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Patrons/Beskermhere: Prof. S. P. Jackson, M.A., D.I.C., Ph.D.
Dr. S. Meiring Naudé, M.Sc., Ph.D., D.Sc.h.c., L.L.D.h.c.

Editor/Redakteur: J. J. Taljaard

Geology by Helicopter: Contrast in Logistics

by

T. W. GEVERS, M.A., Dr.Phil., D.Sc.

Fieldwork

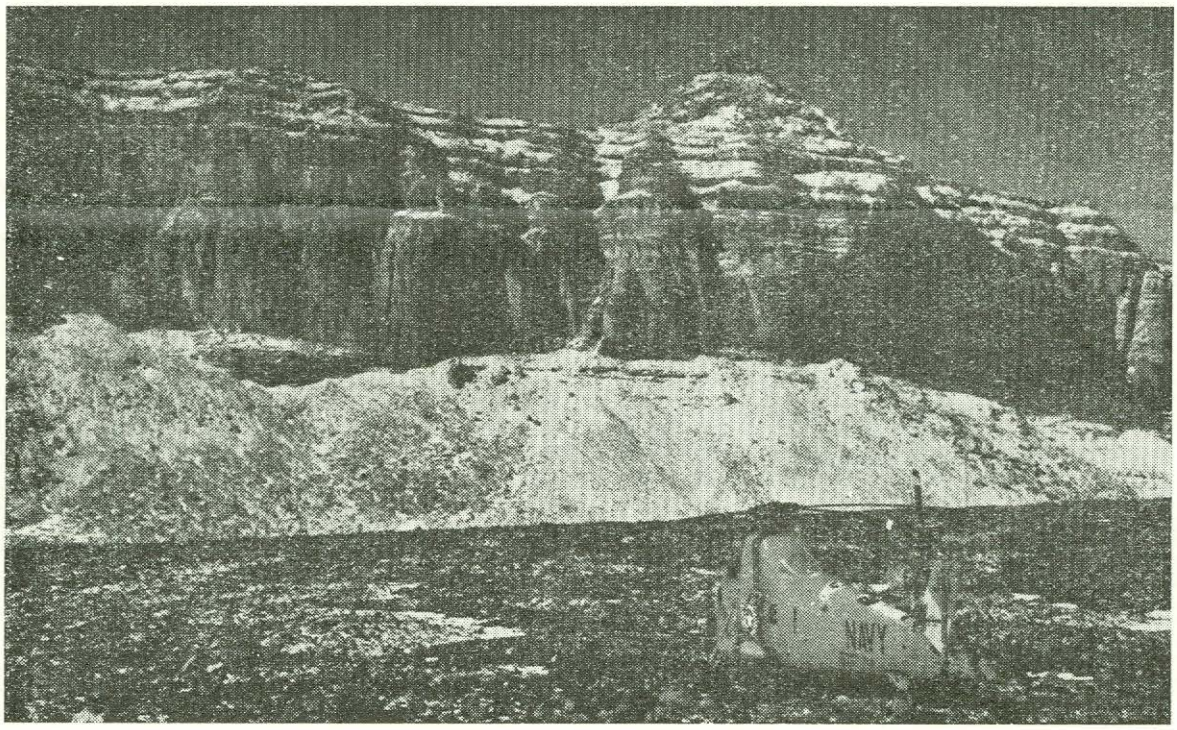
It was the joys of an open-air life that enticed me away from Chemistry to Geology. Reckless rock-climbing as a student on the precipices of Table Mountain and the peaks of the Cape Ranges convinced me that a highly ambulatory profession was much to be preferred to a more or less stationary one. When put into actual practice, however, I soon discovered that fieldwork is not always sheer ecstasy.

Footslogging in Rain and Mud

Working in Upper Franconia, Bavaria, for my doctor's degree the anticipated joys were often excessively diluted with rain. I was also arrested for murder. Fortunately this turned out to be a case of mistaken identity. A frightful killing with a blunt instrument had been perpetrated and a rustic guardian of the law appeared to be unable to distinguish between an innocent geologist with harmless hammer and a murderous loonie wielding a bludgeon of death.

