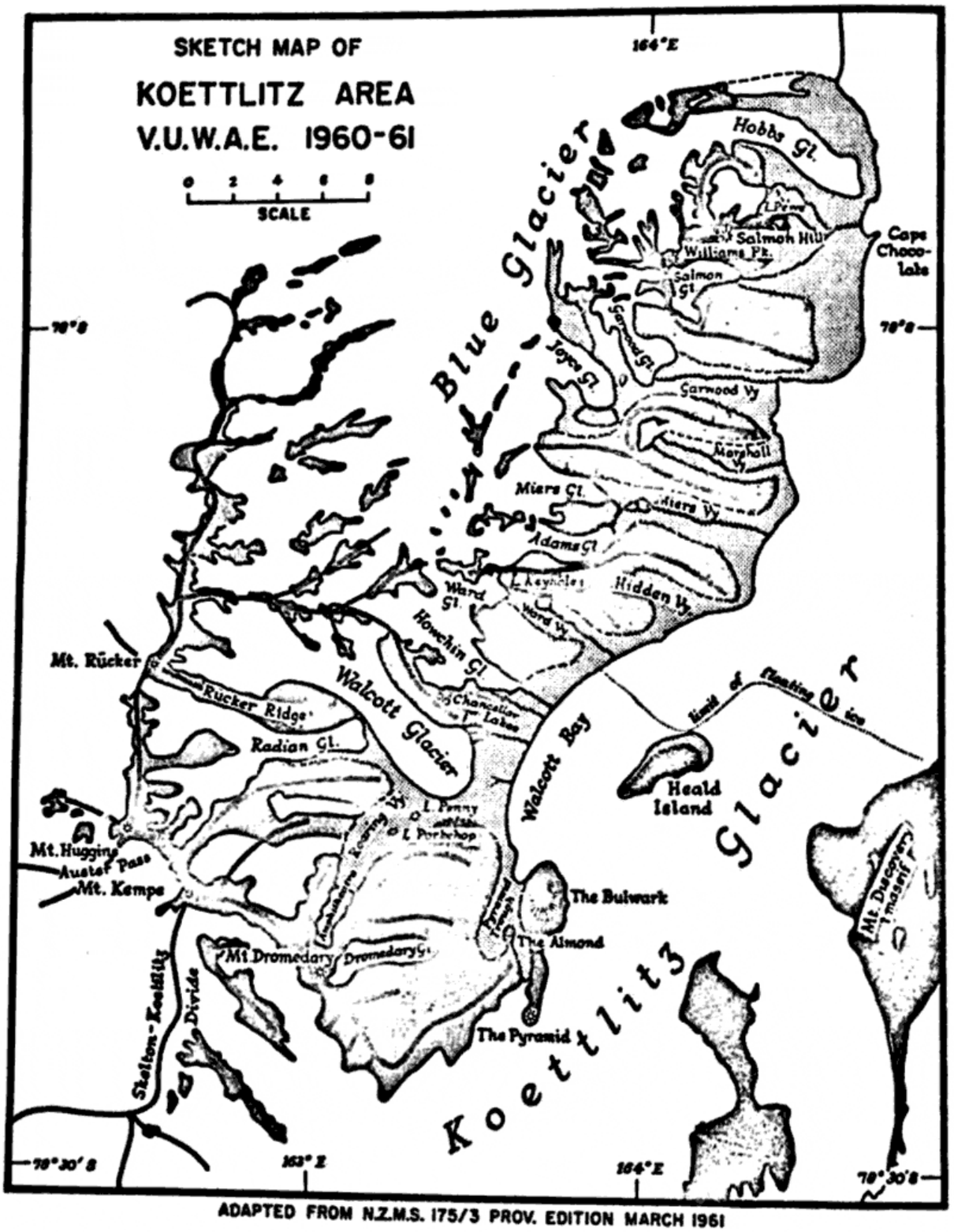
REPORT ON THE

VICTORIA UNIVERSITY OF WELLINGTON ANTARCTIC EXPEDITION

("V.U.W.A.E.") 1960-61

August 1960 - August 1961



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SECTION A

INTRODUCTION

A Victoria University of Wellington Antarctic Expedition was again mounted in the 1960-61 summer to carry out investigation of an ice-free area in southern Victoria Land. The area entered was the left "bank" of the Koettlitz Glacier, an exposed rock area some 50 miles by ten lying, at its nearest point, 40 miles from Ross Island where lies Scott Base. Roughly, the area lies across the 78°S parallel and on the meridian 164°E. This ice-free area has been entered by earlier exploring parties but, until this season, never investigated as a unit.

Financial aid for the Expedition came from several sources: Research Grants Committee of the University of New Zealand (£1,614); University of Wellington (£400 including research grant); Antarctic Division of D.S.I.R. (£300); the residue of a total grant of £1,000 made to the Victoria University of Wellington Antarctic Expedition 1959-60 and 1960-61; National Science Foundation of the United States of America which paid Dr. Blank a salary and allowed a requested £313 for his personal equipment, travel, insurance, freight of specimens and publication expenses.

Personnel

The 1960-61 Victoria University of Wellington Antarctic Expedition, commonly referred to as "V.U.W.A.E.," originally intended to mount a six-man party but, due to circumstances in the early organisation and with regard to the field work to be done, only five could be taken. They were:

R. H. Wheeler, Lecturer in Geography, V.U.W. (Leader)

Dr. C.B.B. Bull, Lecturer in Physics, V.U.W.

Dr. H. R. Blank, Research Fellow, National Science Foundation, U.S.A.

I.A.G. Willis)
R. A. Cooper) Senior Geology Students, V.U.W. (since graduated)

The personnel formed, basically two teams: one geological, the other glaciological-gravimetric but in the latter part of the season the teams split into two mixed parties and thus widened coverage. As a safety factor parties worked within short distance of one another whenever possible and kept in constant communication by short wave radio.

Programme

It was planned to spend about ten weeks in the field but with delays in departures both from New Zealand and Ross Island and need for an early return to work up field material in New Zealand, the actual time in the field was just under nine weeks.

Survey

As with earlier V.U.W.A.E. it was intended that a survey with theodolite be carried out but the day before departure the survey party, Wheeler and Bull, learned that a survey was not needed because other personnel were planning to cover with control points (for aerial photographic coverage) the whole area between the Miller Glacier and Skelton Glacier. It has been found subsequently that the Koettlitz area was not included in this survey (nor aerial photographed) and the survey team (Bull and Wheeler) and the geologists doing a topographic plot for the geological map (Willis and Cooper) were disappointed.

