55
18	1m stake in ground at edge of eroded ground	+10,98
19	1m stake in ground at edge of eroded ground	+ 7,72
20	1m stake in ground at edge of eroded ground	+ 8,71
21	1m stake in ground at edge of eroded ground	+ 8,20
22	1m stake in ground at edge of eroded ground	+ 9,76
23	1m stake in ground at edge of eroded ground	+14,15
24	1m stake in ground at edge of eroded ground	+19,43
25	1m stake in ground at edge of eroded ground	+22,63
26	1m stake in ground at edge of eroded ground	+27,33
27	1m stake in ground at edge of eroded ground	+30,26
28	1m stake in ground at edge of eroded ground	+29,71
29	1m stake in ground at edge of eroded ground	+32,58
30	1m stake in ground at edge of eroded ground	+33,92
31	1m stake in ground at edge of eroded ground	+28,04
32	1m stake in ground at edge of eroded ground	+22,69
33	1m stake in ground at edge of eroded ground	+21,14
34	1m stake in ground at edge of eroded ground	+17,59
35	1m stake in ground at edge of eroded ground	+13,41
36	1m stake in ground at edge of eroded ground	+14,50
37	1m stake in ground at edge of eroded ground	+17,73
38	1m stake in ground at edge of eroded ground at large rock	+17,03
39	1m stake in ground at edge of eroded ground	+12,70
40	1m stake in ground at edge of eroded ground	+10,59
41	1m stake in ground at edge of eroded ground	+ 8,56
42	1m stake in ground at edge of eroded ground	+ 4,29
43	1m stake in ground at edge of eroded ground	+ 3,07
44	1m stake in ground at edge of eroded ground at bottom of slope	+ 6,15
45	1m stake in ground at edge of eroded ground at bottom of slope	+ 3,78

46	No stake - at bottom of slope	+ 1,39
47	1m stake in ground at edge of eroded ground at bottom of slope	+ 1,52
48	No stake - at bottom of slope	+ 1,23
49	1m stake in ground at bottom of sloping ground	+ 9,54
S_1	No stake - stream centre	+ 2,26
S_2	No stake - centre of stream confluence	+ 4,14
S_3	No stake - stream centre	+ 5,99

TABLE 2: Horizontal and inclined areas (where applicable) for Kildalkey Bay. Areas are described by the beacons demarcating them. Total horizontal and inclined areas are given.

Area description	Horizontal Area (m^2)	Inclined Area (m^2)	Difference (m^2)	Percentage increase in area due to inclination
Inclined Ground				
21 → 35 → 49 → 21	6880,01	7109,87	229,86	3,34%
16 → 19 → 16	156,28	160,28	4,00	2,56%
Horizontal Ground				
1 → 4 → S_1 → 5 → 16 → 19 → 21 → 49 → 35 → 48 → 1	27799,35	-	-	-
Total horizontal colony area	34835,64m^2			
Total inclined colony area	7036,29m^2			
Percentage of total colony comprising ground inclined at more than 5°.	20,20%			
Stream bed				
2 → 4 → S_1 → 5 → 7 → 2	2951,16m^2			

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TABLE 3: Ground level elevations of map points for Bullard Beach. The elevation of the ground at the base of the trypot was taken as datum. Beacon descriptions are given.

Beacon	Description	Elevation (m)
Trypot	Centre of base of trypot	0,00
1	1m wooden stake in ground at edge of eroded ground	+ 8,10
2	1m wooden stake in ground at edge of eroded ground	+14,26
3	1m wooden stake in ground on top of bank	+19,24
4	1m wooden stake in ground on top of bank	+33,74
5	1m wooden stake in ground on top of bank	+38,74
6	1m wooden stake in ground on top of bank	+43,84
7	1m wooden stake in ground on top of bank	+45,22
8	1m wooden stake in ground on top of bank	+46,98
9	1m wooden stake in ground on top of bank	+45,81
10	1m wooden stake in ground on top of bank	+47,16
11	1m wooden stake in ground on top of bank	+47,62
12	1m wooden stake in ground on top of bank	+47,23
13	1m wooden stake in ground on top of bank	+46,66
14	1m wooden stake in ground on top of bank	+46,70
15	1m wooden stake in ground on top of bank	+46,73
16	1m wooden stake in ground on top of bank	+47,64
17	1m wooden stake in ground on top of bank	+47,29
18	1m wooden stake in ground on top of bank	+46,65
19	1m wooden stake in ground on top of bank	+45,98
20	1m wooden stake in ground on top of bank	+44,82
21	1m wooden stake in ground on top of bank	+42,40
22	1m wooden stake in ground on top of bank	+41,81
23	1m wooden stake in ground on top of bank	+41,20
24	1m wooden stake in ground on top of bank	+39,41
25	1m wooden stake in ground on top of bank	+38,65
26	1m wooden stake in ground on top of bank	+36,24
27	1m wooden stake in ground on top of bank	+34,26
28	1m wooden stake in ground on top of bank	+31,91
29	1m wooden stake in ground on top of bank	+31,14
30	1m wooden stake in ground on top of bank	+24,56
31	1m wooden stake at edge of stream	+21,92
32	1m wooden stake at edge of stream	+20,55
33	1m wooden stake on top of bank	+22,06
34	1m wooden stake on top of bank	+20,35
35	1m wooden stake on top of bank	+19,94
36	1m wooden stake on top of bank	+14,74
37	1m wooden stake at edge of eroded ground	+17,33
38	1m wooden stake at edge of eroded ground	+ 9,94
39	1m wooden stake in stone cairn	+ 1,74
40	1m wooden stake in stone cairn	+ 0,98
41	1m wooden stake in stone cairn	+ 9,51
42	1m wooden stake in stone cairn	+12,24
43	1m wooden stake in stone cairn	+14,71
44	1m wooden stake in stone cairn	+18,16

Beacon	Description	Elevation (m)
45	1m wooden stake in stone cairn	+20,56
46	1m wooden stake in stone cairn	+24,30
47	1m wooden stake in stone cairn	+32,65
48	1m wooden stake in stone cairn	+31,73
49	1m wooden stake in stone cairn	+29,00
S_1	No stake, edge of stream	- 0,07
S_2	No stake, edge of stream	+ 0,37
S_3	No stake, edge of stream	+ 8,09
S_4	No stake, edge of stream	+11,87
S_5	No stake, edge of stream	+14,62
S_6	No stake, edge of stream	+17,32
B. Waterfall	No stake, bottom of waterfall	+ 1,41
A	1m wooden stake in stone cairn	+41,11
B	1m wooden stake in stone cairn	+13,03

TABLE 4: Horizontal and inclined areas (where applicable) for Bullard Beach. Areas are described by the beacons demarcating them. Total horizontal and inclined areas are given.

Area description	Horizontal Area (m^2)	Inclined Area (m^2)	Difference (m^2)	Percentage increase in area due to inclination
Inclined Ground	18772,65	19408,39	635,74	3,39%
trypot → 1 → 4 → 49 → 41 → B. Waterfall → 39 → 40 → Trypot				
$S_3 \rightarrow S_6 \rightarrow 32 \rightarrow 38 \rightarrow S_3$	1877,10	1970,98	93,88	5,00%
Horizontal Ground				
4 → 31 → 45 → 49 → 4	80661,92			
trypot → 40 - 39 → B. Waterfall → $S_2 \rightarrow S_1$ → trypot	598,90			
Total horizontal colony area	101910,57m^2			
Total inclined colony area	20649,75m^2			
Percentage of total colony comprising ground inclined at more than 5°	20,26%			
Stream $S_3 \rightarrow S_6 \rightarrow 32 \rightarrow 31 \rightarrow 45 \rightarrow 41 \rightarrow$ B. Waterfall $\rightarrow S_3$	2428,20m^2			

DISCUSSION

The percentage increase in area due to inclination was not greater than 5%, the accuracy required for this survey. This suggests that densities of penguins for the inclined ground at both Kildalkey Bay and Bullard Beach would not differ considerably from those for horizontal ground. However, at the time of this survey, the Macaroni penguins had already returned to sea and the effects of inclined ground on the spacing of incubating females in mid-November, the recommended time for censusing breeding birds, were not seen. Mid-March has been recommended as the best time for censusing breeding king penguins, since it is the time when parents have eggs or small young. At the time of this survey, the king penguin chicks were in creches and the effects of inclined ground on the spacing of incubating parents could not be assessed.

Beacon descriptions and heights have been given to facilitate relocation in the field. Contours were not drawn in on the maps since there are insufficient height data inside the colony areas to give a contour interval of 1 - 2m. Beacon heights do however give an indication of the boundary topography.