Donkey-Wagon

When I joined the Geological Survey of the Union of South Africa in 1926 I discovered that the Civil Service cannot reasonably be expected always to be in the forefront of technology. Cabinet Ministers and Departmental Heads admittedly were then already motorised; but the Geological Survey came along donkey-drawn. In the Stormberg region of Northern Cape Province my only fellow travellers were other underprivileged classes of society, exclusively brown and black of hue. The farmers were all Tin-Lizzie and Chevy-borne. Since the maximum speed of a quadruped



Beacon Valley and Beacon Heights, Victoria Land, Antarctica. Type locality of Beacon Sandstone.

(Photo: Gevers)

ass is only one-and-a-half miles per hour, I soon made myself independent of my span of fourteen long-eared sluggards and footslogged over 3,000 miles in seven months. I also obtained a deep insight into assinine mentality. This stood me in good stead in many later walks of life.

Car Without Roads

On transfer to Southwest Africa in 1928, I graduated from donkey to automobile. The Administration made me the proud owner of a Dodge Victory Six open tourer by deducting, for three years, £12.10.0 off my monthly cheque of £28.6.8. (My salary was so high in recognition of a Master's and Doctor's degree.) On hard tyres I was chased into the Namib Desert, there to crash and lurch over rocks and plough through sand at sixpence per mile, while more important officials using built roads, of course, drew a shilling. I soon became expert in patching up broken springs with gemsbok-riems and shovelling my resplendently green chariot out of yellow desert sand, often for hours each day. Oh, for the gears of a four-wheel drive!

My sustenance was mealie pap and hope eternal for better days. High-piled cases of fuel fed my steed of steel, while my own parched gullet was moistened, off and on, by a variety of fluids provided by water holes dozens of miles apart. Always the liquid was brackish and mostly also of very old vintage, dating back to the last rainy episode one or two dozen years ago. Since these water-holes were the only "oases" for all other crazy creatures of the desert, their nourishing contents were sometimes rank with organic pollution and rife with micro-organisms. The stuff then looked like German Bokbier, but lacked the latter's exhilarating properties. As a result of the posthumous activities of a submerged dead jackal, invisible in the murk, I was once laid up for almost a fortnight with acute ptomaine poisoning.

But the geology and scenery were superb! What gracefully curvaceous sand dunes! What soaring mountains shimmering in the heat haze! What deeply cleft canyons!

The magnificent rock exposures of these awesome gashes in a sunburnt earth were my undoing. Three years of unabating thrills were ended when, through walking too far, it took me two days and a night without food and water to return to my car hidden in a maze of sun-scorched canyons. Utter exhaustion, plus a sizeable dose of pathogenic organisms imbibed just previously with dead jackal juice, brought on rheumatic fever, four months in bed, a squelchingly leaking heart valve, and one year's sick leave, during which the plumbing of my blood-pump was slowly being repaired.

A few months later a police camel patrol found two mummified bodies in these selfsame sun-smitten and canyon-riven *badlands*, apparently sailors who had deserted ship at Walvis Bay and had tried to cross the desert without compass. In those tough days I often had the feeling that if I did not manage to get out of the desert alive, the Administration would not bother to search for my bodily remains but would merely advertise for a new expendable junior geologist.

Jungle Joys

In the Namib desert there were at least no wild creatures to menace life and limb. The African elephant is made of much sterner stuff than his docile Indian cousin, so popular in zoo and circus. With my gift for provoking *contretemps*, and to the great thrill of my student companions with whom in 1939 I was studying a volcanic eruption in the Kivu region of the Congo, I managed to get myself favoured with a close-up view of the nether anatomy of the world's mightiest land mammal. It took six months in hospital and bed, four on crutches and many more on walking sticks to recover from the effects of load and stress metamorphism on quite a variety of bones and to regain something akin to upright gait. Just a frolicsome students' lark! Their subsequent solicitude was quite touching.