Geology

As too in earlier V.U.W.A.E., a complete geological coverage of the exposed rock region was intended and carried out despite broken terrain and poor weather. Blank's report is appended.

Meteorology

Due to the attenuated area chosen the field arrangements of the 1960-61 party were planned so that the personnel worked from north to south through the area. Therefore it was not possible to establish a fixed position meteorological

station. A meteorological screen was erected at the third base camp and records are available for the final three weeks of the Expedition. Measurements of temperature, wind, cloud amount and direction of movement were made at main synoptic hours by two members but these are of limited value because the parties were seldom stationary for more than a day. (Records held by Bull, Columbus, Ohio, U.S.A. are not yet analysed - results will be worked up and submitted to the New Zealand Meteorological Office as with earlier V.U.W.A.E. meteorological records.)

Gravity Survey

A gravimeter was obtained on free loan from the Texas Instrument Company, U.S.A., and arrived as the party was working south. Bull and Wheeler returned on the helicopter bringing in the gravimeter to the northern Koettlitz area and began the north-south traverse. Bull's immediate gravimetric report is appended.

Paleomagnetism

Bull's requests to other Antarctic expeditions for paleomagnetic samples have not been productive but Willis of V.U.W.A.E. collected almost a hundred pounds of specimens from the southern Koettlitz area.

Glaciology-Geomorphology

Observations were made by this party throughout the Koettlitz area and a report is appended.

Biology

Algae, lichen, windblown marine shells, sponge remains, were collected and are being studied by the appropriate authorities at Canterbury University. Insects were collected by Willis at Camps I and III.

PREPARATION

The time for organisation for a University Antarctic Expedition is very short. No logistic buying can be begun before grants applied for are officially assured. This means that until late September when the news of the largest grant applied for was confirmed, no large-scale buying could be carried out. On the other hand, applications for grants in February would have to be made before personnel were chosen or could give definite assurance of participation. Again, in the September to early November period (embarkation was 12th November) there is a rush from other expeditions (both government and private) on the few firms in New Zealand supplying equipment and some items were scarce. It was in regard to this rush most fortunate that the major grant, the University of New Zealand grant, enabled V.U.W.A.E. to be financial enough to devote the balance of the D.S.I.R. grant to buying food direct from the Antarctic Division.

Apart from organisation work to mount the Expedition the time needed to buy new or repair old equipment cannot be overstressed. The worst instance of this was the need to call fifteen times on a firm that ultimately effected inefficient repairs to stoves.

The weight of pre-Expedition organisation falls on the University staff component as the student members must be left unhampered to study (successfully) for examinations. The staff members' end-of-year pre-Expedition period becomes as a consequence a hectic gallop which is maintained until one's feet are at last planted on the calm bleakness of the ice-free area.

Equipment used by V.U.W.A.E. was efficient and durable, except that trouble, as on previous V.U.W.A.E., was experienced with sunglasses and snow goggles which broke far too easily. Some items of clothing were outstanding - and made in New Zealand. The Antarctic Division, D.S.I.R., (hereafter referred to as "A.D.D.S.I.R.") rations were very, very good and this is said despite the fact that this standard field ration was unvaried over two months. It is to be admitted however that in our base camps we had "goodies" both donated, by wellwishers and relatives of the party, and purchased. A conversation with Dr. Pardue, United States Navy at McMurdo Base brought to

light the interesting fact that United States survival rations for each of a group of three men, two "up and around" one resting in sleeping bag, was 4,500 calories and the V.U.W.A.E. and D.S.I.R. basic ration calory content was 4,773. This Expedition considers that in the Antarctic, the back-packing, tramping and climbing requirements must be well above both the calories per day figures stated above; extra items at each of the three base camps, particularly those for Christmas, raised the calorific intake over the field period.

Where and Why V.U.W.A.E. Went

This V.U.W.A.E. and others have been unusual expeditions to the Antarctic in that they have specialised in working in continuously exposed rock areas. Most Antarctic expeditions entail travelling great distances in snow vehicles or by dog sledges. Since distances in Antarctica are so vast and the going often so difficult such expeditions spend the greater part of their time in travel and comparatively little in the V.U.W.A.E. type of field work. V.U.W.A.E, having chosen bare rock areas, has been able each season to work continuously on their chosen territory. This was especially so in 1960-61 when the Antarctic continent generally experienced very poor weather conditions. One party of our acquaintance spent out of some 88 days in the field some 27 confined to tents. One United States university expedition was so unfortunate as to fail altogether to reach its proposed area. One party of V.U.W.A.E. on the other hand was snowed in for only two days. Another reason why these V.U.W.A.E. have chosen the ice-free areas of Wright Valley (1958-9), Victoria Valley (1959-60) and the Koettlitz (1960-61) is that no great degree of Antarctic training is needed - nor have we ever had time enough for it - and New Zealand tramping and mountaineering already experienced by members are ideal preparation. Furthermore, since these areas are amongst the largest exposures of geology in Antarctica it is felt that their exploitation is extremely profitable for expeditions of our type.

This year the area chosen was that just north of the Koettlitz Glacier, about 40 miles, at its nearer end, from Scott Base on Ross Island. The area was big - 50 miles by ten miles of ridge and valley topography roughly equivalent in size, to quote a New Zealand example, to the whole of the Wairarapa valley from Palliser Bay to beyond Masterton, and as wide, the whole being regularly crossed along its length by narrow ridges often as high as the Tararua Range - but the choice was determined by proximity to Scott Base and the fact that it had been observed but never studied as a complete unit.

SECTION B

THE FIELD PLAN

Three base camps, each with a satellite food dump, were established along the length of the Koettlitz area and from these the two parties - geology (Blank, Willis and Cooper) and glaciology-gravity (Bull, Wheeler) - each worked the surrounding territory. The base camps and dumps were "laid out" with assistance of a United States Navy helicopter after a reconnaissance in United States Navy "Otter" aircraft.