Quadrats were not set up in the colonies, mainly due to lack of time and hands. Also since stakes marking out quadrats would have had to have been supported by cairns of stones, they would have been vulnerable to disturbance by the birds coming ashore at the end of the year. It is suggested that personnel conducting censuses, set up quadrats, the positions of which could be plotted on maps by scaling off field distances from existing beacons. Suggested quadrat positions are shown on the maps and these are such that they fall in line with colony beacons, whilst giving adquate coverage of the colony areas. Surplus 1m wooden stakes were left at both colonies at the positions indicated in pencil on the maps and these could be used for marking out quadrats. There were approximately 20 stakes left at each colony and a few at the hut at Kildalkey.

Enquiries have been made to the Director of Overseas Surveys and the Directorate of Military Survey in Britain and the South African Naval Hydrographic Office at Simonstown, regarding the acquisition of copies of the 1961 aerial photographs of the colonies. As yet no reply has been received. Further, the colony area estimations of Kevin Hall, previously of the University of the Orange Free State, will be available later this year when he has arrived in Argentina. These and the areas obtained from the aerial photography will be compared with the areas obtained in this survey.

ACKNOWLEDGEMENTS

I should like to thank Rudi Laugksch and John Cooper for assistance with the field work for these surveys, Aldo Berruti for organising this project and Professor D. Jenkins of the Department of Land Surveying, University of Natal, Durban for making equipment in his Department available to me.

PROGRESS REPORT - JUNE 1980.

Title: The influence of southern elephant seals *Mirounga leonina* (Linn.) on the coastal terrestrial ecology of Marion Island.

Project Leader: J.D. Skinner, Mammal Research Institute, University of Pretoria.

Researcher: K. Panagis, Mammal Research Institute, University of Pretoria.

Objectives:

1. The determination of the intensity and degree of utilization of wallow areas on Marion Island.
2. The mapping of all major wallow areas.
3. The quantification of vegetational, soil and topographical changes.
4. The determination of the overall effect of nutrient input into the whole system.
5. The occurrence and monthly variations of soil organisms.

History: Fieldwork to this project is to commence from September 1980 - March 1981. The topographical, soil and vegetational changes in elephant seal wallows on Marion Island, have already received attention since 1971. The changes have to be quantified and the relationship between the main components (soil, vegetation and seals) shown.

Progress: Initially emphasis has been placed on an intensive literature survey and the preparation of the various techniques to be used on Marion Island were formulated and subsequently tested. Following a trip to Marion Island between May and June 1980 preliminary data was collected and the following techniques tested and modified:

1. Exclosures for seals.
2. Selection of study sites to be used during fieldtrips from September to March.
3. The feasibility of destroying an area of vegetation to artificially simulate the disturbance caused by seals.
4. The testing of photographic methods of plant analysis.
5. The collection of preliminary data and the drawing up of computer programmes.

Appendix 1

PROGRESS REPORT

a. Population dynamics and biology of selected seabirds on Marion and Prince Edward islands, with particular reference to their mineral and energy contributions in the terrestrial ecosystem.

M. Schramm, A. Berruti and W.R. Siegfried.

b. 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 the nocturnal burrowing petrels.

c. 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 have drastically 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.

d. Scientific progress

Objective a.

Factors (plant cover by species and total, altitude, slope gradient and aspect, lava type, soil depth, moisture and organic content, particle, and surface morphology) which may determine the distribution of burrows of subterranean nesting petrels (chiefly six species) at Marion Island have been sampled in 191 quadrats (30 m x 10 m) in 13 study areas covering four main habitat types. A further 28 quadrats have been measured at other sites at Marion Island, and the cat-free Prince Edward Island. Only soil parameters still require quantification in Cape Town. The results will allow estimation of population sizes of petrel populations within restricted areas of Marion Island. This work has been supplemented by detailed study of the nest characteristics of the three Pterodroma petrels. The physical dimensions of the nest chamber and tunnel, orientation of the entrance, and plant species growing outside the nest, have been sampled at 51 nests of P. macroptera, 20 nests of P. mollis and 20 nests of P. brevirostris.

Energy and mineral determinations will be completed by April 1981. Write-up will await similar determinations for other petrel species. Diet analysis should be completed by December 1980, and specimens suitable for identification will be sent to P. Laycock, School of Environmental Studies, from July 1980.

Objective b.

Data (described under objective a) on the abundance and distribution of petrel burrows at Marion Island (cat-infested) and Prince Edward Island (cat-free) will be analysed to assess the effect of

cat predation on burrowing petrel populations in similar areas. Observations on chick and adult petrel mortalities attributed to cat predation will be included in this report.

The predation on petrels by a second predator, the skua Catharcta subantarctica during its breeding season, has been assessed by collecting the petrel remains from 40 skua territories. Analysis and write-up of this part of the project will be completed by April 1981. Analysis of the data will be completed in Cape Town by November 1980, and write-up by April 1981.

The documentation of the breeding biology of each species is a necessary pre-requisite for determining the amounts of egg, feather, carcass and guano deposited on the island by each species. The following characteristics of the breeding biology were determined for Pterodroma macroptera, P. mollis and P. macroptera: dates of arrival, egg laying, hatching and fledging, egg size, the length of incubation and fledgling periods, egg and chick losses, chick growth. Moult, mass and mensural characteristics have been determined for adult birds.

In addition, detailed information on nest attendance were obtained for P. mollis (seven weeks) and P. brevirostris (one week) using an automatic activity recorder. Write-up of this data will be completed by April 1981. The following specimens of P. macroptera (3 eggs, 19 chicks, 8 adults), P. mollis (3 eggs, 9 chicks, 10 adults) and P. brevirostris (3 eggs, 11 chicks, 13 adults) were collected for mineral and energy determinations of eggs, feathers and bodies.

Diet material (stomach samples and regurgitations) were collected for P. mollis (20 samples), P. brevirostris (74 samples), P. macroptera (32 samples), Diomedea chrysostoma (40 samples) Wandering Albatross (15 samples) and Pachyptila vittatter (30 samples).

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PLANT ECOLOGY ON MARION ISLAND: PROGRESS REPORT 1980/81

V R Smith

First progress report for the year April 1980 to March 1981

OBJECTIVE:
1. Assessment of bryophyte production in the Marion Island ecosystem
2. Ecology of selected Marion Island bryophytes.
3. Dynamics of biomass and nutrient states of a mire ecosystem

HISTORY OF PROJECT:

Gremmen initiated this project in 1974 with an intensive phytosociological survey of the island bryophytes. The results of this survey will be available in published form by September 1980. Smith, Jubelius, Gremmen and O'Connor assessed various techniques of assessing bryophyte production on the island and these are documented in previous reports to SASCAR. The mire ecosystem study was started in September 1979 in order to compliment earlier studies on non-mire communities.

PROGRESS TO DATE:

During December 1979 to January 1981 Mr Shaun Russell visited British Antarctic Survey and also Professor S W Greene at Penicuik, Scotland to discuss the current state of knowledge regarding bryophyte physiology, ecology and production in the Subantarctic. The time since April 1980 to date has been spent in purchasing equipment for the September 1980 expedition to the island when Mr Russell will be formally engaged as a project participant.

The mire ecosystem study has involved the estimation of the amounts of nutrients reaching the mire via precipitation, those amounts lost by leaching and fortnightly measurements of the biomass, standing dead and litter of the vascular and bryophyte components of the mire vegetation since September 1979. The harvested material is dried, weighed and will be chemically analysed in Bloemfontein. At each harvest point the amounts of inorganic and organic forms of nutrients in the soil are assessed. Twice monthly estimates of soil CO_2 evolution at various sites in the mire

have been made using a chemical absorption method.

RESULTS TO DATE

Only the harvest data and the contents of the various forms of nitrogen in the soils, soil water and rainfall are currently available since analyses for all other elements will be done on return of the expedition from the island in September 1980. Even the available data, however, is still on the island and will only become available on the expedition's return. Much laboratory work involving the suitability of methods of chemical analysis to inland material has been done.

PUBLICATIONS ARISING FROM THE PLANT ECOLOGY PROJECT SINCE 1979

BERJAK, P 1979. The Marion Island flora - leaf structures in *Poa cookii* (Hook.f.). *Proc. Electron Microscopy of Southern Africa. (Port Elizabeth)* 9: 67-68.

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SMITH, V R (1979) Evaluation of a resin-bag procedure for determining plant available P in organic, volcanic soils. *Plant and Soil* 53: 245-249.

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SMITH, V R (1979) A comparison between the H_2SO_4-H_2O_2-li_2SO_4-Se oxidation method and alternative digestion procedures for plant nutrient analysis. *Communication in Soil Science and Plant Analysis* 10 (7): 1067-1077.

