REPORT ON ELEVENTH VICTORIA UNIVERSITY OF WELLINGTON

ANTARCTIC EXPEDITION

NOVEMBER AND DECEMBER 1966

Introduction

Three independent, two-men parties were in the field. One comprising Dr. H.W.Wellman and A.R. Duncan were studying weathering processes and Quaternary geology, one comprising Dr. D.A. Christoffel and I.M. Calhaem attempted to determine geothermal gradients in the bed of the sea off McMurdo, and one comprising Mr. Ian Smith and Mr. Vince Neall studied dyke swarms in the Wright Valley and at Nussbaum Riegel. Dr. H.W. Wellman was the scientific leader and Mr. Ian Smith the Field Leader. The reports for the three parties are given separately below.

Weathering processes and Quaternary Geology

H.W.Wellman and A.R. Duncan

At Wright Valley for 10 days, mostly near Lake Vanada, with a two day trip as far east as Meserve Glacier. At Marble Point for five days. At Mt Falconer for three days. At Nussbaum Riegel for five days. During a day trip from Scott Base a half-hour was spent at Cape Bird.

Lake Vanda Area

One of the members of the party had spent several weeks in the area previously and some tentative conclusions on the weathering processes had been reached, and the purpose of the trip was to check their validity.

Soils and Salt Fretting

Wellman and Wilson have suggested that salt fretting is an important erosive agent where soluble salts are abundant. The Wright Valley is the classic area for the process. The soils were studied in more detail than they had been previously because it is thought that salt fretting within the soils, although less obvious, is more important than the spectacular cavernous weathering of boulders that stand above soil level. Within the area we examined there are at least two main soil types: an arid soil which covers most of the Wright Valley and is never flushed out by water, and a non-arid soil which is flushed out annually by melting snow. The arid soils contain much soluble salt and have well defined horizons. They require detailed study in order to find the processes that control horizon formation. The uppermost horizon is normally described as being "lag gravels", inferring wind transport of fines. Wind is important but does not explain all the profiles observed.

Wet Bands

On previous expeditions a band which appears to be permanently damp flanks the western side of the valley and extends for several kilometres. It also occurs around the sides of lakes and borders stream courses. The most interesting wet bands are these distant from obvious water sources. All were explained as being related to the snouts of glaciers which have now retreated. They are important for glacial correlation and have a profound effect on weathering, rocks on the wet bands being considerably more weathered than those on either side. Differential weathering caused by the wet bands makes it impossible to place soils in order of age solely from the degree to which they have been weathered.

Pedimentation

Pediments, the term being used in a broad sense, and not glacial features, are the most striking landscape forms to be seen in the middle part of the Wright Valley. Pediments are essentially a flattish surface with a knick separating it from a steeper surface above. The knick is the critical part. It is related to the way in which rock waste is broken down. To produce a knick the material has to be broken down to a size that can be transported away and the breaking down has to be done in a single step, from large to fine and without appreciable material of intermediate sizes. Salt fretting does this very thing, breaking rocks at one step into their component crystals. At Lake Bull, the name given to a small lake in the Wright Valley, about a mile east of the east end of Lake Vanda, pedimentation is actively in progress, salts being supplied during the flooding of the Onyx River, and the fretted material being wind transported. The flooding carries the salts away from all except the edge of the lake and prevents salt fretting from pitting the lake bed itself. Higher pediments are also attributed to salt fretting, but the controlling details are less well understood.

Maximum Wind Velocities.

Below Bull Pass and on the south side of the valley just east of Lake Vanda are two places in Wright Valley that appear to be subject to extremely high westerly winds. Pebbles up to 2 inches in length have been transported for as much as 0.5 km from their source outcrop. In an attempt to find how strong these winds are and how often they blow, a set of primitive maximum velocity indicators were set up on the Lake Vanda Peninsula in 1964. The indicators consisted of a series of tins of different squatness filled with sand and set up on flat rock surface. In December 1966 it was found that the beer cans had been blown over by westerly winds and that the squatter tins had not. At some time in the last few years there must have been a gale very much stronger than any I have experienced. I would estimate a velocity of about 100 knots and suggest that an experiment should be made in a wind tunnel or at an airport to obtain a more accurate value, as it will be important to know what is to be expected if a hut is to be built in the valley.

Elevated Beach Ridges.