THE OPERATIONS

First Bull and Wheeler were left at the southernmost base to mark and measure the Radian glacier for movement measurements. When the second party was flown in three days later the first party was picked up and deposited with them at the northernmost camp, Lake Péwé to begin the exploration of the Koettlitz area from north to south. It was found that as the parties worked southwards and away from Scott Base radio communication by pack radio set became unreliable and the Leader of Scott Base had two "sledge sets" or "557" flown in to us together with a gravimeter which had just arrived. Bull and Wheeler took advantage of this aircraft and were flown back to near Cape Chocolate in northern part of the Koettlitz to start a gravimetric survey with the newly arrived gravimeter. On re-uniting, both parties worked south from camp to camp along the Koettlitz area. At Christmas the two teams were together by Lake Miers from Christmas Day to 29th December. The helicopter (due after Christmas) to pick up "557" radio for delivery at Camp III (the third base camp) arrived on 4th January, by which time the two parties had moved to Lake Ward further south. The opportunity offered by the arrival of the helicopter allowed a geological party (Willis and Blank) to be dropped to the north (Hobbs Glacier area) and complete an area abandoned earlier due to poor weather. On the same flight another geological party (Cooper, Wheeler) was placed on the Miers-Marshall ridge some miles away to complete work there. On the return of these parties at Lake Ward a further reshuffle occurred, Bull and Cooper continuing gravimetric, glaciological and geological work on the Koettlitz Glacier coast and Blank, Willis and Wheeler carrying out geological and glaciological work on the inland area.

At about this time (early January) it became imperative that Bull who was about to take up a position with the Institute of Polar Studies, Columbus, Ohio, should be uplifted to return to Scott Base and New Zealand. Bull and Cooper carried out work in Pyramid Trough in some extremely bad weather and Wheeler, Blank and Willis after a brief stay at Camp III (Walcott Glacier district) set out for a survey of Heald Island. Cooper and Bull joined the party there until Bull returned to Camp III to complete the Gravity traverse and measurements of glacial movement. Meanwhile the four-man party, Blank, Willis, Cooper and Wheeler, after a reconnaissance of Pyramid district, climbed to a high altitude camp southeast of Mount Dromedary and covered this area. Snow and zero visibility in low cloud prevented work for two days but the area was successfully examined. The party split, Willis and Cooper taking a northerly route 4-5,000 feet to Camp III and Blank and Wheeler a southerly route up to 7,000 feet via the Mount Dromedary area. The reunion at Camp III with Bull was short, as a bare eight hours after the 2 a.m. arrival of the Dromedary party on 19th January Bull was uplifted by helicopter and returned to Scott Base. Then Cooper and Blank carried out two major excursions, one to Rücker Ridge to find the Beacon sandstone contact at the foot of the Royal Society Range and another to Auster Pass to geologise there. During this trip they camped at 6,000 feet and recorded temperatures around -6°F. Willis and Wheeler at Camp III made local sorties carrying out geological, paleomagnetic, glaciological work and packing, preparatory to leaving, work until immediately after the return of the Auster Pass party (Cooper, Blank) the whole party of four was returned to Scott Base by helicopter.

Return to New Zealand was made by ship U.S.S., "Alatna," an ice-breaking oil tanker which rolled markedly and caused the party fresh from the open air, to pine in an indoor temperature of 70°F plus. The outward trip had been by

"Globemaster" aircraft lasting some ten hours; a contrast to the seven-day return sea voyage. The outward and inward voyages (totalling over 4,000 miles) cost the Expedition about £5 per head only (cost of rations) for which we are grateful to the United States Military Air, and Sea, Transportation Services and the United States Antarctic Research Programme.

SECTION C

REPORTS

GEOLOGY REPORT

General Statement

The primary mission of the Victoria University of Wellington Antarctic Expedition, 1960-61, was to investigate the geology of the ice-free terrain bordering the western edge of the Koettlitz Glacier. Early reconnaissance expeditions had indicated the presence of three roughly parallel bands of rock in this area: a strip of deformed and metamorphosed sedimentary rocks closest to the coast, a belt of granites farther inland and finally a belt of younger sediments and dolerites constituting the Royal Society Range. The first two comprise the so-called "basement complex;" it is with these rocks that the present expedition was chiefly concerned.

Using the base map compiled by Trans-Antarctic Expedition survey parties at a scale of four miles to the inch, and aerial photographs taken by the U.S. Navy, geologists of the expedition mapped about 500 square miles of largely ice-free territory during the field season. The main accomplishments were, in addition to completion of the mapping programme, establishment of a metamorphic stratigraphy and analysis of the relation of the granitic rocks to the metasediments. Rocks of the Beacon series and Ferrar dolerites in the Royal Society Range were reached at two localities; field studies were also made of Quaternary volcanics present in the southern half of the area. Observations on glacial geomorphology and surficial deposits were made throughout, particularly by the senior members of the expedition working in coastal areas.

Basement Complex

The basement rocks of the Koettlitz area consist of schists, quartzites, marbles, and granitic rocks of uncertain age, which are cut by numerous acid and lamprophyric dikes and sills. The granites lie for the most part in a loosely-defined zone extending north-south through the central part of the area between the coast and the Royal Society Range; their overall trend seems to parallel that of the main range, separating the metasedimentary rocks into two main bodies. Tentative field correlations were made between metasediments on either side of the granites, and on this basis three metamorphic formations are distinguished.

(a) Hobbs Formation - The type locality for the Hobbs Formation is a ridge in the northernmost part of the area studied, between the Hobbs and Blue Glaciers. The unit consists of about 12,000 feet of metamorphosed conglomeratic greywackes, quartzites, and argillites. It becomes calcareous in its basal portion, passing through a transition zone of interbedded marbles and schists into the underlying Salmon marble.

(b) Salmon Marble - Several thousand feet of coarse white and grey, massive to thin-bedded marble occupy most of the terrain between the Salmon and Hobbs Glaciers, and are designated the Salmon Marble Formation after the feature known as Salmon Hill in the type locality. Bands of lime-silicate material interbedded with the marble contain garnet, diopside, wollastonite, and a variety of related minerals which indicate a high metamorphic rank. The discovery of possible fossil remains is suggestive of a lower Paleozoic age for these rocks, rather than Pre-Cambrian as had been generally believed.

(c) Marshall Formation - This term designates a varied assemblage of micaceous, amphibolitic, and calcareous schists, with interbedded marble, paragneiss, and schistose quartzite, outcropping in the vicinity of the Marshall Valley. On the basis of present knowledge the formation is inferred to underlie the Salmon Marble. Several members were distinguished in the mapping but were not traceable over large distances. The schists

attain very coarse textures in the southwestern portion of the area, where they are interbedded with granites.

(d) Granitic rocks - Granitic rocks are the principal basement type in terms of outcrop area. They range from coarsely porphyritic, often gneissose, to uniformly fine-grained varieties, and in composition from aplogranites through adamellite to diorite. The different types are in many cases interleaved. Where finer-textured are in contact with coarser, it can be demonstrated that the first-named are the younger. Samples were collected for absolute age determinations by the potassium-argon method.