PROJECT TITLE: NITROGEN CYCLING ON MARION ISLAND

PROJECT LEADER: Professor D F Toerien

PROJECT RESEARCHER: Mr M G Steyn

FIRST PROGRESS REPORT FOR THE YEAR APRIL 1980 TO MARCH 1981

OBJECTIVES:

1) To quantify the input of nitrogen via precipitation to the island ecosystem.
2) To monitor the changes in inorganic nitrogen content of a mire peat during the year and compare these with changes in bacterial and fungal population.
3) To determine the spatial and temporal variations of populations of bacteria and fungi at 20 island sites.
4) To initiate studies on the rates of denitrification in mire peats using column methods
5) To assess the amount of nitrogen entering the mire ecosystem via heterotrophic fixation

RESULTS:

Investigations into these topics are currently being carried out on the island. Preliminary results will only become available on return of the expedition in September 1980. Up until April 1980, 112 soil samples and 320 rainwater samples had been analysed for inorganic nitrogen. Fifteen sets of nitrogen fixation incubations under aerobic and anaerobic conditions had been completed and two nitrification incubations attempted.

The twenty sites were sampled for bacterial and fungal organisms in January 1980. Two depths were sampled at each site. Bacterial and fungal counts were carried out for each depth and 250 isolates made and stored for later identification and physiological characterization. Enrichment experiments to identify thiobacilli, azotobacter, aerobic and anaerobic cellulose decomposing organisms, nitrosomonas and nitrobacter in a mire peat, soil near an albatross nest and near a petrel burrow were carried out.

POLLEN ANALYSIS AND LONG-DISTANCE DISPERSAL

Report over the period 1-4-1979 to 1-4-1980

by Dr E.M. van Zinderen Bakker

Task a. Analysis of samples collected by Dr Hall.

The samples of interglacial and interstadial age brought back from the island did unfortunately contain very little pollen or were sterile. More samples will have to be collected especially of the last interglacial as soil conditions and circumstantial oceanic evidence strongly indicate that during the Eemian the climate of Marion Island must have been considerably warmer with more seasonal rainfall.

Two cores collected by Dr K.J. Hall between moraines 2 and 3 at the Albatross Lake site were available for analysis. A core which had already been studied and dated was collected in 1965 between moraines 3 and 4 and should accordingly contain younger material. It is unfortunate that the new cores are incomplete and had to be collected in unfavourable weather conditions so that contaminations cannot be excluded. More borings should be done between these various moraines as they provide excellent means for establishing the age of glacial stages in order to compare these with the well known chronology of the Northern Hemisphere. Although I was promised that the ^{14}C - age determinations would be available in June, this is not the case, so that the following description is of a very preliminary nature.

The two pollen diagrams can together be divided into three pollen zones :

Zone 1 this lowest zone is characterised by very high percentages of *Azorella* pollen with maxima of 45 and 54%. Grass pollen reached a percentage of 60 while *Acaena* was only represented with 1-3% of the pollensum.

The occurrence of *Potamogeton* pollen at the bottom could indicate the presence of open water behind the push-moraine, although this may well be a contamination, as is certainly the case with Caryophyllaceous pollen found at depths of 1.6 and 2.7 m. Low percentages of *Cotula* and *Callitriche* might indicate coprophilous influence.

The entire zone represents fairly cold climatic conditions and could, compared with the 1964 boring, have been deposited round the Pleistocene/Holocene boundary.

Very low percentages of *Tillaea* pollen may be blown in from the nearby shore.

Zone 11 is the middle zone of the sequence. The grass pollen percentages are again high (maxima 64 and 45%). *Azorella* however declines steadily from 47 to 15%. *Acaena* reaches a conspicuous maximum (25%) while *Blechnum* spores occur in low percentages. These pollen spectra compared with Zone 1 are typical for less cold and more sheltered conditions.

The constant occurrence of *Montia* pollen and some *Callitriche* may indicate biotic influence. Other taxa like *Uncinea*, *Ranunculus* and *Lycopodium magellanicum* will have been growing in the mire, which had developed in the depression behind the moraine. This zone might be of middle-Holocene age.

Zone 111 is only represented in two of the youngest spectra. Grass pollen reached 71%, *Acaena* is hardly represented and *Azorella* is present with 4 to 7%.

It is difficult to conclude whether these spectra represent stages of succession of the vegetation or whether they indicate climatic change.

In the absence of ^{14}C - dates the preliminary conclusion, based on comparisons

with the 1964 boring, is that the two new cores represent a transition from a cold climate probable of Late-Glacial age, to ameliorated conditions perhaps of the middle Holocene. Several more cores should be studied to obtain more information about the glacial stages, the evolution of the vegetation and the influence of the fauna.

Task b. Analysis of samples from a penguin study by Dr H. Lindeboom.

The peaty deposits along the penguin rookery at Bullard Beach have a thickness of nearly 2.-m. Two radiocarbon dates are available for this profile. The clay underneath the peat is 7340 ± 120 years old and the peat at 1.9 m depth has been dated at 4800 ± 1000 years.

Five samples at depths of 30, 70, 110, 150, 190 cm and the underlying clay were analysed on their pollen content. The pollen spectra show that the present day vegetation of the lowlands was surrounding the site during seven millenia. Coprophilous species like *Montia fontana*, *Callitriche antarctica* and *Ranunculus* (prob. *biternatus*) were represented by large numbers of pollen grains in the entire profile indicating the continuous existence of the rookery. From the pollen diagram it can be inferred that the penguins settled in the area when the influence of the glaciation had completely disappeared and climatic and oceanic conditions were optimal more than 7000 years ago.

Task c. Study of Marion Island pollen types with scanning electronmicroscopy.

This project was started but had to be discontinued as no material was received from the island.

Task d.e. Boring to be made in 1980.

It was for various reasons not possible to visit Marion Island during 1980. Elaborate personal arrangements for the visit had been made, but the delay of the voyage to full winter time prevented me from taking part in the trip.

Task g. Atmospheric pollen.

In the course of the year problems have arisen with the availability of the required samples mainly because of the long distances concerned, the rare transport from isolated islands like Signy Island and misunderstandings about the handling of the samples. Some bottles arrived empty or the content was mouldy because not enough carbolic acid had been added to the samples.

Marion Island. No samples have been received from the island as instructions have not or could not be followed up.

Argentina. According to the latest information, Tauber traps have been erected on the Antarctic Peninsula and on Tierra del Fuego but no samples have so far been received.

South Georgia. The British Antarctic Survey provided excellent assistance and sent snow samples collected on glaciers during the 1978/79 summer. These samples have been analysed and contained the following sporomorpha from the island and from Argentina :

Acaena, Pisonia, Nothofagus, Ephedra, Plantago, Myriophyllum, Chenopodiaceae, Compositae, Labiatae, Gramineae, Caryophyllaceae, Iridaceae, Cyperaceae, Umbelliferae, Liliaceae, Portulacaceae, Leguminosae, Myrtaceae, besides mossplants, plant tissue, several spores such as *Alternaria*, parts of Diptera and butterfly scales.

The results of the Tauber traps were rather unsatisfactory and more attention will in future be given to snow samples. Good contact was established with Dr C.J. Barrow from Swansea (Wales) who wrote his doctor thesis on the palynology of South Georgia. If my results are of sufficient value a joined paper will be published with Dr Barrow.

Signy Island. Samples have been collected on the island by B.A.S. and are on their way to South Africa.

Kerguelen. Much assistance has been received from the French organisation T.A.A.F. Most of the samples arrived, however, in mouldy condition. The treatment will be improved

Macquarie Island. At the time of writing this report 28 samples were received from the island through the assistance of the Antarctic Division at Melbourne.

This projects is now becoming well established and should be continued for 2 to 3 years.

3. EARTH SCIENCES

3. AARDWETENSKAPPE

NATIONAL ANTARCTICA RESEARCH PROGRAMME July 1980

THE GEOCHRONOLOGY OF SELECTED ROCK SUITES FROM QUEEN MAUD LAND, ANTARCTICA AND POSSIBLY RELATED ROCKS FROM NATAL, SOUTH AFRICA

Progress Report by T P ELWORTHY, BPI GEOPHYSICS

1 INTRODUCTION

In reconstructions of Gondwanaland in the Mesozoic the east coast of Southern Africa and Queen Maud Land, Antarctica are often juxtaposed. This study, now in its second year, has investigated the geochronology of selected rock suites from both areas in an attempt to test the validity of this model.