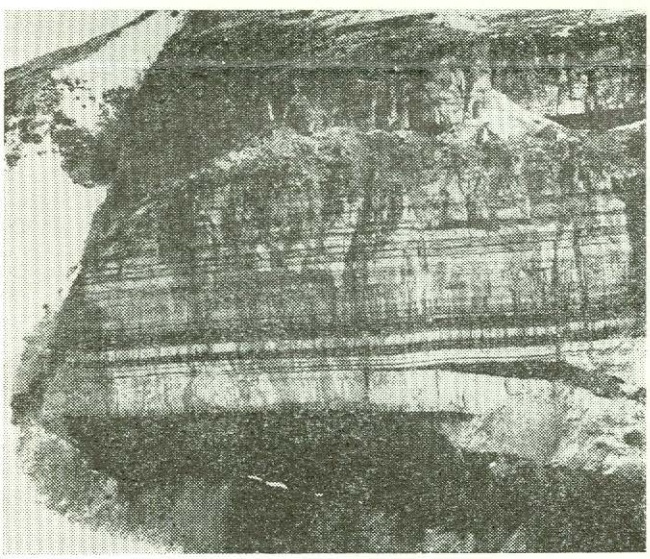
Wings Over Volcanoes

From donkey via motor (and for a brief moment also elephant) conveyance, it was now time for me to be promoted to air transport in field work. Through the munificence of a Belgian coffee-planter in the same Kivu region, I was enabled in 1948 to study the eruption of Kituru volcano not only from the ground but—what a thrill!—also from the air. Flying very low in the excessively turbulent air close above the whole length of a red-hot lava flow, however, caused me on landing to carry out my breakfast in a paper bag.

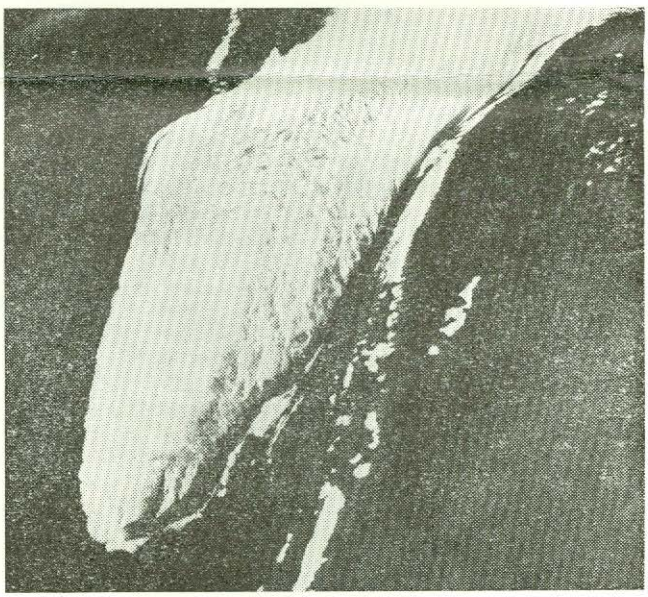
Chopper over Ice and Snow

The trouble, for a geologist, about airplanes, even small ones, is that they go too fast. A helicopter would have been much better! But to experience that thrill I had to transfer from incandescent lava flows and hot volcanic gases to the "icy wastes" of the Antarctic. Again it was foreign generosity that made my long-cherished dream come true. The United States Antarctic Research Program of the National Science Foundation in Washington invited me as an exchange scientist for the austral summer of 1964-65.

Two Johannesburg specialists had declared me to be absolutely fit for this venture. But my *wanderlust* has not decreased with age; so I travelled to the South Pole via Persia, Afghanistan and India, there—due to my usual poverty-stricken mode of travel—to collect dysentry, sinusitis, bronchitis and congestion of the lungs, and to arrive in Christchurch, New Zealand, woefully emaciated and no fit sight for the medical profession. But the Americans took me along nevertheless. In their care—and that of the cold, dry and dustfree Antarctic air—I soon recovered to experience one of the greatest thrills of my life. God bless America!