In the neighbourhood of Hidden Valley the granites fade into metasediments along strike and appear to have been formed by metasomatic replacement processes. Elsewhere there are criteria diagnostic of intrusive emplacement; the granites spectacularly interbedded with schists on Mount Dromedary seem to have been emplaced by both processes. Inasmuch as the origin of granites is a subject of widespread controversy, the results of the current study should be of considerable interest.

(e) Dikes - Both acid and basic, or lamprophyric, dike rocks are abundant in the basement complex. The acid varieties consist mainly of quartz and feldspar, and are often coarsely pegmatitic - a single microcline crystal was found to measure 29 inches in diameter. The lamprophyres are of two principal types, a schistose biotite-rich variety and hornblende-feldspar porphyry; some contain a high admixture of more acidic material. These rocks also occur as sills, but in general they cut the country rock at high angles following predominantly northeast trends. The acid dikes were injected prior to, during, and after the period of deformation and granite emplacement, while the lamprophyres exclusively post-date such activity.

Beacon Series - Ferrar Dolerites

Rocks of Upper Paleozoic age, correlative with units named by expeditions working north of the Koettlitz area, form the high scarp at the western margin of the area studied. Owing to their elevation and remoteness from the coast they were not a principal target of the current study. However, the contact of these rocks with metamorphics of the basement complex was reached at two localities, both at elevations above 6,000 feet. There were no visible contact effects of the lowermost dolerite sill where it rests on basement quartzite, although specimens collected for petrographic analysis may reveal their existence. The basal Beacon is a medium-grained arkosic sandstone. Some evidence was found for the presence of a major unconformity a few hundred feet above the base of this series.

Quaternary Volcanics

Numerous cinder cones of olivine basalt penetrate bedrock and moraines throughout the Koettlitz area from Marshall Valley southward, and associated lava flows cover large tracts in the vicinity of Mount Dromedary. The basalt contains inclusions of morainal material as well as olivine nodules of unusual dimensions. Volcanic activity apparently commenced subsequent to the ice maximum but recurred sporadically during and between later glaciations. Moraine was found interbedded with lava in the gorge of the Walcott meltwater stream, where an excellent stratigraphic section is exposed. It may be that the characteristic presence of hydrogen sulfide gas in the basement marbles is related to the episode of Quaternary volcanism.

Structure

The metamorphic rocks of the Koettlitz area have been folded into a number of broad anticlines and synclines of several mile amplitude. Northeast of the central granitic mass the bedding attitudes and fold axes strike predominantly northwest-southeast, normal to the coastline and into the granites, this trend continuing as foliation in the granitic bodies. The trends become more nearly east-west in the central and southwestern portions, but their interpretation is progressively more tenuous. The beds are steeper and in some cases overturned. Minor plications are characteristic structures in the Salmon Marble, especially near its contact with schist and paragneiss.

High angle faults cut the basement rocks in many places; their displacement could generally not be determined except where they offset the lamprophyres.

Economic Geology

No materials of economic importance were found in the area. The only metallic mineral encountered was pyrite, which occurs in negligible quantities in the metasediments.

Work in Progress

Geologic work in progress at Victoria University in connection with the 1960-61 Antarctic Expedition comprises the following three main categories:

1. Preparation of geologic map. By the use of oblique aerial photographs, a new semi-controlled base map has been constructed for the entire Koettlitz dry valley area. Geologic data has been transferred to this map. In view of its improved accuracy the new map should be of considerable value not only for the current work but also for future expeditions.

2. Petrography - Over 100 thin sections are in course of preparation and examination, for the purpose of studying mineralogy, petrogenesis, and metamorphic facies of rock specimens from the Koettlitz area. A number of thick rock slices will be cut, etched and stained in order to determine their modal content.

3. Formal presentation of results - A paper concerning the general geology of the Koettlitz area is planned for publication in the New Zealand Journal of Geology and Geophysics. In addition, separate papers will deal with specific aspects of metamorphism (Dr. Blank), granitic and dike rocks (Mr. Cooper), and Quaternary volcanics (Mr. Willis).

GLACIOLOGY REPORT

Much of the work of the two earlier Expeditions, to the ice-free Wright and Victoria Valleys was concerned with observations of the glacio-geomorphology. From the re-location of remnant glacially-cut benches and the distribution of moraines of different ages in the two valleys, history of the retreat of the ice has been inferred.

The glaciological work of the present Expedition has been mainly a continuation and extension of these observations. The glaciers which formerly filled the Wright and Victoria Valleys were of a different type from those which previously filled the tributary valleys in the area north of the Koettlitz Glacier; in the Wright and Victoria Valleys the glaciers were carrying ice from the west of the Victoria Land ranges, through the valleys to McMurdo Sound, while in the Koettlitz area most of the small glaciers were supplied completely from local névé fields. The Koettlitz Glacier itself is fed from a larger nevé which however is comparatively small compared to, say, the Skelton Glacier which cuts the Koettlitz off from the Antarctic ice plateau.

From the pattern of moraines and glacially-cut benches throughout the area, several phases in the valley glaciers and of the Koettlitz Glacier can be inferred:

1. At some early stage, perhaps of maximum Antarctic glaciation, all the area, with the exception of the divide of the Royal Society Range and a few nunataks to the west, was ice covered. Accordance of peak levels on the spurs along the front of the southern Royal Society Range suggests older glacially cut surfaces of a later period. There is reason to suspect that the peaks of the northern Koettlitz (Salmon District) area likewise show such an accordance of peak level. The spurs of the dividing ridges of the Koettlitz alpine glaciers also show vestigal evidence of glacial benching. These accordant height areas have since been severely fretted by alpine (valley) glaciation. In the area surveyed peaks have been ice sculptured to "horns" and the

alpine valleys cut to almost present level: those in the south being above present sea level, those in the north below.

2. Later or even contemporaneous with this later stage of (1) such moraines as those of the Hidden-Miers ridge (red granite and Vanda porphyry, approximately 1,800 feet altitude) and definitely later moraines as on the Hobbs-Blue Glacier bench were deposited by a large and vigorous glacier. Vulcanism was occurring at this time as a large proportion of the Hobbs-Blue Glacier bench is volcanic material.

3. The valley (or alpine) glaciers retreated from their former union with the Koettlitz Glacier (possibly the Koettlitz ablated too, but there is no field evidence for us to be sure that tributary and trunk glaciers were synchronous in maxima). The prominent 1,200 feet (approximately) bench of the Koettlitz left bank may have been cut at this stage.