This report covers radiometric analyses performed on samples from the Ahlmannryggen formation, Queen Maud Land, and the Kaapvaal Craton in the region of the Natal Frontal Zone, South Africa, over the past year. A review paper, giving a full discussion of the Antarctica results, has been prepared for a forthcoming publication on South African Antarctic research. Only the data and calculated ages will be detailed here. A draft copy of the review paper has been appended.

2 AYLMANNRYGGEN AND BORGMASSIVET SEDIMENTARY-VOLCANOGENIC FORMATIONS

2.1 Results

Ten samples of mafic sills from diverse localities in the Ahlmannryggen and Borgmassivet regions were analysed by the total rock Rb-Sr method. The results are given in Table 1 below, and in Figs. 1 and 2.

TABLE 1

	Locality	Sample No	$^{87}Sr/^{86}Sr$ +	$^{87}Rb/^{86}Sr$ ++ (atomic)	^{86}Sr (ppm)	^{87}Rb (ppm)
*	Framskottet	HAB 1B	0.7208	0.71	12.745	9.160
*	Spiret	HAB 26D	0.7231	0.84	19.573	16.596
	Iskollen	I.1	0.7405	1.77	12.514	22.361
+	Veten	ER VE 13	0.7313	1.24	16.439	20.579
*	Nalegga	ER NAL 1	0.7238	0.89	17.959	16.102
*	Pyramiden	HAB 1505 A	0.7400	1.95	13.278	26.185
*	Knallen	HAB 1479 G	0.7254	1.01	15.635	15.944
+	Brapiggen	B1	0.7065	0.23	36.549	8.667
*	Fingeren	ER FING 8	0.7339	1.54	18.139	28.249
*	Nashornet	NI9/α2	0.7288	1.25	11.795	14.927

\+ Normalised to $^{88}Sr/^{86}Sr$ ratio of 8.375. Error of 0.0003 assumed in York regression.

++ Analytical error of 1.5% assumed in York regression.

Following the regression analysis of York (1966) data for 7 samples (marked * in Table 1) define an isochron (MSUM = .37, F = 2.71) giving an age of 1075 ± 18 m.y. with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7010 ± 0.0003 (Fig.1).

Data for two samples, B1 and ER VE 13, lie well off the trend of this isochron (by more than 10 σ). The 2 analyses, however, fall on the isochron reported by Allsopp and Neethling (1970) for 4 samples of the "Borg Metamafics", metamorphosed mafic sills, from the same area. These 6 samples define an isochron (MSUM = 2.42, F = 2.87) giving an age of 1668 ± 39 m.y. with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7009 ± 0.0006 (Fig.2).

Sample I1 is anomolous and has been omitted from the regression analysis pending thin section investigation for signs of alteration.

3 NATAL MOBILE BELT

3.1 Introduction

Matthews (1978) has suggested that the eastern, or Natal, sector of the Namaqua-Natal mobile belt might represent the site of a former continent-continent collision. In terms of his tectonic model, the Natal granite-gneiss complex and the infolded meta-greywacke-volcanic Mapumulo sequence represent the northern margin of a continental plate that was deformed in an enviroment above a subduction zone, as the leading edge of the plate moved into the collision zone with the Kaapvaal Craton.

Attention has been drawn to the contrast in structural style and lithology between the main body of the mobile belt and the northern "frontal zone". In the latter, northward overthrusting, perhaps with as much as 100 km lateral displacement, led to the development of the Natal Nappe Complex and the imbricate structures of the Natal thrust-belt along the front of the mobile belt. (Matthews, 1972). Interpretation of the metavolcanics association in this region as the upper part of an ophiolitic complex has led to the suggestion that the frontal zone contains tectonic slices of transformed oceanic crust and sediments that were obducted from a marginal basin onto the southern flank of the Kaapvaal Craton.

Presented here are the preliminary results of a geochronological study of the Archean rocks of the Craton abutting the frontal zone. This investigation had two primary objectives. Firstly to look for possible correlations with Archean ages reported for basement rocks in Western Queen Maud Land, Antarctica. And, secondly, to determine whether the Namaqua-Natal mobile belt formerly extended into this region of Antarctica.

During the course of this study a third avenue for research became apparent. This was to look for evidence, in the isotope systematics of minerals (particularly biotite) in rocks marginal to the frontal zone, of elevated temperatures in the Craton during overthrusting that may lend support for the continent collision model. Of particular interest was the extent of overthrusting north of the present frontal zone.

Results

Suites of granite gneiss were collected from 9 localities from the southern margin of the Kaapvaal Craton, in an approximately N-S traverse between Piet Retief and the northern limit of the frontal zone, about 18 km south of Nkandla. (see Fig.3).

Biotite was separated from the freshest sample from each suite and together with the corresponding total rock powder analysed by the Rb-Sr isotopic method. The results are presented in Table 2 and Figs. 4 and 5.

TABLE 2

Locality		Sample No	$^{87}Sr/^{86}Sr^{+}$	$^{87}Rb/^{86}Sr^{++}$	^{86}Sr(ppm)	^{87}Rb(ppm)	Whole-rock Mineral Age
Mhlatuze River	*	0G170 A(R)	0.8430	3.06	10.901	33.770)	
		0G170 A(B)	2.2628	104.89	1.885	200.082)	956 ± 14 m.y.
		0G170 A(P)	0.8143	0.84	15.798	13.431)	
	*	0G170 B(R)	0.8995	4.28	6.904	29.867	
	*	0G170 C(R)	0.8435	3.11	11.208	35.146	
		0G170 D(R)	0.8457	2.71	10.841	29.682	
		(0G170 D(RD)	0.8415	2.67	11.332	30.640)	
		0G170 E(R)	0.8965	4.66	6.644	31.311	

TABLE 2 cont'd

Locality	Sample No	$^{87}Sr/^{86}Sr^{+}$	$^{87}Rb/^{86}Sr^{++}$	^{86}Sr(ppm)	^{87}Rb(ppm)	Whole-rock Mineral Age
Mhlatuze	(OG170 E(RD)	0.8916	4.62	6.670	31.163)	
River cont'd	* OG135 (R)	0.8266	2.71	12.506	34.295	
	* OG136 (R)	0.7991	2.13	14.088	30.405	
	* OG137 (R)	0.8204	2.46	14.222	35.444	
Nkandla	OG174 A(R)	0.7790	1.97	28.543	56.780)	990 ±
Mica Mine	OG174 A(B)	2.5269	125.47	2.434	308.919)	15 m.y.
	OG174 B(R)	0.7849	2.09	25.560	53.955)	990 ±
	OG174 B(B)	2.2176	103.62	2.927	306.866)	15 m.y.
	MM 1 (R)	0.7791	1.95	28.843	56.990	
	MM 2 (R)	0.7802	1.99	28.968	58.193	
	MM 3 (R)	0.7803	2.21	25.330	56.500	
Nya Woshane	* FW 2 (R)	0.7185	0.35	57.998	20.721)	958 ±
River	FW 2 (B)	1.449	53.71	2.110	114.643)	14 m.y.
Maphophoma	* MO 2 (R)	0.7352	0.68	25.527	17.671)	† 2537 ±
River	MO 2 (B)	0.7944	2.32	2.958	6.948)	38 m.y.
White Umfolozi River	* WUG 1 (R)	0.9067	4.44	10.722	48.185	
Barclayside (Nr Nondewni)	* BG 1 (R)	0.8087	2.27	19.538	44.938)	2610 ±
	BG 1 (B)	11.0588	273.71	0.994	275.130)	35 m.y.

TABLE 2 cont'd

Locality		Sample No	$^{87}Sr/^{86}Sr^{+}$	$^{87}Rb/^{86}Sr^{++}$	^{86}Sr(ppm)	^{87}Rb(ppm)	Whole-rock Mineral Age
Natal Spa	*	NS 1 (R)	0.7578	1.18	29.090	34.832	
	*	NS 4 (R)	0.7153	0.30	57.073	17.310)	2640 ± 39 m.y.
		NS 4 (B)	3.3570	69.48	1.631	114.720)	
	*	NS 8 (R)	0.7163	0.32	53.251	17.452	
	*	NS 11 (R)	0.7116	0.22	62.378	13.654	
Piet Retief	*	EPR 2 (R)	0.7252	0.50	43.681	22.247)	2670 ± 40 m.y.
		EPR 2 (B)	4.1706	89.64	2.040	185.007)	
Nseleni		NGC1/5 (R)	0.7211	0.40	32.160	13.130)	933 ± 14 m.y.
		NGC1/5 (B)	1.7966	81.03	1.613	132.211)	
Western Queen Maud Land		No.1143 (R)	0.7765	1.64	26.288	43.633	

Note + and ++ as Table 1.

† biotite chloratised. (Age may have no true geologic significance).