During the five days spent in the Marble Point area 12 profiles were measured across the elevated marine shore lines which extend over about half the coast between Gneiss Point and Cape Bernacchi. The shorelines are partly cut in rock but are mostly defined by gravel and cobble ridges that are similar, except that the boulders are subangular and not well rounded, to those that have formed during the last few thousand years in New Zealand. The ridges appear to be wave-formed but the sea was frozen for the whole time we were in the area (early December) and we have no idea, if, and for how long, waves now beat against the coast. Because of the lack of continuity of the ridges it was not possible to trace them far but they could be correlated by reasonable certainty from the heights alone. Heights were measured from the water in tidal holes in the ice, using a staff and the horizon as a level surface, and are probably accurate to about 0.1 metre - the accuracy being greater than the irregularity in the heights of the ridges themselves. The heights are given below (with range in brackets):
A ..2(0.2), B 2.2. (0.2), C 3.1 (0.2), D 3.9 (0.2), E 6.0 (1.4),
F 7.2 (0.6), G 9.2 (0.5), H 10.4 (0.2), I 11.3 (?). J 13.1 (0.2),
K 115.0 (0.9), L 18.1 (1.0)

In Northern Norway a similar but more numerous series of ridges that have been attributed to isostatic uplift are reasonably well dated by four radio-carbon samples. Isostatic uplift is generally assumed to be a continuous and not an intermittent process, and isostatic continuity in Finland is substantiated by tilt observed on lakes during the past 40 years. Uplift but not the formation of specific beach ridges can be attributed to the isostatic movement, and their formation must be due to some intermittent factor, either directly climatic or to some small sea-level oscillations. The radio carbon samples indicate that the time interval between the formation of the Norwegian ridges is remarkably uniform with a value of almost exactly 400 years. Because of the uniform interval, and because the rate of isostatic uplift has been decreasing while sea level has remained substantially stationary the vertical interval between successive Norwegian beach ridges has progressively decreased with time for the last 6,000 years.

In South Victoria Land there is no general agreement on the age of shore line features of the kind we measured near Marble Point. However, it is possible that the 400 year cycle may well operate, and this is made likely by progressive decrease in the vertical interval between successive beach ridges indicated by the values given above. The progressive decrease in vertical interval indicates that the ridges are a single series and not, for example, in part 100,000 or more years old and in part less than 6,000 years old. The distance over which the ridges were observed is too small to determine the small tilt that is likely to have taken place, and because the difficulties in correlation it is unlikely that the direction and tilting can be established anywhere in South Victoria Land. One clear relation was observed: the older and higher ridges progressively cut out towards the south. The cut-out is attributed to the southerly retreat of the Ross Ice Shelf while the beach ridges were being cut.

Geothermal heat flow studies from Ocean floor west of McMurdo

D.A. Christoffel and I.M. Calhaem

The thermal gradient probe used was constructed in the Physics workshop of Victoria University and is 6 ft long and 1 inch in diameter. It has 24 differential thermocouples extending over a length of 4.5 ft and has a built-in heater to determine thermal conductivity of the sediments it penetrates. Sea ice served as a convenient working platform and the probe was lowered through an existing hole in the ice and through a new hole that was drilled.

Unfortunately, because of hard bottom conditions, only one gradient measurement appeared to be successful. It indicated a heat flow of about 1.9 micro-calories per cm^2 per second and is slightly above the generally accepted world average value. It is important for future work that more stations be occupied in the hope of finding softer bottom conditions.

A Weddel Seal co-operated in providing an interesting Zoological sideline to the geophysical work. He, or she, repeatedly visited us at one of the holes, often with a fish in its mouth. On one occasion we were able to take a live fish in good condition from the seal. It weighed 65lbs and was 4.9 ft long and proved to be a species, Dissostichus mawsoni, that had not previously been fully described. The fish and behaviour of the seal are to be the subjects of a short paper.

Dykes at Nussbaum Riegel

I. Smith and V. Neall

During November and December 1966, 25 days were spent at Nussbaum Riegel, to the east of Lake Bonney and to the south of a deep arcuate gorge in the Taylor Valley. Nussbaum Riegel stands several thousand feet above the Taylor Valley and is connected with the Kukri Hills to the south by a moraine-mantled platform.

Igneous dykes have been reported from as far north as the Admiralty Range and as far south as the Darwin Mountains. Nussbaum

Riegel contains one of the best exposed and most readily accessible dyke swarms and the various petrological types were collected and the field relations of the dykes determined.