4. The Koettlitz Glacier re-expanded whilst the valley (alpine) glaciers were at or near minimum extent and deposited moraine one-third to half way up their full valley length. Vulcanism was again synchronous as the moraine of this phase is markedly dark with basaltic material probably derived from the Mount Dromedary sector of the Koettlitz area.

5. Since this phase the Koettlitz Glacier has had two periods of notable deposition - a "brown phase" still in place on the glacier wall from Walcott Bay to Marshall Valley and almost equal in altitude with the phase described in (4) and a "black phase" of moraine almost entirely volcanic (Kenyite and basalt) clearly traceable from opposite Heald Island to the Blue Glacier. This is the most recent major morainal deposition of the area and is still ice-cored. To the north where the alpine valley floors are at or below sea level this moraine fills the seaward end of the valley and carries a rugged minor relief of morainal ridges and circular kettle lakes. Cape Chocolate is composed of this moraine.

6. The above are the main glaciological events of the area but in comparatively recent times the Koettlitz Glacier has again increased slightly leaving complicated evidence in Pyramid Trough where minor vulcanism and moraines are intermixed and further complicated by a "backwash" of ice from the Koettlitz main stream re-entering the Trough from Walcott Bay after passing between the Bulwark and Heald Island. A small increase in the height of the Koettlitz Glacier surface would cause re-occupation of the Trough both from the upstream (southern) and the northern (Walcott Bay) end.

Minor surges of the Koettlitz have built up small fresh moraines on the Walcott Bay coast and on the upstream side of the barrier of Heald Island. These may be contemporaneous with the resurgence of the valley glaciers of the Koettlitz area (observed also in the Taylor Valley and even as far south as the Beardmore Glacier).

Today the glaciers of the Koettlitz area are almost stationary - that is, there has been no notable change in glacier snouts since exploration in Southwest McMurdo Sound began.

Five specimens of dried algae from dried up lakes in the moraines were collected. These will be dated by the C^{14} radio-active method and will give minimum ages for these moraines.

Observations of surface movement and ablation were made on the Radian Glacier. During the months of December and January the surface melted about 10 cm. This probably exceeds the local annual precipitation, and the glacier can be maintained in equilibrium only by forward movement. However (subject to recalculation) the glacier in this period did not move forward more than a few cms., and since the surface slope is small, this probably means that this glacier is out of equilibrium and is retreating.

PALEOMAGNETIC REPORT

This season a total of 72 samples were collected; 39 from Quaternary Volcanics, 6 from Beacon Sandstone and 27 from basement granite.

The granite and Beacon sandstone samples complete the collections of previous Expeditions from the Wright and Victoria Dry Valleys. The granite samples are of particular interest as, unlike those collected previously, they are not close to the dolerite intrusions and hence were not reheated by them. This reheating is thought to be the cause of the uniformity in pole direction shown by the dolerite and granite, two formations of different ages which should have different pole positions and it is hoped that this year's collection will show this to be so.

The volcanic specimens where possible were collected from a series of lavas in order that the secular variation may be measured. As the volcanics predate at least one of the glaciations of this region the pole position obtained from them may be able to be used to give an approximate age to the volcanics and the glaciation that they predate.

CARTOGRAPHY REPORT

As no triangulation surveying was done this season, due to a planned coverage of the area with vertical aerial photographs which did not eventuate, the only materials available for plotting a base map were United States Navy aerial oblique photographs. Several standard methods of plotting from oblique photographs were tried but could not be used because of the lack of ground control. Eventually a plotting method using a peak of approximate known height and distance from the camera (to determine the horizontal plane in the photograph and which was used as a reference plane) was evolved.

This method enabled an accurate base map to be plotted. This process took most of the first term with Willis and Cooper working on the basic plotting full-time. Accuracy was necessary to show on the map the complexities of the metamorphic rocks which comprise the Koettlitz area. Several runs of vertical photographs have turned up since the map was plotted and a comparison of these and the map led to a few minor alterations in ridge lines, shapes of glaciers, etc. but has proved the overall accuracy to be comparable with that of the normal practice of plotting from verticals (a slower, more elaborate method).

Thanks are due to Dr. Wellman, Geology Department, Victoria University of Wellington, for his guidance in working out the method of plotting used, and to Cartographic Division, Lands and Survey Department, for lending aerial photographs.

GRAVIMETRIC SURVEY REPORT

Bouguer Anomaly Map

In Figure 1 the values of Bouguer anomaly at a representative number of gravity stations are plotted, together with the isogals obtained by considering all of the station values. The Bouguer anomaly decreases from a value of 0 mgals in the northeast to -90 mgals at the extreme western point of the survey. A full consideration of the results has not yet been made but the following points may be significant.

1. In the northeast part of the area the isogals are approximately north-south, as they are in the Wright Valley further north. This probably indicates that if the coastline is fault controlled, that the fault continues southwards from Cape Chocolate and does not swing southwesterly to follow the northern side of the Koettlitz Glacier.

2. The gravity gradient in the north-east part of the area is smaller than the 10 mgals/mile which occurs at the coastal end of the Wright Valley, and which has been interpreted in accord with the existence of a major fault along the coastline.

3. A gravity graidnet of about 10 mgals/mile does occur a few miles to the west, between the mouth of the Marshall Valley and the head of Miers Valley. This large gravity gradient is not associated with any major fault.

4. Heald Island appears to be gravitationally associated with the area on the mainland immediately west of it. It is unlikely that the northern side of the Koettlitz Valley is fault-controlled.

5. Values of Bouguer anomaly are significantly higher near the Pyramid, which was one of the main centres of recent volcanic activity in the area.

6. The overall east-west gradient is approximately 2 mgals/mile. This is a value similar to that found in traverses from the lowlands of Austria or Italy into the regionally isostatically compensated Alps.

7. In the western end of the Wright Valley the gravity gradient changes sign, and higher values of Bouguer anomaly are found to the west. This probably indicates that the western side of the Victoria Land mountain chain is also fault controlled and that the formation is a horst. No similar change in the gravity gradient is found in the present survey; values of the Bouguer anomaly continue to decrease westwards. It is regretted that time was not available to continue the survey into the Royal Society Range.

Glacier Thicknesses

The route taken in this gravity traverse included the crossing of three glaciers. From the measurements of gravity on the glacier approximate estimates can be made of the thickness of ice under the gravity staton. The method has been fully described elsewhere (C. Bull and J. R. Hardy, "Gravity Measurements on a Glacier," Journal of Glaciology, March 1957). Values of the Bouguer anomaly obtained on rock at the sides of the glacier are interpolated across rhe glacier, to determine the value of the Bouguer anomaly which would occur at the gravity stations on the glacier, if the ice of the glacier (density about 0.9 gm.cm^{-3}) were replaced by "standard" rock of density 2.67 gm.cm^{-3}. In fact the values of gravity on the glacier are less than those required to give the values of Bouguer anomaly obtained by interpolation in this way; the deficit is attributed directly to the replacement of "standard" rock by the much less dense ice.