Lower Beacon Sandstones with layers of siltstone and intrusive dolerite sills. Mount Feather, Victoria Land.
(*Photo: Gevers*)



Hanging glacier, Lower Taylor Dry Valley, Victoria Land.
(*Photo: Gevers*)

Volcanic Studies by Helicopter

The first helicopter I set eyes on at McMurdo Base was resplendent in its normal bright orange-red hue, but otherwise looked somewhat ill-used. It was minus its tail and also the rotors were missing; not exactly a confidence-inducing sight. But so superb was the skill of those chopper pilots that subsequently I never gave it another thought. Up we "staggered"—in another machine, whole and sound—swerved, and then soared over the multi-coloured hutments and fuel tanks of McMurdo, over the gale-embattled old wooden huts of Captain Scott at Hut Point and Cape Evans towards Cape Royds, to have a look at the Kenyite lavas of Mt. Erebus. Professor Treves, of Nebraska University, was my guide. I had last seen this type of lava, studded with beautifully idiomorphic phenocrysts of anorthoclase, on Kilimanjaro in East Africa. But then there was no helicopter and fatigue induced by oxygen deficiency at 19,000 feet somewhat spoilt the enjoyment of fieldwork.

Next day Professor Treves and his assistant took me out to Minna Bluff, a long curved horn of black and brown McMurdo volcanics projecting from the foot of extinct Mt. Discovery far out into the Ross Ice Shelf. The Bluff appears to be the partial rim of a vast sunken caldera. Professor Treves was making a preliminary investigation for later detailed work. Particularly interesting were outward-dipping *water-borne* volcanic breccias, some layers with magnificent cross-bedding. Only a considerable amount of melt water rushing down the slopes of a former volcanic cone of large size, now obliterated through collapse, could have been responsible for transport and disposition. Only detailed study of moraines in the general environment can determine to which particular episode in the complex history of glaciation these sediments belong.

The chief pilot on this occasion was Lt.-Commander James Brandau from Iowa, who himself was keenly interested in all scientific investigations being carried out from McMurdo Base, particularly geological. When Professor Treves left for home a few days later and I expressed a desire to carry out some independent original research, Jim bethought himself of numerous dark patches he had seen from the air below the cliffs of the Royal Society Range. So Jack Twiss, USARP Manager, laid on for me a schedule of flights to this region.

The very first dark patch on which Jim brought down his *helo*, at the end of a long ridge stretching down from Salient Peak between the Howchin and Walcott valley glaciers, proved to be a volcanic cone of absorbing interest. In between outward-dipping layers of olivine basalt slag and cinders we found a zone simply crowded with well rounded inclusions, many of them of deepseated ultramafic type.

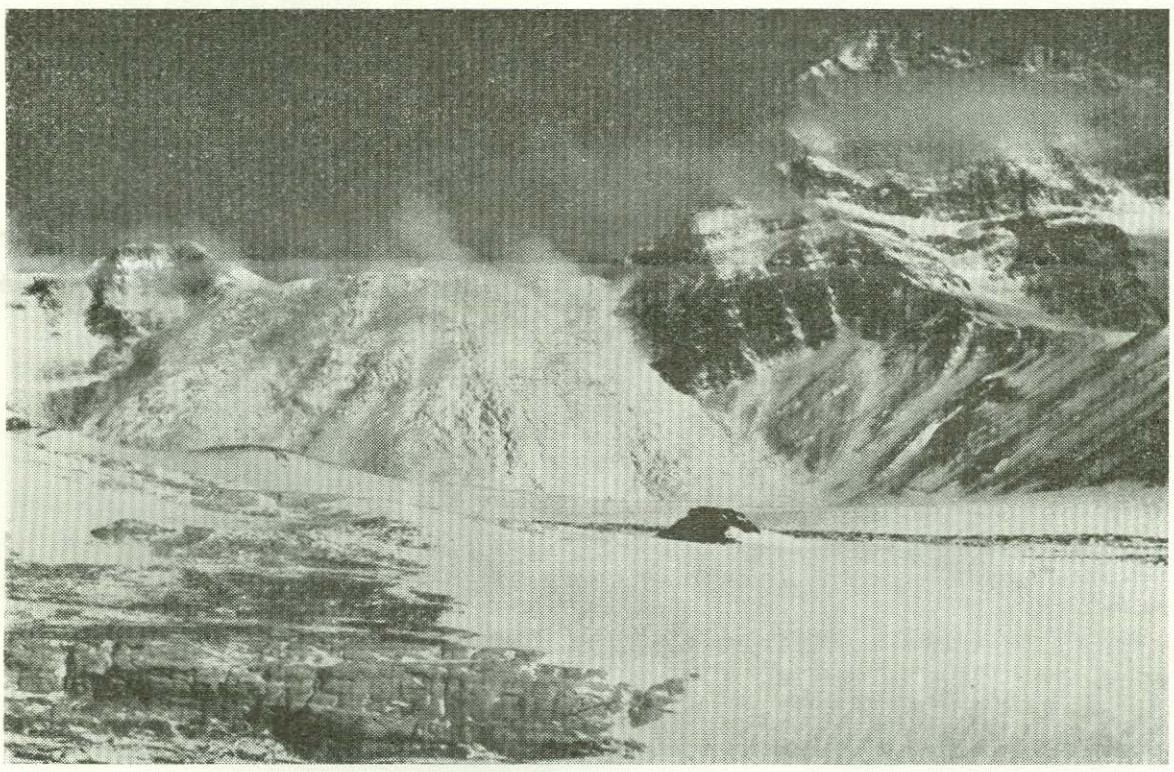
The origin of such inclusions is being extensively debated. Are they *cognate*, i.e. derived from the same magma chamber as the olivine-basalt lavas, there formed by gravitational differentiation (crystal settling)? Or have they been brought up from still greater depths, the upper mantle itself, below the earth's crust?