Subscripts (R) = whole rock
(B) = biotite
(P) = plagioclase

Fifteen whole-rock samples (denoted with an * in Table 2) define an isochron (MSUM = 2.11, F = 2.25) yielding an age of 3214 ± 28 (1σ) m.y. with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7017 ± 0.0003 (1σ) (Fig.3). Samples OG170D and OG170E from the Mhlatuze river, and the 5 rocks analysed from the Nkandla Mica Mine diverge widely from the regressed line (by more than 6σ). These have been omitted from the regression analysis pending thin section study. It is not yet known whether the divergent samples have been altered or represent granitic bodies of a different age.

Mineral "ages", calculated using the biotite and corresponding whole-rock analysis from a sample, are presented for each locality in the last column of Table 2. An analytical error of 1.5% in the $^{87}Rb/^{86}Sr$ ratio has been assumed in the age calculations.

Discussion

An age of ∿3 200 m.y. for the rocks of the southern margin of the Kaapvaal Craton is in good agreement with ages previous obtained from this region by Allsopp (pers.comm). Considering the large distance (almost 200 km) spanned by the sample sites, the linear array defined by the data gives a good indication that we have sampled the same geochronologic unit throughout. The initial $^{87}Sr/^{86}Sr$ ratio of 0.7017 is in good agreement with that postulated by Davies and Allsopp(1976) for the subcontinental mantle beneath Southern Africa about 3200 m.y. ago.

Mineral ages in the samples analysed, recorded in the overprinted isotopic system of biotite, show two distinct groups of about 930-990 and 2600-2670 m.y. (Table 2) with the ages increasing to the north (Fig.5.). The extent of the ∿2600 m.y. overprint age, found from Barclayside northwards to Piet Retief, suggests a widespread thermal event occurred at this time. Granite plutons and rocks from the Usushwana layered intrusive complex from Swaziland, dated by Davies et. al. (1970), show similar ages and may provide a possible heat source, although there is no direct evidence of their emplacement this far south.

The ∿960 m.y. mineral ages, recorded at the Nya Woshane and Mhlutuze river sites (and a slightly older age of ∿990 m.y. at the intervening Nkandla Mica Mine - the whole rock analyses lay below the 3.2 b.y. trend line and may not have remained a closed system for Rb & Sr), and the 933 m.y. age from further east at Nseleni (see Fig.3), extend at least 15-20 k.m. into the archean rocks of the foreland (Fig.5). These ages are within the range 900-1190 m.y. reported

from total rock Rb/Sr and U/Pb zircon studies on suites from the frontal zone and the main body of the mobile belt. This correlation suggests that the biotite in the foreland rocks are recording "cooling ages" (the time when biotite last cooled through its blocking temperature ~300°C) in response to a thermal pulse, or sustained heating that subsided, associated with tectonic activity within the mobile belt and frontal zone to the south, at about 1000 m.y. ago.

In terms of the tectonic model of Matthews the heat source was provided by "hot" thrust sheets of oceanic crust obducted onto the southern margin of the Craton during closure of a marginal basin. With subsequent erosion the overthrusting slabs have been planed off back to their present exposure level in the frontal zone. Key et. al. (1976), however, noted that the frontal zone formations have certain lithological affinities with typical greenstone sequences. In brief, he proposed that this greenstone-type supracrustal sequence, of possible late Precambrian age, was deposited during an early volcanic episode along the northern margin of the Mobile belt. The tectonic development of the Natal Nappe Complex and Natal thrust-belt could then be attributed to northward, lateral gravitational spreading from a region of major uplift within the central zone of the Mobile belt. At present the data is insufficient to resolve between these two general models.

Conclusions

In conclusion, this preliminary study of the southern margin of the Kaapvaal Craton has shown that (a) the same geochronologic province, with an age of ~3200 m.y., has been sampled from within 50 metres of the frontal zone (Nya-Woshane River) up to 200 km to the north (Piet Retief); (b) biotite separated from rocks between Barclayside (~57 km north of frontal zone) and Piet Retief give mineral ages between 2600-2670 m.y. and (c) mineral ages between 930-990 m.y. are recorded in cratonic rocks at least 15-20 km north of the frontal zone.

Whether the ∿950 m.y. overprint fall off sharply between Nkandla and Barclayside, or rises gradually to the older age is, as yet, unresolved. Further sampling between these two regions was undertaken in June this year and the samples will be processed shortly.

In connection with the former juxtaposition of eastern South Africa and Queen Maud Land two interesting results have arisen. Halpern (1970) reported a single Rb/Sr total rock analysis of a biotite granite which, assuming an initial $^{87}Sr/^{86}Sr$ ratio of 0.704, gave a model age of 3170 m.y. This analysis fits, within experimental error, on the trend of the southern Kaapvaal Craton regression line (see Fig.4). Halpern actually postulated an extension of the 3 b.y. province of Swaziland north-east beneath the Cenozoic cover to join Antarctica along the Princess Martha Coast. Secondly, three suites of high grade (upper amphibolite facies) gneiss from the Sverdrupfjella Group, Kirwanveggen, Queen Maud Land, give Rb/Sr total rock isochron ages between 1000-1180 m.y., with initial $^{87}Sr/^{86}Sr$ ratios of ∿0.704. Similar ages, as discussed earlier, are reported in the medium to high grade gneiss in the Natal mobile belt also with initial $^{87}Sr/^{86}Sr$ ratios of about 0.704 (Welke, pers. comm.).

Much more data is clearly needed, especially from Queen Maud Land, to clarify the picture. The use of fission track "cooling ages" in accessory minerals from rocks of both continental margins, to determine the thermal history of rifting, may help resolve the former relationship between these two areas in Gondwanaland (see NP10 project proposal form).

References

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ISOCHRON NAME :BORG MAF. SILLS'79
DECAY CONSTANT (*10-11)= 1.42
NO. OF POINTS= 7

87Rb/86Sr(X)	87Sr/86Sr(Y)	SIG.X(%)	SIG.Y(A)	SAMPLE	LOCATION
.71	.7208	1.5	.0003	HAB1B	FRAMSKOTTET
.84	.7231	1.5	.0003	HAB26D	SPIRET
.89	.7238	1.5	.0003	ERNAL1	NALEGGA
1.95	.74	1.5	.0003	HAB1505A	PYRAMIDEN
1.01	.7254	1.5	.0003	HAB1479G	KNALLEN
1.54	.7339	1.5	.0003	ERFING8	FINGEREN
1.25	.7288	1.5	.0003	NI9/a2	NASHORNET

ResX	Resx/SigX	ResY	ResY/SigY
-.00138	-.12934	.00007	.23679
.00397	.3152	-.00015	-.48772
.00286	.21454	-.00009	-.31332
.00124	.04245	-.00001	-.02829
-.00265	-.17507	.00007	.2253
.00897	.38834	-.0001	-.32776
-.01253	-.66839	.00021	.69501

M SUM = .365

AGE (M.Y.) = 1075.4 +/- 17.9 (1 SIG.)

INITIAL 87Sr/86Sr RATIO = .70997 +/- .00028 (1 SIG.)