The dykes were previously mapped as being entirely lamprophyres but the more detailed studies have shown that they are more correctly termed dolerites. One is possibly a quartz porphyry.

Most of the dykes strike at right angles to the general strike of the basement rock, and are dextrally displaced by three faults, the amount of displacement at each fault being about 200 ft and the sense of displacement dextral.

The dyke rocks are at present being studied in detail and samples are being prepared for K/Ar dating.

Acknowledgements

The expedition was made possible by financial and other assistance from several organizations and individuals, to all of whom we are extremely grateful. The University Grants Committee and Victoria University of Wellington provided financial assistance. The United States authorities provided transport to and from New Zealand and within South Victoria Land.

The Antarctic Division of the Department of Scientific and Industrial Research arranged our transport and provided accommodation while we were at Scott Base.

We would specially like to thank Professor Clark, Geology Department, for his help and continued interest in the University Antarctic Expeditions.

As with previous expeditions, the greatest possible help and co-operation was forthcoming from the Leader and staff at Scott Base. We would like to take this opportunity of thanking Mr. Colin Clark and his colleagues very warmly.

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VICTORIA UNIVERSITY OF WELLINGTON

P.O. Box 196,
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16th March, 1967.

The Secretary,
R.D.R.C.,
P.O. Box 8018,
WELLINGTON.

Dear Sir,

Re VUWAE 12

It has been difficult to formulate our proposals as fully as we would have wished until VUWAE 11 results were evaluated, and until Assoc. Professor A.T. Wilson returned to New Zealand. It now is possible to state in detail what we would like to do in the 1967/68 summer.

VUWAE 12 would consist of 6 persons operating in three detached pairs.

Composition:

VUWAE 12	H.W. Wellman - Leader
VUWAE 12 (a)	H.W. Wellman - Sub-leader A.N. Other (possibly Mr. Neall)
VUWAE 12 (b)	A.T. Wilson - Sub-leader Probably Mr. C. Hendy
VUWAE 12 (c)	(Programme of D. Christoffel) Sub-leader A.N. Other

Programmes

12(a). Wellman's party would collect fossil material from Bull Pass, operating from the Wright Valley. It would then proceed to Black Island for more detailed work on high moraines and elevated benches examined by VUWAE 9. It is considered that the work of this group might be completed by mid-December and it could be withdrawn to New Zealand.

12(b). A programme set out fully by Wilson follows:-

Logistic Programme

Movement 1

November 3	A.T. Wilson and Hendy together with 1500 lb equipment leave Christchurch for Scott Base.
November 5-10	Wilson and Hendy travel by motor toboggan to Cape Royds to work on moraines on slopes of Erebus and return to Scott Base. (see Problem No. 1).
November 11	Wilson and Hendy carry out aerial reconnaissance flights from the Victoria Valley along eastern edge of Polar Plateau as far south as possible searching for ice tongues originating from polar plateau and ending in dry areas (see Problem No. 3).

November 13	Wilson and Hendy travel to Byrd Station with 500 lbs equipment and remain four days. (see Problem No. 2).
November 18	Wilson and Hendy travel to Plateau Station with 500 lbs equipment and remain four days. (see Problem No. 2).
November 23	Wilson and Hendy travel to Pole Station with 500 lbs equipment and remain four days. (see Problem No. 2).
November 27	Wilson and Hendy return to Scott Base and are moved to upper Wright Valley near upper Wright Glacier. After dropping off equipment 1000 lb make reconnaissance by helicopter of area where polar plateau joins upper Wright Glacier land to collect snow samples. (see Problem No. 3).
November 30 December 2 December 4 December 6	Move Wilson and Hendy by helicopter to selected areas at head of Taylor Glacier. (see Problem No. 3).
December 8	Return to Scott Base.
December 10	Return to New Zealand.

If it would be at all possible during this programme it would be very desirable to go to Vostok (see Problem No. 2). It is realised that this may be difficult.

Scientific Background to Proposals

Problem No. 1

Glacial History of Ross Dependency

As a result of work on previous expeditions Wilson has worked out a glacial history of the Ross Dependency. Part of this history involves an ice sheet from the sea which entered the Taylor Valley to cover the slopes of Erebus and Terror up to 1000 ft. This glaciation has been called the "Great Flood Glaciation" by earlier workers.