Four boxes full of these inclusions have arrived in my Department and Dr. J. McIver and I are busy studying them. Not only did Jim Brandau, armed with hammer like any professional geologist, help in collecting these rocks and carrying them to load up his helicopter, but it was also comparatively easy to persuade young physicists at McMurdo Base that outdoor geological field work was a very much more enticing occupation than reading indoor instruments measuring cosmic rays, etc., etc. Jim Salisbury in particular was helpful in lugging along a large rucksack usually filled to the brim with specimens.

Geologic and Scenic Paradise

It was incredible on which inaccessible places Jim Brandau managed to get his *helo* down on the rocks; sometimes also on adjacent ice. The scenically most spectacular highlight was the investigation of some volcanic vents immediately below the stupendous wall of the Royal Society Range between Mt. Rücker and Mt. Huggins, each towering to over 13,000 feet above sea, viz. ice shelf level. I often wondered which was more to be admired: Jim Brandau's fantastic skill as a *helo* pilot or his uncomplaining, courteous willingness to proceed wherever an excessively exuberant, enthusiasm-crazed geologist of advanced age wished to go.

What unforgettable thrills he enabled me to enjoy! We "scraped" at different altitudes a practically vertical wall, 5 to 6,000 feet high, of Lower Beacon Group sandstones (age equivalent of our Table Mountain sandstone) interspersed with (Karroo) dolerite sills, some more than a thousand feet thick. We hovered close to the basal contact of these sediments, here overlying with a ninety degrees unconformity highly metamorphic crystalline basement rocks. No mountaineers, however well equipped, and crazy, could have hoped to get to these places.



View over Radian Glacier towards Mount Rücker on right, with ice-fall and small black volcanic cone projecting through glacier. Limestones and quartzites of Skelton Group in left foreground. Royal Society Range, Victoria Land.

(Photo: Gevers)

Antarctica's Largest "Oasis"

This particular area is the southern portion of the "Dry Valley" region of central Victorialand, with approximately 3,500 square miles—the largest "oasis" in the Antarctic. It is undoubtedly also the scenically and geologically most varied and impressive. Traversed by only a few outlet glaciers draining from the interior ice plateau into McMurdo Sound, snowfall is high enough to form extensive ice masses only along the high crest of the Royal Society Range, from where many alpine valley glaciers descend eastwards, mainly to form the Blue Glacier. Below an altitude of about 3,000-3,500 feet summer ablation is more than sufficient to remove the sparse falls of snow. Bare rock exposures are hence widespread, particularly in the coastal belt below the Royal Society Range and in the environs of the three celebrated "dry valleys"—the Taylor, Wright and Victoria—to the north of the Ferrar outlet glacier. In this region, a South African visitor is often reminded of certain parts of the Karroo, except of course for frozen meltwater lakes in the valley floors and small hanging ice-tongues clinging precariously to very steep slopes.