In the three glaciers measured by this method the Bouguer anomaly expected at the glacier stations (assuming that all of the glacier ice were replaced by rock) can be interpolated with some confi ence to an accuracy of 2 milligals. The maximum gravity deficiencies on the three Glaciers are 25 mgals (Koettlitz Glacier), 12 mgals (Radian Glacier) and 16 mgals (Hobbs Glacier) so that the error in the estimate of thickness should not exceed 20 per cent.

The three profiles are given in Figure 2. At the position of the profile the Hobbs is a noticeably underfit glacier flowing from a deep valley into a lowland region. In the profile of the Radian Glacier there is some suggestion that the valley is a pair of parallel troughs. Since the glacier is fed by two approximately equal size tributaries this is not completely unexpected, but it is unusual for the two tributaries to maintain their identity so far down the glacier. A similar feature has been observed on a Norwegian glacier by the writer, but only within a short distance of the confluence of the two tributaries (C. Bull and J. R. Hardy, loc. cit.). The southern arm of the Koettlitz Glacier, between Heald Island and the Pyramid area, is a slow-moving or dead relic of a much larger glacier fed from the inland ice of eastern Antarctica. However, at the position of the traverse its thickness exceeds 1,100 feet and the sub-glacial surface is below sea level. The glacier valley is appreciably deeper on the northern side, the outer side of the curve of the arm of the glacier as it swings northward.

These profiles of the glaciers and their significance will be discussed further in the Report on the Glaciological work of the Expedition.

Note: The calculations of the values of gravity and all the attendant corrections have not yet been checked. These preliminary results and considerations may not remain unaltered in the light of recalculations and more mature judgement.