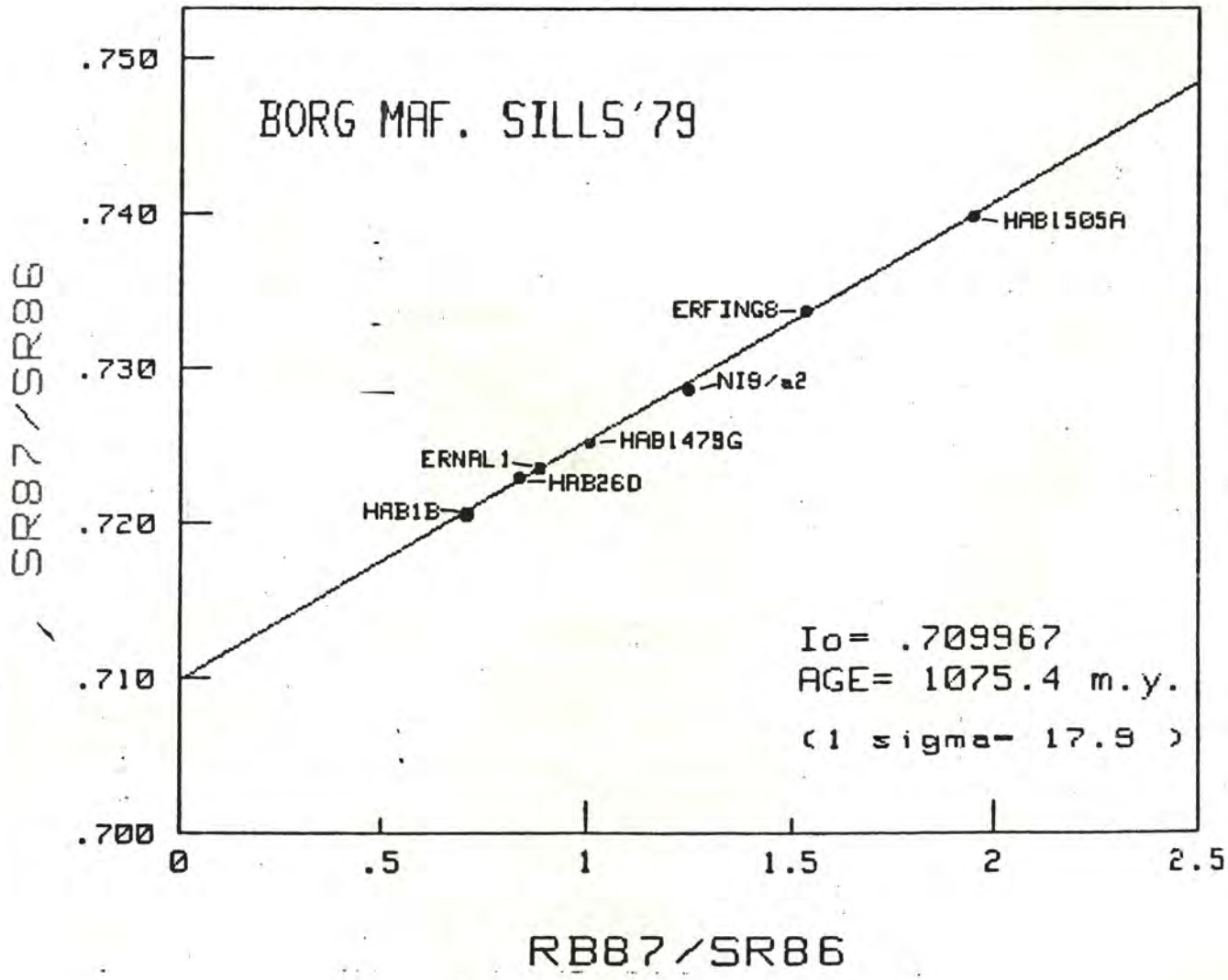


Fig. 1.

ISOCHRON NAME :BORG METAMAFICS'80
DECAY CONSTANT (*10-11)= 1.42
NO. OF POINTS= 6

87Rb/86Sr(X)	87Sr/86Sr(Y)	SIG.X(%)	SIG.Y(A)	SAMPLE	LOCATION
1.24	.7313	1.5	.0003	ERVE13	VETEN
.23	.7065	1.5	.0003	B1	BRAPIGGEN
1.34	.734	1.5	.0003	N70A	JEKSELEN
1.65	.7405	1.5	.0003	N71A	JEKSELEN
1.61	.7383	1.5	.0003	N402A	JEKSELEN
.9	.7219	1.5	.0003	PM2A	JEKSELEN

ResX	Resx/SigX	ResY	ResY/SigY
.01883	1.01219	-.0002	-.6813
.00017	.04937	-.00005	-.17916
.02884	1.43493	-.00027	-.89376
.00102	.0414	-.00001	-.02094
-.03982	-1.6489	.00026	.8548
-.0134	-.99244	.00028	.92036

M SUM = 2.416

AGE (M.Y.) = 1667.6 +/- 38.5 (1 SIG.)

INITIAL 87Sr/86Sr RATIO = .70093 +/- .00056 (1 SIG.)

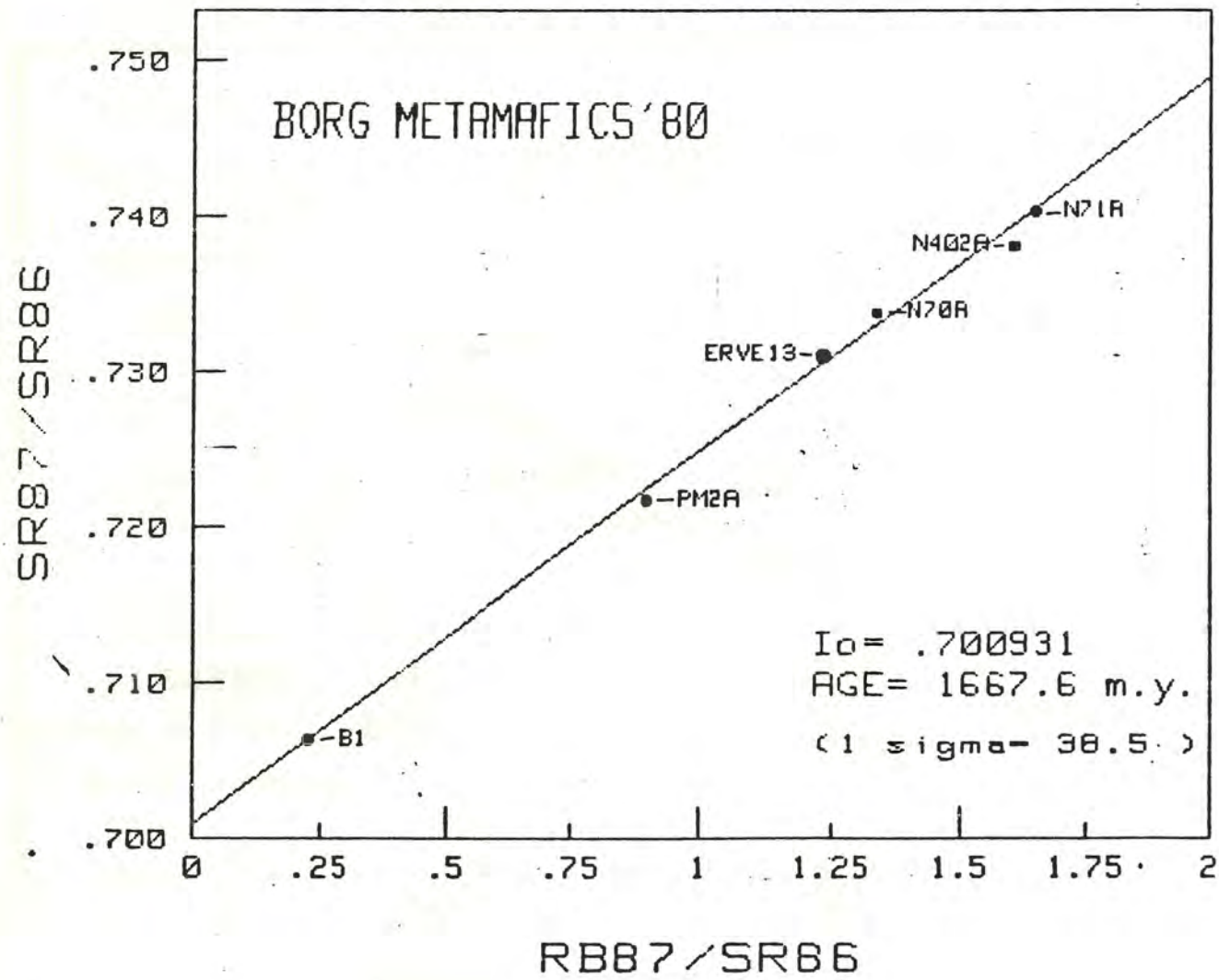
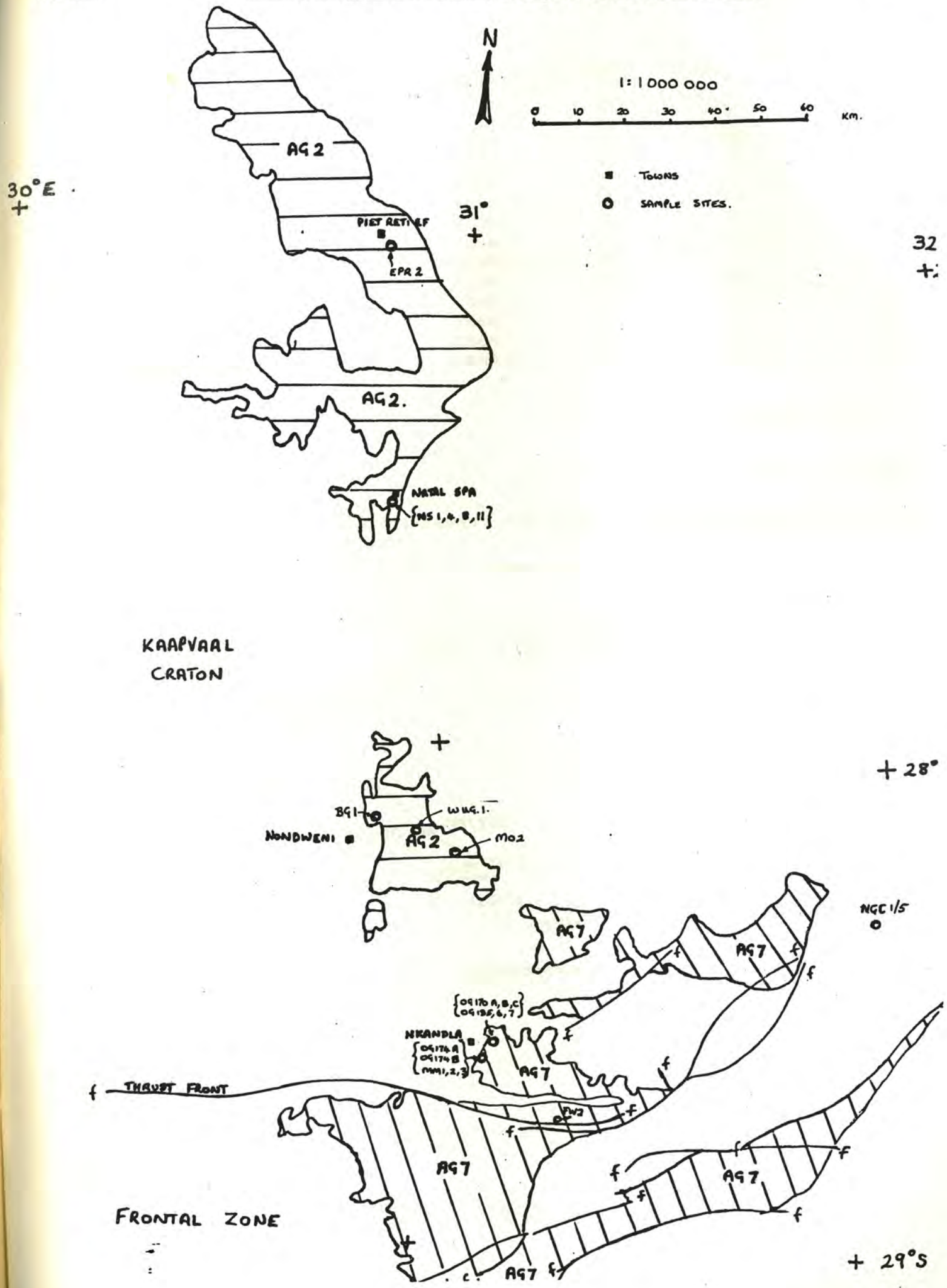