Of unusual interest, too, are the so-called piedmont glaciers along the coastline of McMurdo Sound. Similar to some lobes of ice extending down to valley floor, their interior margins flow *upstream* into some of the "dry valleys". To a very considerable extent these low-lying coastal ice accumulations are not true piedmonts, but fringing glaciers nourished largely by snow driven by gales from off the sea-ice of McMurdo Sound.

Advantages of Adequate Logistic Support

Even in this region of extensive rock exposures, the amount of time saved by the availability of helicopters is indeed striking. In the study and sampling of several dozen volcanic vents below the Royal Society Range I was able to accomplish in about six days what would have taken me several weeks on the ground. All hold-ups due to laborious crossing of valley glaciers and reaching points difficult of access are entirely eliminated. As already emphasized, it is possible to reach with ease points altogether inaccessible even to skilled mountaineers. Only a helicopter can hover at any desired point on vertical precipices thousands of feet high. Furthermore, from the air it is so much easier to decide on the most suitable places from where to continue on foot.

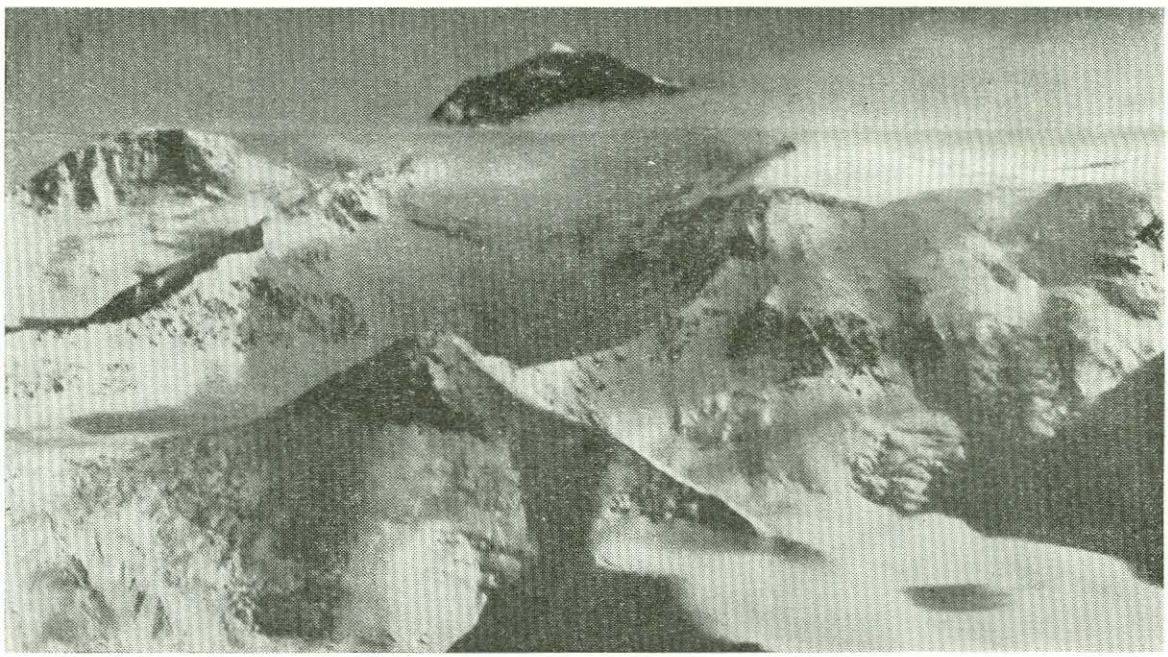
Needless to say, for detailed systematic mapping much more time has to be spent on the ground than I did for my particular work. But for every type of investigation a helicopter is invaluable. I visited two Australian field parties, of two men each, who with complete camping equipment had been flown out by helicopter from McMurdo Base. They were revictualled and generally looked after by the Americans. If they wanted to shift camp, a helicopter flew out and lifted everything, lock, stock and barrel, to the new site. I only had to listen to the enthusiastic praise from these Australians to appreciate to the full what a boon these helicopters were to them. They were doing work of the most detailed and specialised kind. One party was carrying out a minute tectonic analysis of the crystalline basement according to the most modern and refined techniques, including statistical analysis of minor structures. The other was engaged in a minute stratigraphic revision of the sediments of the Beacon Group in the type locality.