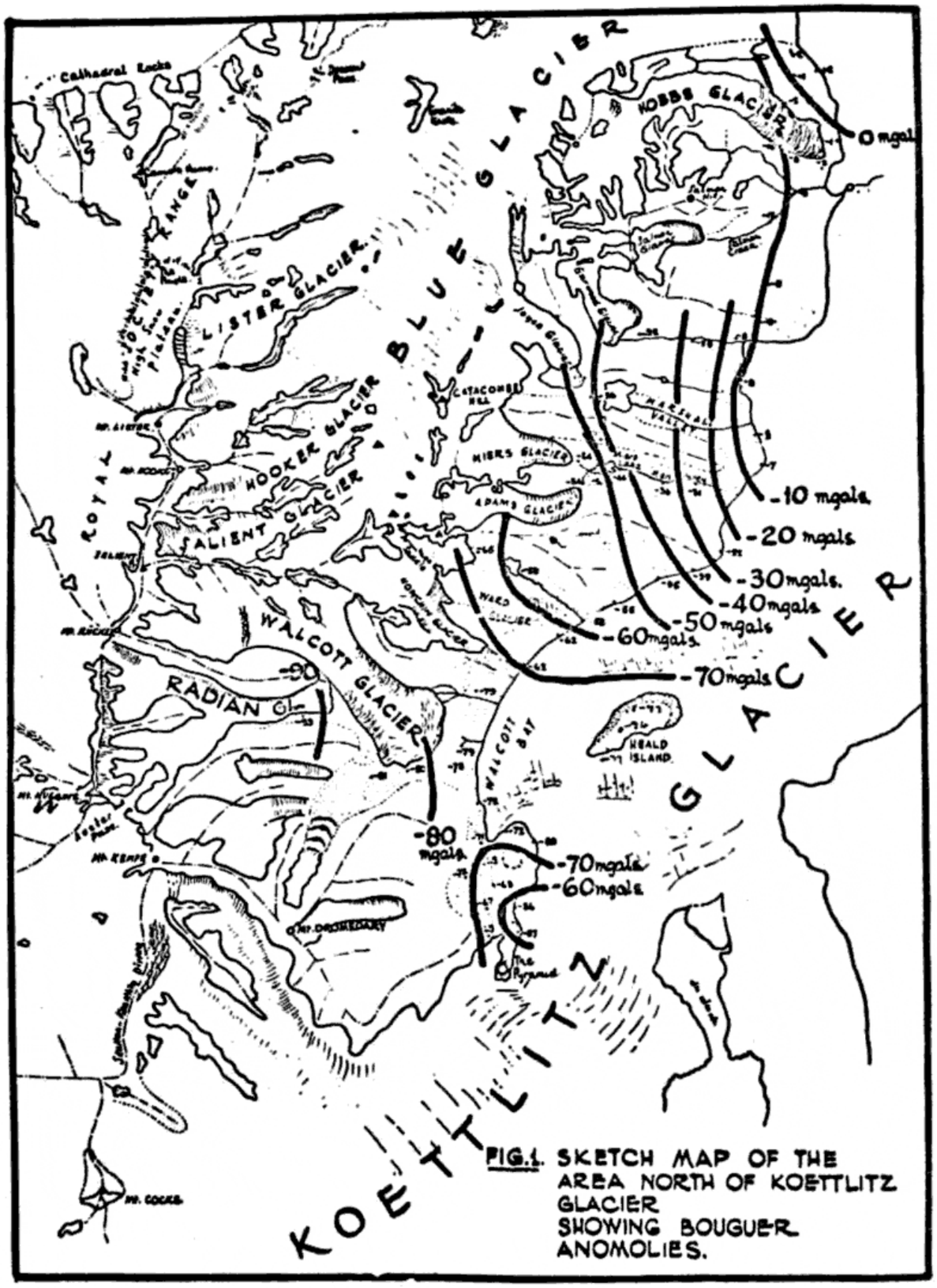
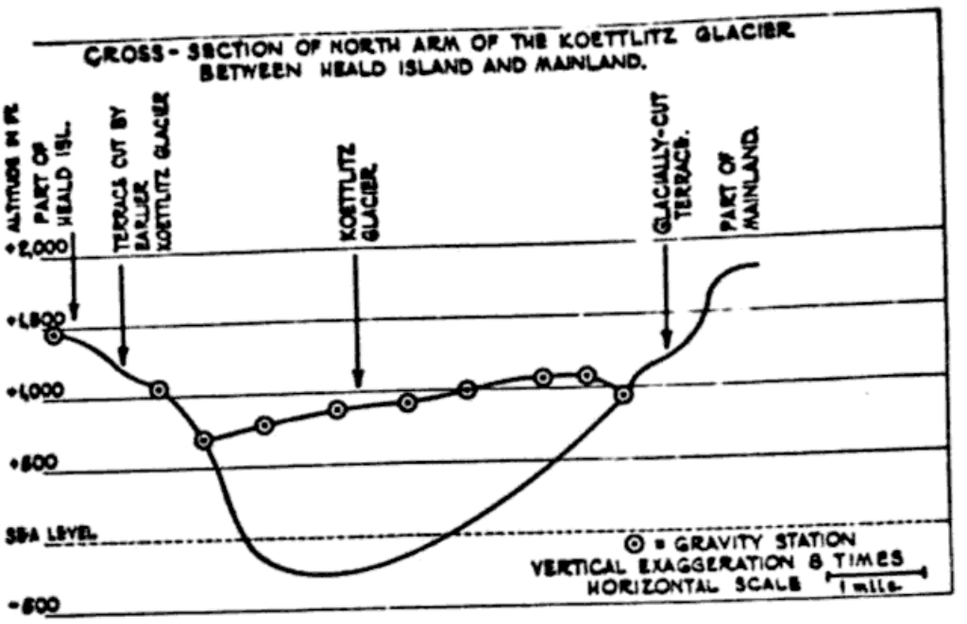
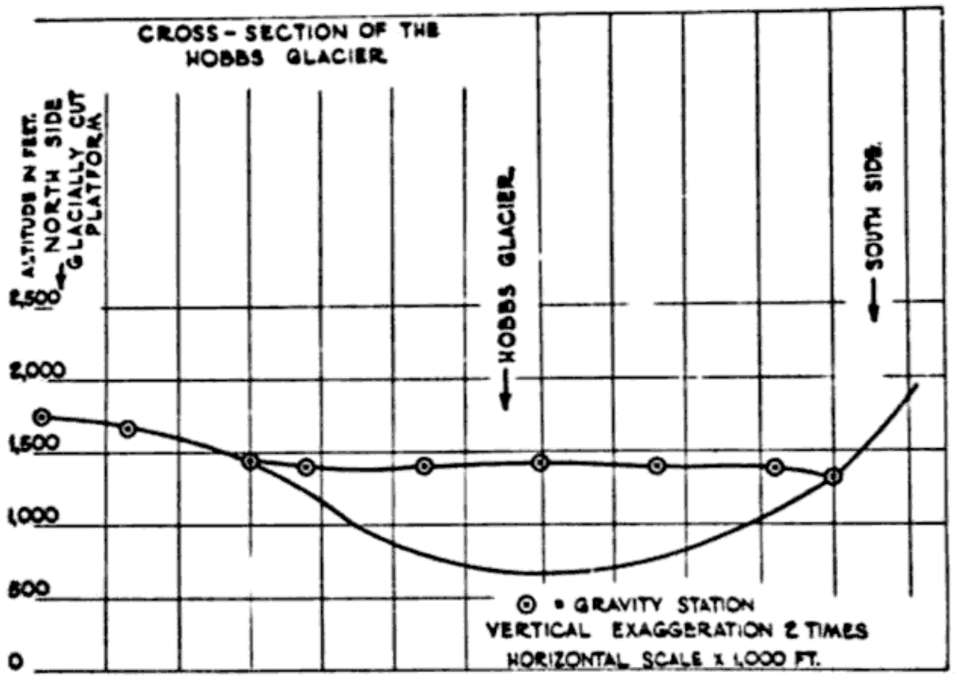
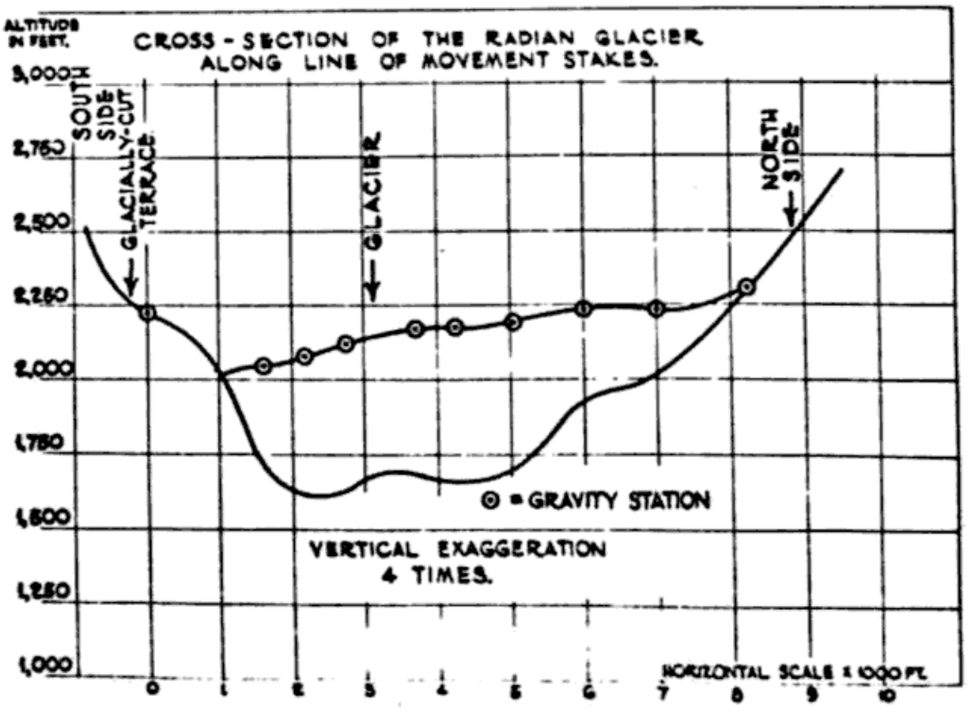


FIG.1. SKETCH MAP OF THE AREA NORTH OF KOETTLITZ GLACIER SHOWING BOUGUER ANOMOLIES.


CROSS-SECTION OF NORTH ARM OF THE KOETTLITZ GLACIER BETWEEN HEALD ISLAND AND MAINLAND.
ALTITUDE IN FT.
+2,000
+1,800
+1,000
+600
SEA LEVEL
-600
PART OF HEALD ISL.
TERRACE CUT BY EARLIER KOETTLITZ GLACIER
KOETTLITZ GLACIER.
GLACIALLY-CUT TERRACE.
PART OF MAINLAND.
⊙ = GRAVITY STATION
VERTICAL EXAGGERATION 8 TIMES
HORIZONTAL SCALE 1 mile.