Fig. 2.

8/7/80.

FIG. 3. NORTHERN TRAVERSE. (NATAL) / SAMPLE LOCALITIES



[illegible] NAME : S.KAAPVAAL N.T.'80
DECAY CONSTANT (*10-11)= 1.42
NO. OF POINTS= 15

87Rb/86Sr(X)	87Sr/86Sr(Y)	SIG.X(%)	SIG.Y(A)	SAMPLE	LOCATION
.95	.7185	1.5	.0003	FW2	NYA-WOSHANE R.
3.06	.843	1.5	.0003	OG170A	MHLUTUZE R.
4.28	.8995	1.5	.0003	OG170B	MHLUTUZE R.
3.11	.8435	1.5	.0003	OG170C	MHLUTUZE R.
2.71	.8266	1.5	.0003	OG135	MHLUTUZE R.
2.13	.7991	1.5	.0003	OG136	MHLUTUZE R.
2.46	.8204	1.5	.0003	OG137	MHLUTUZE R.
.68	.7352	1.5	.0003	MO2	MAPHOPHOMA R.
4.44	.9067	1.5	.0003	WUG1	W.UMFOLOZI R.
2.27	.8087	1.5	.0003	BG1	BARCLAYSIDE
1.18	.7578	1.5	.0003	NS1	NATAL SPA
.3	.7153	1.5	.0003	NS4	NATAL SPA
.32	.7163	1.5	.0003	NS8	NATAL SPA
.22	.7116	1.5	.0003	NS11	NATAL SPA
.5	.7252	1.5	.0003	EPR2	E.PIET RETIEF

M SUM = 2.111

AGE (M.Y.) = 3214.1 +/- 28.4 (1 SIG.)

INITIAL 87Sr/86Sr RATIO = .70171 +/- .0003 (1 SIG.)

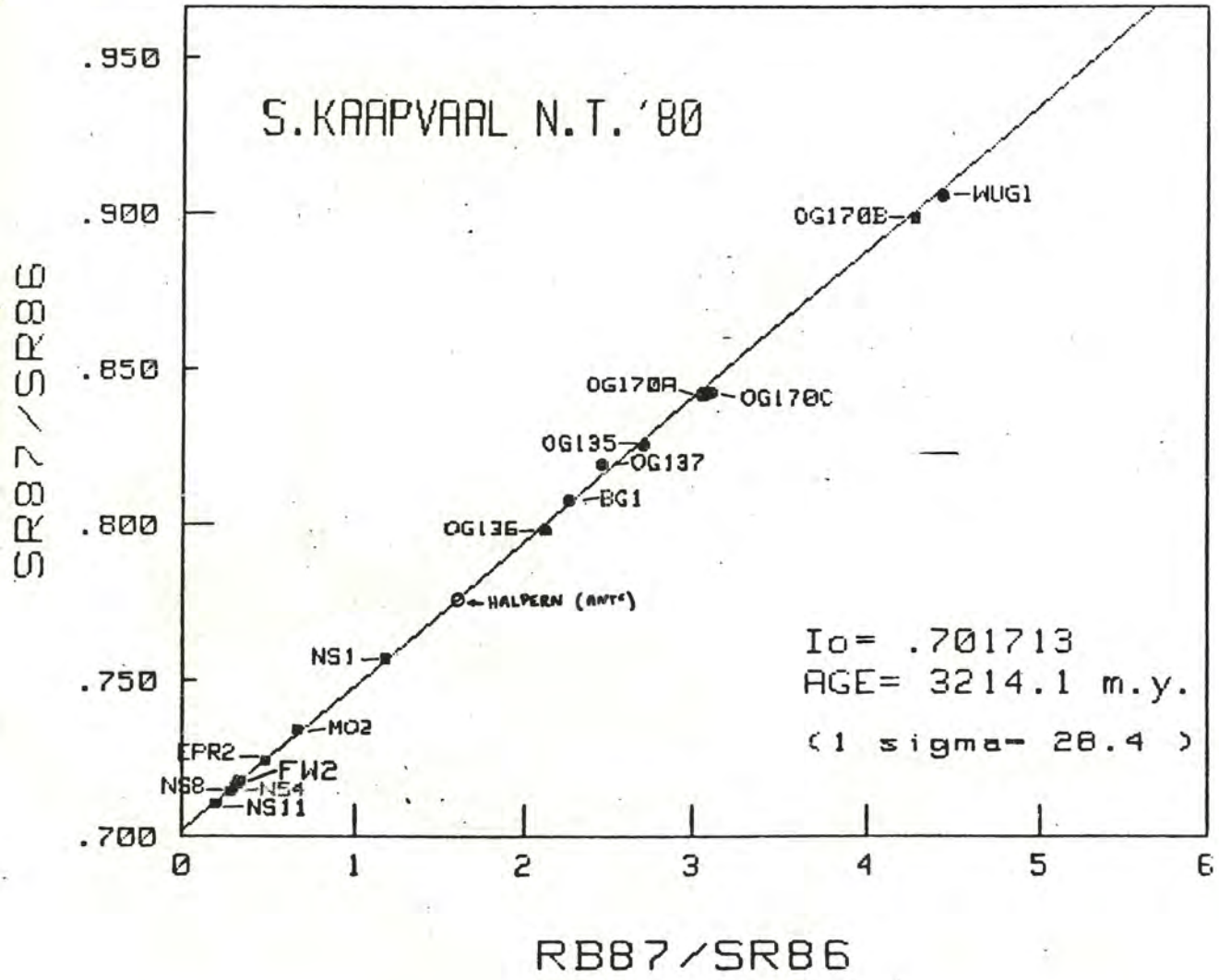


Fig. 4.