At the 1963 Symposium on Antarctic Geology in Cape Town, Guyon Warren's (Geological Survey of New Zealand) description of glacial sediments of Jurassic Age (Mawson Tillite) rather upset adherents of Continental Drift. A party of four specialists therefore visited the type-locality at the Carapace and Allan Nunataks, some 120-140 miles away from McMurdo Base, during the spring of 1964. They were flown out by an American helicopter, thus saving weeks of laborious ground travel. When Guyon Warren on the very first day of fieldwork unluckily slipped on a steep ice-slope and badly smashed a leg on crashing into rocks below, a radio-signal brought back the chopper and an American transport plane took him home to hospital in Christchurch, New Zealand.

With their superb logistic support—and generous attitude towards international co-operation!—the Americans are playing the rôle of fairy godmother to all and sundry. My own trip out to the Carapace and Allan Nunataks was unfortunately prevented by bad weather.

Helicopter transport also enables every experienced geologist enormously to extend his interests and scope of work. With no difficulty he can encompass everything he is trained for. Also specialists in different aspects of geology can use the same helicopter with the minimum loss of time and energy. Dr. Tilley, of the Geography Department of the University of Sydney, and I, often flew out together. He was interested especially in aeolian processes: loess, cavernous weathering, etc. The latter is strikingly developed on a wide scale, in different rock-types and at varying altitudes. It very soon became apparent that there is much more to it than just wind corrosion.

Provided it did not cloud or fog up, practically at no time during helicopter flights was there nothing of interest to see and study. The great beauty of choppers is that their speed and height can be so rapidly controlled and adjusted. When flying out from McMurdo in the "mornings" and back again in the "evenings" across the Sound, I never tired of studying the fracture pattern of the sea-ice breaking up. Particularly around the volcanic Brown Peninsula and Dailey Islands it was amazing to behold the results



Cirques near north end of Royal Society Range, Victoria Land.

(*Photo: Gevers*)

of the *albedo* effect on firn and ice adjacent to rock outcrops, or carrying rock debris, or merely strewn with windblown grit and dust. The resulting melt-water pattern is often astonishing in complexity and, when refrozen, splendid in the colourful beauty of all imaginable shades of deep bluish-green, emerald green, pale pastel green, greenish white, and the pure white of driven snow.

Lesson for SANAE

I have never been to the South African Base in the Antarctic; but I know that geological fieldwork from there with currently available means of transport is fraught with considerable difficulties. The hinterland of SANAE is one of the geologically least-known regions of the Antarctic. I am filled with admiration for what the few young South African geologists have achieved under often very difficult conditions; but it is time that geological and geophysical exploration from SANAE is stepped up by the provision of much more adequate logistic support. This simply *has* to be done if South Africa is to make really significant contributions to the vast pool of data rapidly being accumulated elsewhere in the Antarctic by other nations.

The South African Government would be well advised to follow up the suggestion submitted by Mr. D. C. Neethling, co-ordinating geologist for Antarctic geological and glaciological research, who visited McMurdo Base in November and December 1964.

If helicopters of the South African Air Force can be made available for meteorlogical purposes on Bouvet Island, why not for geological work in the Antarctic? The enthusiasm and enterprise of South African geologists would be boundlessly stimulated.

ANTARCTIC "INDOOR" TEMPERATURES

by

V. von Brunn

Following on J. J. la Grange's contribution to the *Antarktiese Bulletin* (No. 7, January, 1965), the purpose of this short article is to demonstrate the difference in temperature between occupied and unoccupied buildings under the snow.

In his article La Grange dealt with temperatures recorded in, firstly, the heated apartments and, secondly, the ice corridor, passages and tunnels of the main building of Norway Station (70°30′S, 2°32′W) during the course of 1960.

In order to appreciate the relative "warmth" of the unheated parts of the main building, it is necessary to glance at the temperatures prevailing in the magnetic hut which was completely isolated from the living quarters.