One explanation for this glaciation is that due to sea level lowering during the last glaciation the ice shelf became grounded and hence became part of the Continental ice sheet. If this explanation is correct one would expect the retreat to have taken place about 6000 years ago, and hence the glacial moraine would be very fresh as compared with the glacial debris in the dry valleys. Thus it is proposed to study the moraines on the slopes of Erebus which are easy to find and well described by early workers. The weathering of the granite should provide a good indication of age. It is desired to travel by motor toboggan rather than by helicopter as this will give a greater range and enables one to take one's camp with one when mapping the moraine.

Problem No. 2

Ablation measurements on the Antarctic Ice Sheet

During an earlier expedition Wilson and House developed a technique for measurement of ablation rates. It is proposed to develop this technique further and to extend the measurements to other areas on the polar ice sheet. This is the only method of making this measurement and it has never been determined at Byrd Station or at Plateau Station. No one else has the necessary technique to make the measurement. The measurements have to be made in the field as a very large number of samples are involved and contamination is a real problem. It is hoped to extend the technique to measurement of the contribution by drift to the total accumulation.

Importance of measurements: besides its own intrinsic interest - the ablation when combined together with nett accumulation (which is known) gives the gross precipitation. These figures are needed to enable one to estimate the effect on the budget of the Antarctic ice sheet on any change - such as for example the growth of an ice shelf around Antarctica, the increase in sea ice or a change in world temperature.

It is proposed that Wilson and Hendy spend four days at each of the following stations:-

Byrd Station
Pole Station
Plateau Station
and, if possible, Vostok

Problem No. 3

Ice budget of Antarctic Ice Sheet

Is the Polar Plateau going up or down or remaining constant?

Since the Antarctic Ice Shelf theory for Pleistocene Glaciations was proposed.

There has been much interest in this problem. The English are doing radio echo soundings on outlet glaciers to determine total ice budgets. The Russians and French have a strain set-up to measure the change directly.

It is proposed to tackle the problem another way and to examine points where the Polar Plateau pushes ice tongues into dry areas. Since the Polar Plateau ice contains salts and these remain behind when the ice evaporates it is possible to determine how long the ice tongue has been supplied by the Polar Plateau.

The upper Wright Glacier is an example of this situation and it is proposed that

1. A two man party go to the upper Wright Glacier area by helicopter to study this problem.

2. That a reconnaissance be made in an aircraft from the Victoria Valley and along the edge of the Polar Plateau as far south as possible looking at other critical areas.

NB. In my view, Wilson's "Problem 2" is of fundamental importance and should be given all reasonable priority, with the proviso that it is realised Vostok may be impractical.

The remainder of Wilson's programme is sound, but the degree of support requested may be unreasonable. I would welcome discussion with Mr. Thompson on this point.

12(c). It is proposed to continue and expand the project commenced with VUWAE 11. The following are the objects:

1. Measure the heat flow through the bottom of McMurdo Sound on a line extending from McMurdo Station to Brown Peninsula.

2. Measure the heat flow through the bottom of Lake Bonney.

3. Measure the heat flow through the bottom of Lake Vanda.

Personnel required - two.

Duration of projects -	1.	4 weeks
	2.	10 days
	3.	10 days
	Total	7 weeks

Equipment

1. Heat flow probe to drive into the bottom. Three probes have been built and satisfactorily tested. However, to work through a Cipri drill hole as envisaged for (2) and (3) a new small diameter head must be constructed.

2. Electric cable and lowering wire. These items are to hand.

3. Cable reeling drums - 2 required; 1 to hand, 1 to be purchased from the Army. Cost: £8.

4. Metering blocks - 2 required; 1 to hand, 1 to be obtained.

5. Cipri ice drill?

6. One 18" chain saw for cutting large holes in the ice - to be purchased.

7. Ice tongs - 2 pairs to purchase.

8. Portable potentiometer - to hand.

9. Sheer legs: 3 aluminium pipes, probably obtainable from Scott Base.

Background

On the 1966 operation, difficulty was experienced in driving the probe into the gravel bottom encountered in McMurdo Sound. The sites tried were close to C. Armitage and strong sea currents were found. It is felt that further out in the sound conditions are likely to be more favourable. The measuring equipment itself worked well and apart from reducing the physical diameter of the probe head, no changes are required.

Support required: Transport to the Wright and Taylor Valleys;
A tractor, Wan nagon and sledge for operating on the sea ice.

Dr. Wright hopes to visit the Boomerang Range. This is the subject of a separate memorandum and is not discussed here.

Yours faithfully,

R.H. CLARK
Convener,
V.U.W. Antarctic Research Committee