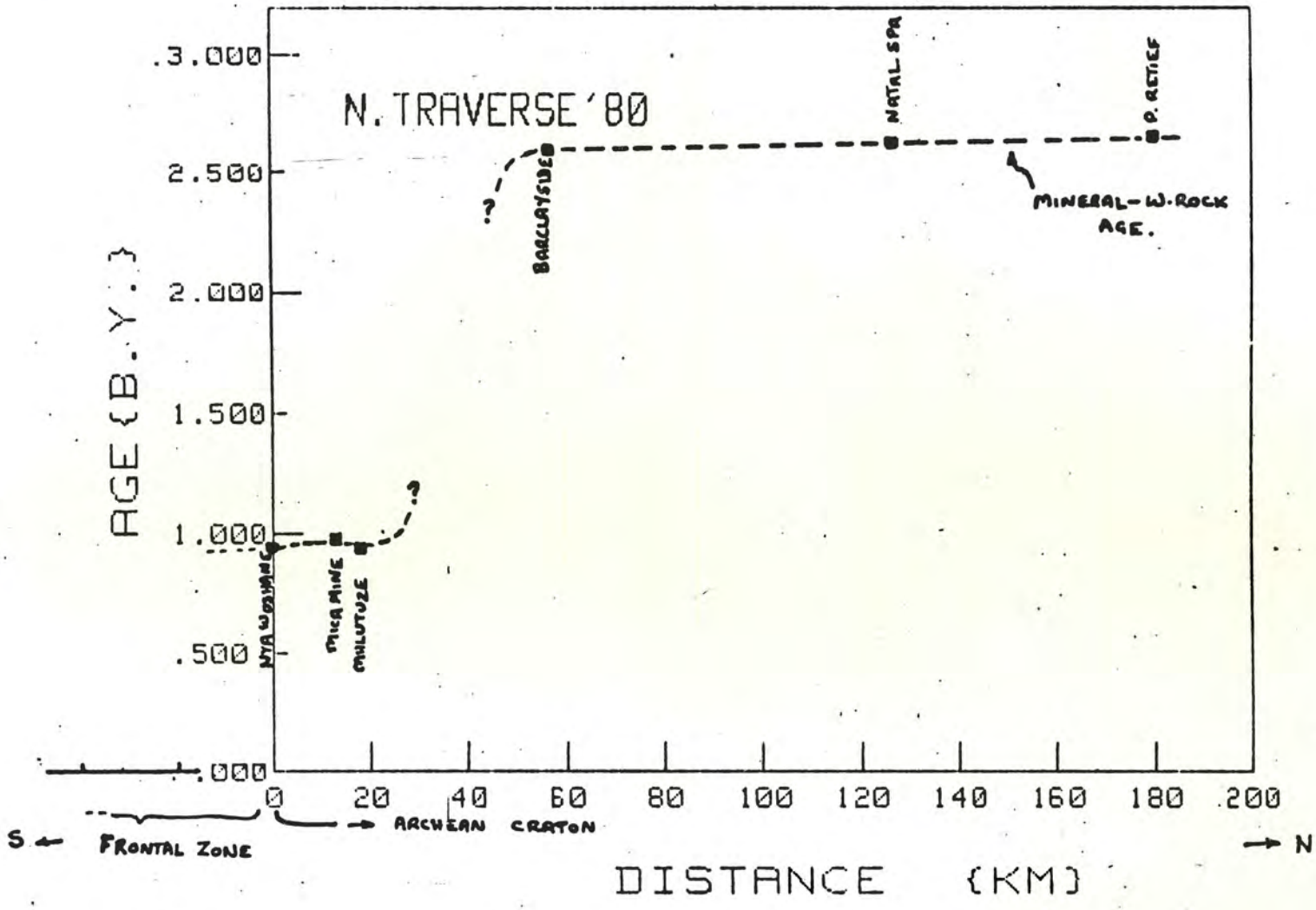

N. TRAVERSE '80
AGE (B.Y.)
3.000
2.500
2.000
1.500
1.000
.500
.000
0
20
40
60
80
100
120
140
160
180
200
DISTANCE (KM)
S
N
FRONTAL ZONE
ARCHEAN CRATON
NATAL SPA
P. RETIEF
BARCLAYSIDE
MINERAL-W. ROCK AGE.
MICA MINE
PHILUTUZE
?
?

Fig. 5.

GUIDELINES FOR THE PREPARATION OF

PROGRESS REPORTS

TO

SASCAR COMMITTEES

GUIDELINES FOR THE PREPARATION OF PROGRESS REPORTS TO SASCAR COMMITTEES

From 1980 we will be producing a simply bound volume of annual progress reports on Antarctic research projects. The annual volumes will be entitled "PROGRESS REPORTS TO SASCAR" and will include all reports from the atmospheric (physics), biological and earth sciences programmes. Reports to be included in the annual volumes will be photo-copied directly from reports submitted with NP 10 forms and we will add a list of contents. There is therefore a need to introduce a degree of standardization in the format of the progress reports and we would like them to be prepared in future according to the following guide-lines.

The report should be first identified as follows:

Project Title (in capitals)	- as given on the NP 10 forms
Project Leader	- name and address
Project Researcher(s)	- name(s) and address(es)
Date	- the report should be dated (e.g. third annual progress report, July 1980 to June 1981, submitted in June 1981).

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

1. Objectives	- referring to the objectives as stated in the previous NP 10 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 project as a whole.
3. Scientific Progress	- made in the year under consideration, with particular emphasis on specific scientific findings and/or achievements, such as answers to key questions given in the previous or original NP 10 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. Publications	- list separately; (i) those published, (ii) those accepted for publication and (iii) relevant internal reports which are likely to remain unpublished. Listings under these sub-headings include only those published or accepted for publication since the previous progress report was submitted and only those which have originated directly from the work being done.

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 photo-copied as is. Reports may be submitted in English or Afrikaans.

Although we have requested the body of the report (i.e. 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.

At the beginning of the project term, a report describing the proposed research in greater detail than can be accommodated on the NP 10 form could be submitted with the first NP 10 form. At the end of the project term (commonly three years, with a maximum of five years) a final project report should be submitted whereas an NP 10 form would not normally be submitted. The final project report would usually be an expanded version of a normal progress report (i.e. up to 10 pages), describing to what extent the original objectives have been met and scientific conclusions which can be drawn from the work. However, the relevant SASCAR sub-committee might decide that the number and/or content(s) of publications (published and accepted for publication) is sufficient, in which case a shorter report, with a list of publications would be satisfactory.

RIGLYNE BY DIE VOORBEREIDING VAN

VORDERINGSVERSLAE

AAN

WKAN-KOMITEES

RIGLYNE BY DIE VOORBEREIDING VAN VORDERINGSVERSLAE AAN WKAN-KOMITEES

Die jaarlikse vorderingsverslae wat handel oor Antarktiese navorsingsprojekte, sal vanaf 1980 in 'n eenvoudige bundel getiteld "VORDERINGSVERSLAE AAN WKAN" saamgebind word. Hierdie bundel sal alle vorderingsverslae wat betrekking het op atmosferiese, biologiese en aardwetenskap-programme insluit. Fotostatiese afdrukke van die vorderingsverslae wat saam met die NP 10-vorms ingestuur word, sal vir hierdie doel gebruik word en ons sal slegs 'n inhoudsopgawe verstrek. Dit is derhalwe nodig om 'n mate van eenvormigheid in die samestelling van verslae te verkry en dit sal waardeer word as toekomstige vorderingsverslae aan die hand van die volgende riglyne voorberei word.

Die verslag moet eerstens geïdentifiseer word:

Naam van Projek (in hoofletters)	- soos dit op die NP 10-vorm voorkom
Programleier	- naam en adres
Programnavorser(s)	- naam(name) en adres(se)
Datum	- die verslag moet gedateer word (bv derde jaarlikse vorderingsverslag, Julie 1980 tot Junie 1981, ingehandig Junie 1981).

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

1. Doelstellings	- verwys na die doelstellings soos uiteengesit in die vorige NP 10-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 NP 10-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 sub-hoofde 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 foto-afdrukke 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 toerusting-probleme 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.

Aan die begin van die program-termyn kan 'n verslag waarin die program in fyner besonderhede omskryf word as waarvoor daar spasie is op die NP 10-vorm, saam met die eerste NP 10-vorm ingestuur word. Aan die einde van die program-termyn (gewoonlik na drie - of 'n maksimum van vyf jaar) behoort 'n finale vorderingsverslag ingestuur te word alhoewel 'n NP 10-vorm dan normaalweg nie ingestuur word nie. Dergelike finale vorderingsverslae sal meesal 'n breedvoerige weergawe van 'n gewone vorderingsverslag wees (dws tot tien bladsye) waarin die doeltreffendheid van die program (ten opsigte van oorspronklike doelstellings) asook wetenskaplike gevolgtrekkings waartoe geraak kan word as gevolg van die program, uiteengesit word. Die betrokke WKAN-subkomitee kan egter besluit dat die aantal publikasies en/of die inhoud daarvan (dws van werke wat gepubliseer is of aanvaar is vir publikasie) voldoende is, in welke geval 'n korter verslag met 'n lys van publikasies aanvaarbaar sal wees.