Main Building

A block plan of the building is given by La Grange, who also points out that the station was overlain by 3 to 4.5 metres of snow (firn) at the time of occupation in 1960. The temperatures of the ice corridor and passages leading off it were influenced by warmer air originating from the meteorological and radio offices, kitchen, sleeping hut, diesel generators and electric bulbs which illuminated the passages for 24 hours of the day. On the other hand, cold air from outside was free to enter through the ventilators and the open hatch/hatches, while low temperatures could also penetrate the firn surrounding the building.

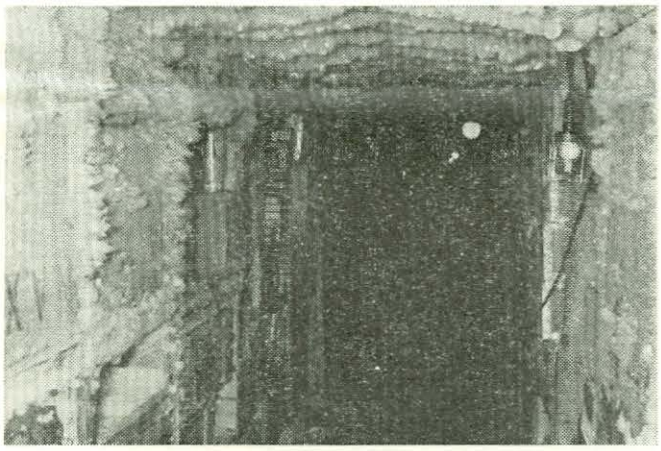


Fig. 1—Ice corridor, main building.

Magnetic Hut

The magnetic hut housing the variometers was situated 150 metres from the main building, beneath a cover of approximately 2.5 to 3 metres of firn. Its dimensions were 2 by 3.5 metres of which 1 by 2 metres was taken up by an ante-room which was separated from the variometer room by heavy curtains. The ante-room was accessible through a hatch, which was closed at all times, on the snow surface. The magnetic hut was built of a wooden framework covered with black cloth and canvas. Temperatures within the variometer room were recorded daily at 12 noon when the magnetograms were changed, a process which lasted only a few minutes. The hut was never occupied except on a few occasions when the instruments had to be calibrated or adjusted.

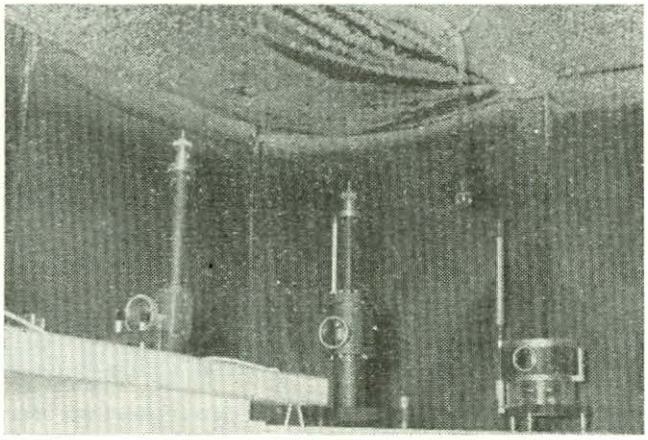


Fig. 2—Interior of magnetic hut.

The mean monthly temperatures inside the magnetic hut and outside in the screen are given in Table 1 and depicted in Figure 3. Although there is a considerable difference in the temperature ranges inside the hut and in the screen, the arithmetic means for the year differ by a mere 1.4°C. Snow (firn) temperatures measured during the year at depths of approximately 150 cm beneath the snow surface compared favourably with those recorded in the hut and were similarly characteristed by a low monthly temperature range.

Table I

Mean monthly temperatures (°C) in magnetic hut and screen

	Magnetic hut	*Screen (outside)*
Jan.	−15·8	− 5·4
Feb.	−15·2	−11·4
Mar.	−15·9	−15·5
April	−17·2	−22·5
May	−19·5	−20·5
June	−20·5	−24·2
July	−21·4	−26·3
Aug.	−22·8	−28·2
Sep.	−23·5	−29·2
Oct.	−22·7	−18·6
Nov.	−21·7	−11·7
Dec.	−20·2	− 5·9
Year 1960 ..	−19·7	−18·3