CROSS-SECTION OF THE HOBBS GLACIER.
ALTITUDE IN FEET.
NORTH SIDE GLACIALLY CUT PLATFORM.
2,500
2,000
1,500
1,000
500
0
HOBBS GLACIER.
SOUTH SIDE.
⊙ = GRAVITY STATION
VERTICAL EXAGGERATION 2 TIMES
HORIZONTAL SCALE 1 1000 FT.


ALTITUDE IN FEET.
CROSS-SECTION OF THE RADIAN GLACIER ALONG LINE OF MOVEMENT STAKES.
3,000
2,750
2,500
2,250
2,000
1,750
1,500
1,250
1,000
SOUTH SIDE GLACIALLY-CUT TERRACE
GLACIER
NORTH SIDE
⊙ = GRAVITY STATION
VERTICAL EXAGGERATION 4 TIMES.
HORIZONTAL SCALE 1 1000 FT.
0
1
2
3
4
5
6
7
8
9
10

SECTION D

ACKNOWLEDGEMENTS

V.U.W.A.E. 1960-61 wishes to record its very great appreciation of the assistance given by these bodies:

Antarctic Division, D.S.I.R. (N.Z.) for advice, material help during the field season and during preparations.

The services of the United States of America for sea and air transport to and from Antartica and in the field.

Other grateful acknowledgements are made to:

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Lands and Survey Department for essential aerial photographs and maps before, during and after the field season.

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Anonymous firm for colour and black and white film donated.

R.N.Z.A.F. Antarctic flight for use of a banding machine to secure specimen boxes and for the loading of specimen boxes on U.S.S. "Greenville Victory."

MISCELLANEOUS

Whilst in the field we were asked to collect rocks for the Admiral Byrd memorial (to be erected on Mount Victoria, Wellington) and a collection of half to three-quarters of a ton was obtained. This entailed much effort in carrying 20-30 pound rocks back to camp but we were pleased to help in this work requested.

THE FUTURE

The successful work of the Koettlitz Expedition work marks virtual completion of geological and glaciological mapping by V.U.W. of the known ice-free areas between the Mackay and Koettlitz Glaciers.

Future Expeditions by members of the University will depend on the existence of suitable areas elsewhere in Antarctica. In the coming summer it is hoped that we will be able to reconnoitre large sections of Victoria Land to help us decide if further operations are feasible and in addition certain specialist personnel from V.U.W. may re-enter the Dry Valley to look briefly into specific minor problems which have emerged during evaluation of results here.

PLACE NAMES

The following place names in the Koettlitz area have been approved by the New Zealand Antarctic Place Names Committee:

Almond	Lake Penny
Pyramid Trough	Rivard Glacier
Dromedary Glacier	Holiday Peak
Amphitheatre	Rücker Ridge
The Bulwark	Pipecleaner Glacier
Lake Péwé	Roaring Valley
Hobbs Peak	Williams Peak
Goat Mountain	Chancellor Lake
Hidden Valley	Glimpse Glacier
Keyhole	Glee Glacier
Lake Keyhole	Shangri La
Lake Teardrop	Mount Lama
Dismal Ridge	Buddha Lake
Kempe Glacier	Penance Pass
Lake Porkchop	Radian Glacier

PUBLICATIONS BY ANTARCTIC EXPEDITIONS

Webb, P. N. and McKelvey, B. C., 1959: Geological Investigations in South Victoria Land, Antarctica. Pt. I. Geology of Victoria Dry Valley. N.Z. Journal of Geology and Geophysics, 2: 120-36.

McKelvey, B. C. and Webb, P. N., 1959: Geological Investigations in South Victoria Land, Antarctica. Pt. II. Geology of Upper Taylor Glacier Region. New Zealand Journal of Geology and Geophysics, 2: 718-28.

Bull, C. and Irving, E., 1960: The Palaeomagnetism of some Hypabyssal Intrusive Rocks from South Victoria Land, Antarctica. Geophys. Journal Royal Astron. Soc., Vol. 3, No. 2, 1960: 211-24.

Bull, C., 1960: Gravity Observations in the Wright Valley Area, Victoria Land, Antarctica. New Zealand Journal of Geology and Geophysics, 3: 543-52.

McKelvey, B. C. and Webb, P. N., 1961: Geological Reconnaissance in Victoria Land, Antarctica. Nature, Vol. 189, No. 4764, pp. 545-47.

Clark, R. H., 1960: Geological Work in Antarctic Dry Valleys. Report of International Geological Congress, XXI Session, Norden, 1960, Pt. XXI.

In press: Glaciology of Wright Valley and of Victoria Valley (Journal of Glaciology)

In preparation: Four papers on Geology of Victoria Valley in final stages. One paper on Koettlitz area Geology and Glaciology.

ROSS DEPENDENCY RESEARCH COMMITTEE

P.O. Box 8018, Wellington

12 October 1961

Antarctic Research Programme 1962/63

As you are no doubt aware the Ross Dependency Research Committee is charged with the responsibility of putting forward to the Minister for Scientific and Industrial Research the annual programme of scientific work to be undertaken in Antarctica. The Committee is now formulating the programme to cover the summer season, 1962/63 and throughout the winter of 1963. The Committee is prepared to consider proposals from interested University Departments and individual research workers. The current fields of work are in Biology, Geology, Oceanography, Seismology, Geomagnetism, Upper Atmosphere Physics and Meteorology. The Committee is prepared to consider proposals in these and other fields where worth-while scientific research can be conducted.

I would be glad, therefore, if you would circulate the attached copies of this memorandum to the appropriate departments in your University, advising them that any proposals must be in my hands not later than 15 November 1961.

It will be appreciated that the scale of activity is limited by finance resources and men, and therefore the Committee has to evaluate the relative merits of proposals received, and include in the programme only those which it considers most worthy. To aid the Committee in its task any applications should give a general outline of:

1. the objectives of the project or expedition (including sketch maps) and proposals for publishing findings;

2. the man-power involved in carrying out any Base project, the size and probable composition of any field party; the scientific standing and general competence of prospective members should be stated;

3. the sponsoring body;

4. the estimated cost of the project or expedition and sources of financial assistance;

5. proposals for transport and communications;

6. arrangements for equipment and supplies (for a field party include communications equipment, which should be sufficient to enable the party to maintain contact with Scott Base or any other base stipulated by the Committee).

J. A. Corcoran,
Secretary, Ross Dependency Research Committee.